EXPLORING HOW UNQUALIFIED SENIOR PHASE NATURAL SCIENCE TEACHERS CONDUCT PRACTICAL WORK IN GRADE SEVEN IN LEBOPO CIRCUIT

BY

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DECLARATION

I, ***<u>Mogale Khutso Charles</u>*** declare that, apart from the assistance acknowledged, this research report, titled: ***"Exploring how unqualified natural science teachers conduct practical work in senior phase in grade seven"*** is my own work. All of the sources that I have used or quoted have been acknowledged by means of complete citation and referencing. This research report is being submitted to the University of South Africa in partial fulfillment of the requirements for the Masters of Education degree with specialization in Natural science (MEd). It has not been previously submitted for any other university.

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ABSTRACT

The rationale behind this study was, to explore how unqualified natural science teachers in grade seven conduct practical work. Furthermore, the study explored an understanding of some of the experiences, beliefs and views of unqualified NS teachers. This was a qualitative study. Data was collected through classroom observations and semi-structured interviews. The three cases were interviewed and observed separately. This study was guided by main research question: How do unqualified grade seven natural science teachers facilitate practical work in the senior phase? Which was further unpacked into three sub-questions: How do unqualified NS teachers define practical work? What are the views, aims and objectives of unqualified NS teachers about practical work? How do unqualified NS teacher conduct practical work? The study revealed that in all three cases, practical work was conducted consecutively as poorly, outstandingly, and excellently. Moreover, an intensive professional pedagogical development is recommended for natural science teachers.

KWI-ABSTRACT

Isizathu emva kwesi sifundo sasiyihlolisise indlela abafundisi bezesayensi bezendalo abangafanelekanga ngayo kwiibakala ezisixhenxe ezenza umsebenzi osebenzayo. Ngaphezulu, uphando luhlolisise ukuqonda kwamanye amava, iinkolelo kunye neembono zabafundisi be-NS abangafanelekanga. Oku kwakufundwe ukufaneleka. Idatha yaqokelelwa kumagumbi okufundela kunye noonononongo olulungelelanisiweyo. Amatyala amathathu axoxwa ngumbutho kwaye athathwa ngokwahlukileyo. Olu pho nonongo lukhokelwa ngumbuzo ophambili wokuphanda: Ootitshala abangabalulekanga bakala be-sayensi bendalo abasixhenxe banceda njani umsebenzi osebenzayo kwisigaba esiphakamileyo? Yiyiphi enye eyayixhaswa kwimibandela engaphantsi kwemibuzo emithathu: Ootitshala abangenasigxina be-NS bachaza njani umsebenzi osebenzayo? Ziziphi iimbono, iinjongo kunye neenjongo zabafundisi be-NS abangafanelekanga malunga nomsebenzi osebenzayo? Umfundisi ongenagunyaziwe we-NS uqhuba njani umsebenzi osebenzayo? Uphononongo lubonakalise ukuba kuzo zonke

iimeko ezintathu, umsebenzi osebenzayo wenziwa ngokulandelelanayo, ngokugqithiseleyo, nangokugqwesileyo. Ngaphezu koko, uphuhliso olunzulu lwezobugcisa lunconywa kubafundisi bezesayensi zendalo.

UKUQALA

Isizathu esilandelayo kulolu cwaningo kwakuwukuhlolisisa ukuthi othisha bezesayensi engokwemvelo abangafaneleki yini ebangeni lesi-7 ukuqhuba umsebenzi osebenzayo. Ngaphezu kwalokho, lolu cwaningo luhlolisise ukuqonda okunye okuhlangenwe nakho, izinkolelo nokubukwa kwabafundisi be-NS abangafaneleki. Lokhu kwakuyi-study qualitative. Idatha yaqoqwa ngokusebenzisa ukuhlolwa kwamakilasi kanye nezingxoxo ezihleliwe. Amacala amathathu axoxwa futhi ahlonishwa ngokwehlukana. Lesi sifundo sasiqondiswa umbuzo oyinhloko wocwaningo: Abafundisi abangayifaneleki bangabafundi abayisikhombisa besayensi yemvelo benza kanjani umsebenzi osebenzayo esigabeni esiphakeme? Yikuphi okwakungeniswa phakathi kwemibuzo emithathu engaphansi: Abafundisi abangaqiniseki NS bachaza kanjani umsebenzi osebenzayo? Yiziphi imibono, izinhloso kanye nezinhloso ze-NS abangaqeqeshiwe mayelana nomsebenzi osebenzayo? Ngabe uthisha we-NS ongagunyaziwe uqhuba kanjani umsebenzi osebenzayo? Ucwaningo luveze ukuthi kuzo zonke izimo ezintathu, umsebenzi osebenzayo wenziwa ngokulandelana, ngokungafani, nangokugqamile. Ngaphezu kwalokho, ukuthuthukiswa okujulile kwezobuchwepheshe kunconywa othisha bezesayensi yemvelo.

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DEDICATION

This dissertation is dedicated to my parents: My Mother Moraga Raestja Paulinah Mogale, and my late father who wished me to be an **HOD** before he passed on long ago, of which I am today. This dissertation is also dedicated to all teachers especially in Mankweng cluster circuits pursuing science programs in science education at UNISA and other universities.

Alluta continua!!!

GLOSSARY OF ACRONYMS

CAPS	CURICULUM ASSESSMENT POLICY STATEMENTS
CASS	CONTINUOUS ASSESSMENT
CPTD	CONTINUOUS PROFESSINAL TEACHERDEVELOPMENT
DBE	DEPARTMENT OF BASIC EDUCATION
DoE	DEPARTMENT OF EDUCATION
HED	HIGHEST EDUCATION DIPLOMA
HOD	HEAD OF DEPARTMENT
JPTD	JUNIOR PRIMARY TEACHERS DIPLOMA
NEPA	NATIONAL EDUCATORS POLICY ACT
NPDE	NATIONAL PROFESSIONAL DIPOLOMA IN EDUCATION
NPFTED	NATIONAL POLICY FRAMEWORK FOR TEACHER EDUCATION DEVELOPMENT
NS	NATURAL SCIENCE
PCK	PEDAGOGICAL CONTENT KNOWLEDGE
PGCE	POST GRADUATE CERTIFICTE IN EDUCATION
PTC	PRIMARY TEACHERS CERTIFICATE
REQV	RELATIVE EDUCATION QUALIFICATION VALUE
SAASTE	SOUTH AFRICAN ASSOCIATION OF SCIENCES AND TECHNOLOGY
SACE	SOUTH AFRICAN COUNCIL OF EDUCATORS
SADTU	SOUTH AFRICAN DEMOCRATIC TEACHERS' ASSOCIATION
SA-SAMS	SOUTH AFRICAN SCHOOLS ADMINISTRATION AND MANAGEMENT SYSTEMS
SBA	SCHOOL-BASED ASSESSMENT
SAQA	SOUTH AFRICAN QUALIFICATION AUTHORITY
SMT	SCHOOL MANAGEMENT TEAM
SPTD	SENIOR PRIMARY TEACHERS DIPLOMA
STD	SECONDARY TEACHERS DIPLOMA

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CHAPTER ONE

INTRODUCTION

1. INTRODUCTION

1.1. BACKGROUND TO THE STUDY.

In the past two decades, Department of Education has experienced a massive loss and reduction in teacher population due to various reasons. These included among others: resignation of teachers for greener pasture, unhealthy working conditions in the teaching fraternity especially the salaries, retirement of teachers, death toll, student behavior, workloads, etc. (SADTU, 2003). Certain schools were left without the scarce skills teachers who were responsible for the teaching of science and mathematics. This has also resulted in an increased teaching workload for the remaining few teachers in some schools. On the other hand, in some schools, natural sciences subject would be allocated to unqualified teachers while the schools were waiting for the posts to be advertised. In some schools the scarce skills teachers were replaced with less experienced, novice and the unqualified teachers to teach natural sciences.

This study was intended to explore how unqualified grade seven natural science teachers conduct practical work. Practical work was considered to be a prominent and distinctive feature of science education by many science teachers, and that practical work should be carried out by students as an essential element of good science teaching (Donnelly, 1995). The same grade seven natural science teachers were expected as stated in CAPS document (DoE, 2012) to do practical work in the senior phase. According to grade seven CAPS policy for natural science, the school based assessment (SBA) prescribed the following activities to be executed by natural science teachers every year: - twenty five percent for practical work and seventy five percent for the theory work (Department of Education, 2012). Additionally; four practical tasks must be recorded per year, one per quarter for assessment purpose. Furthermore, individual learners were supposed to do demonstration of a practical task chosen for the purpose of evaluation and assessment.

1.2. PROBLEM STATEMENT.

Interacting with the novice and unqualified natural science teachers in grade seven resulted in persuading the researcher to realize that there might be some problems experienced in preparation, designing and doing practical work. The study was also influenced by the anecdotal statistics taken during the natural science briefing workshop at the beginning of every year, in which novice and less experienced natural science teachers participated. Subsequently, the researcher realized that there was a need to explore how unqualified, novice and less experienced grade seven natural science teachers were coping in demonstrating/facilitating practical work in the real classroom situation in Lebopo circuit. Hence the researcher saw a need to explore how unqualified natural science teachers conduct practical work.

1.3. AIMS AND OBJECTIVES OF THE STUDY.

1.3.1. Aim of the study.

The main aim of the study was to explore how unqualified natural science teachers facilitate practical work, in grade seven, in a certain circuit in the Limpopo Province.

1.3.2. Objectives of the study.

- To explore how unqualified natural science teachers define practical work.
- To explore how unqualified natural science teachers conduct practical work.
- To determine the views, aims and objectives of practical work by the unqualified natural science teachers.

1.4. RESEARCH QUESTION.

How do unqualified grade seven natural science teachers facilitate practical work in the senior phase?

1.5. RESEARCH SUB QUESTIONS.

a. How do unqualified natural sciences teachers define practical work?

b. What are the views, aims and objectives of unqualified natural science teachers with regard to practical work?

c. How do unqualified natural sciences teacher conduct practical work?

1.6 RATIONALE AND SIGNIFICANCE OF THE STUDY.

The rationale behind this study was to explore how to assist the unqualified natural science teachers in grade seven when conducting practical work. The research study was intended to assist the department of education to plan and provide the capacity building workshops, pre-service, in-service training for natural science teachers. This study has also assisted in realizing problems or successes encountered by the unqualified teachers by encouraging teachers to either participate in capacity workshop and induction, or to nurture the successes.

Many natural science teachers showed inability to conduct practical work. This is from the statistics provided during natural science briefing and workshops sessions, realistically as the policy required them to do so. Moreover, it warranted an investigation through exploration based on how these unqualified natural science teachers who actually facilitated practical work in their classroom context. By initiating a research study of this nature, the researcher aimed to acquire insight into how practical work was conducted by these unqualified natural science teachers.

1.7. RESEARCH DESIGN AND METHODOLOGY.

It was a qualitative research study. According to Creswell (2008), the qualitative research design was about exploring common experience of individuals to develop a theory, exploring the shared culture of a group of people, and exploring individuals’ stories to describe the lives of people. In this study, the researcher used open-ended and semi- structured questions through pre and post face to face interviews, classroom observations, as well as document analysis. These three were conducted and triangulated on the three participants at their three respective schools. This study was purposive sampling as the participants were sampled purposefully and on the basis of their qualifications with regard to natural science in grade seven. Additionally, only teachers who were not qualified to teach natural science were selected as participants.

The study was a non-experimental research project of the three unqualified teachers who were allocated to teach natural science. They were purposively selected because they did not major or professionally trained for that subject for the required minimum stipulated period of years. The study was conducted in Lebopo circuit at Ga-Molepo area from Mankweng cluster circuits, Capricorn Distirct, Polokwane, in Limpopo province. This research was conducted during school hours in a flexible time table tabled for the sampled schools. Only unqualified natural science teachers were involved in the research.

1.8. DELIMITATIONS AND LIMITATIONS OF THE STUDY

The study was limited to the unqualified senior phase teachers who were teaching natural science in grade seven and they have not studied any of the science subjects like life science, physical science or mathematics. The presentation of the lesson demonstration of a practical work was limited to one hour. Although both teachers and learners were observed, the main focus was only on the teacher. Therefore the researcher acknowledged that only three unqualified natural science teachers were visited, observed and interviewed. The results of the findings were not generalized to other remaining teacher population teaching natural science in grade 7 in primary schools.

1.9. DEMARCATION OF THE STUDY.

The study was conducted in Lebopo Circuit in Molepo area under Mankweng clustered circuits in Limpopo Province. Molepo area is situated next to the capital city of Zion Christian Church in Moria, 45km from Polokwane. There are 33 primary schools in Lebopo circuit, but only the three natural science teachers from three primary schools were used in the study.

1.10. ETHICAL CONSIDERATION.

An important thing to consider, when conducting research, was to inform participants about how the research was to be conducted and how they were to be involved so that they could make informed decisions about their participation. As a result, all participants gave their informed consents and were informed that they would remain anonymous and that the data that to be derived from their feedback would only be used for purposes of reporting and analyzing. In this regard, the participants completed a consent form. Informed consent means that the participants or their legal representative understood the nature of the study and the risks the participants were to be exposed to. Then they made a decision to participate free from force, fraud, duress, deceit or any other forms of constraint or coercion (Mouton, 2001).

For the purposes of confidentiality and anonymity, the identities of the teachers were indicated by means of the pseudo names. The results and the findings of the research were treated with strict confidentiality. The participants' identities in the study were not disclosed to anyone. The participants were protected and a consent was obtained from those three natural science teachers who were purposefully sampled. The participants were not forced to part- take and they were also informed that participation was voluntarily.

Permission to carry out the study was obtained from the Limpopo Department of Education, because the study involved teachers in Lebopo circuit, Mankweng cluster, Polokwane district, South Africa (see Appendix F). As the study also involved interviewing and observing teachers in their classrooms, the researcher obtained permission from the school principals of the schools participating in the study (Appendix G). The teachers were informed that their participation was important, but that their role was voluntary and that they were free to withdraw should they feel uncomfortable during the course of the study. Permission was also granted by principal. All the ethical issues were clarified and approved by the Research Ethics Committee of Unisa and the researcher complied with all the ethical issues raised by the Unisa ethics committee. The ethical clearance certificate was issued to the researcher by Unisa ethics committee.

In this study, the researcher took cognisance of research ethics by observing, respecting and protecting the rights, dignity and privacy of all the teachers participated in the study. All the participants were assured of confidentiality of the findings and all the data collected was destroyed after the research study. The researcher also abided by the policies and regulations of the department of education in Limpopo Province, Unisa code of ethics, and all the policies of the three sampled primary schools. The ethics and the policies of the schools were adhered to with due respect and the participants also gained knowledge from the study. The Unisa ethical considerations were highly adhered to. The data collection process commenced after the Unisa clearance certificate was issued to the researcher, and the Limpopo department of education had also issued an acceptance letter to conduct the research study.

1.11. THE STRUCTURE OF THE STUDY.

The study was comprised of five chapters

Chapters Division	**Descriptions**
Chapter 1	**Introduction** This chapter provides the context and the background to the study, the purpose of the study, research questions, and the problem statement of the study, significance of the study, delimitations and limitations, research design and methodology, demarcation of the study, ethical considerations, and the structure of dissertation.

Chapter 2	**Literature review** This chapter discusses literature review and theoretical background, definition of the practical work by various authors. Classroom practices in terms of practical work, the purpose of practical work, the effectiveness of practical work. How scientists do practical work, CAPS policy in relation to practical work. Discussion of various assessment strategies in relation to practical work commonly used by teachers. Professional development of teachers. Definition of concepts.
Chapter 3	**Methodology and designs** This chapter provides the ontology of the study, research design/approach, sampling method, research question, delimitations and limitations of the study, data collection, data analysis, and document analysis, ethics, and triangulation.
Chapter 4	**Presentation, discussions of findings and research reports.** This chapter provides a presentation of the findings as well as the interpretation of the findings. Discussion of finding, research reports. In this chapter the findings are discussed in length and research reports are discussed in relation to the purpose of the study.
Chapter 5	**Summary, Conclusion and Recommendations** This chapter provides a summary of the study, draws conclusion from the findings, the challenges met during the study, and outlines the recommendations of the research study.

Table 1.1. The structure of the study

1.12. DEFINITION OF KEY TERMS.

Practical work:

Are experiences in the learning and teaching process where students interact with materials to manipulate, observe and understand the natural world (Hofstein and Mamlok-Naaman, 2007).

Unqualified teacher:
A professional teacher who is allocated to teach a particular subject but who did not specialized in that subject for a minimum period of three or more years (SOUTH AFRICAN QUALIFICATION AUTHORITY, 2012)

Under qualified teacher:
A teacher with incomplete teaching qualification i.e. without a method diploma or certificate (SOUTH AFRICAN QUALIFICATION AUTHORITY, 2012)

Qualified teacher:
A professional teacher having undergone a minimum training of three years or four years, and above with PGCE or HED (SOUTH AFRICAN QUALIFICATION AUTHORITY, 2012)

Conducting:
A process of practical presentation of an event or practical work in the field of work.

Professional development:
A professional programme which is designed for development of various professional skills (Kennedy, 2005)

Pedagogy:
Strategy and a method of teaching acquired through a professional training for a stipulated period (Kennedy, 2005)

Assessment:
Process of checking as whether the learner meets the minimum requirements for progression (DoE, 2011)

Natural Science:
subject that is generally a combination of life science and physical science offered in the senior phase from grade seven up to grade ten (DoE, 2011)

Pedagogical content knowledge:
Is the understanding and the knowledge of ways which are known as the transformation of subject matter, pedagogical and contextual knowledge into a unique form a Transformative model (Berry et al., 2012; Shulman, 1986).

1.13 SUMMARY AND CONCLUSION.

In this chapter, the following were described: the background of the study, problem statement, aims and objectives of the study, research question and sub-research questions that guided the research study, the rationale and the significance of the study and the research methodology. Demarcations, delimitations and limitations of the study, ethical considerations were also elucidated. The structure of the study was also outlined, the aspect of the definition of the key concepts was described, and lastly, the summary of the chapter was discussed.

In the next chapter the literature review and the conceptual framework was presented.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

The main focus of the study was to explore how the unqualified natural science teachers conducted practical work in the senior phase, particularly in grade seven. The how part or the pedagogical strategies and content knowledge of conducting practical work was the concern for the researcher. The researcher has been instigated by the statistics of the high number of the novice and the less experienced teachers who seemed to have pedagogical knowledge or challenges in explaining some of the concepts during natural science briefing sessions and workshops. However, novice and less experienced teachers appeared to lack pedagogical knowledge compared with their more experienced counterparts.

It is thus reasonable to suggest that experienced teachers can provide more and deeper insights into the nature of the practical knowledge they possessed and could utilise them in their teaching strategies. Based on this consideration, this study aimed at exploring and understanding on how to teach practical work in natural sciences subject (pedagogical content knowledge) and the ways/and or methods of teaching (instructional strategies), could be employed in conducting practical. This chapter discussed and reviewed the relations on the followings aspects: definition of practical work, types of practical work, the purposes of practical work, the teachers' views with regard to practical work, situating practical work in the South African curriculum (CAPS).

The study further discussed the aims and the objectives of practical work, pedagogical content knowledge of the natural sciences teachers on teaching natural sciences. Clearer distinction was also given with regard to a professionally qualified teacher, unqualified teacher, under qualified teacher in the context of South African Qualification Authority (SAQA, 2012). This chapter also discussed about the conceptual framework and the design of the model, and how the conceptual framework was applicable to the research study. It also focused on the contextual factors which influenced the conduct of practical work, the role of the teacher in facilitating the practical work and the chapter conclusion.

2.2 Natural sciences as a subject in curriculum assessment policy statement (CAPS).

Natural Sciences at the Senior Phase level lays the basis of further studies in more specific Science disciplines, such as Life Sciences, Physical Sciences, Earth Sciences or Agricultural Sciences. These sets of knowledge, each woven into the history and place of people, are known as indigenous knowledge systems. Indigenous knowledge includes knowledge about agriculture and food production, pastoral practices and animal production, forestry, plant classification, medicinal plants, management of biodiversity, food preservation, management of soil and water, iron smelting, brewing, making dwellings and understanding astronomy. As society changes, some of that knowledge is being lost. People such as biologists, pharmacists and archaeologists are seeking it out and writing it down before it is gone. It prepares learners for active participation in a democratic society that values human rights and promotes responsibility towards the environment. Natural Sciences can also prepare learners for economic activity and self-expression (DBE, 2011).

In this curriculum, the knowledge strands below are used as a tool for organising the content of the subject Natural Sciences Knowledge strands

- Life and Living (Which is life sciences),
- Matter and materials (Which is physics),
- Energy and Change (Which is chemistry), and
- Planet Earth and Beyond (Which is physical sciences and life sciences)

Each Knowledge Strand is developed progressively across the three years of the Senior Phase. The Knowledge Strands are a tool for organising the subject content. When teaching Natural Sciences, it is important to emphasise the links learners need to make with related topics to help them achieve a thorough understanding of the nature of and the connectedness in Natural Sciences. Links must also be made progressively, across grades to all Knowledge Strand. Furthermore, natural science teaching has a consequential effect on FET phase subjects such as Life Sciences, Physical Sciences, Earth Sciences or Agricultural Sciences. It therefore provides basis for those FET band subjects. It further provides learners with preparedness for economic activity and self-expression (DBE, 2011).

Moreover, in teaching natural sciences, a careful selection of content, and use of a variety of approaches to teaching and learning, should promote understanding of:

- Science as a discipline that sustains enjoyment and curiosity about the world and natural phenomena.
- The history of Science and the relationship between Natural Sciences and other subjects.
- The different cultural contexts in which indigenous knowledge systems have developed.
- The contribution of Science to social justice and societal development.
- The need for using scientific knowledge responsibly in the interest of ourselves, of society and the environment.
- The practical and ethical consequences of decisions based on Science (BDE, 2011).

The teaching and learning of Natural Sciences involves the development of a range of process skills that may be used in everyday life, in the community and in the workplace. Learners also develop the ability to think objectively and use a variety of forms of reasoning while they use these skills. Learners can gain these skills in an environment that taps into their curiosity about the world, and that supports creativity, responsibility and growing confidence (DBE, 2011). These cognitive and practical process skills include: doing investigations, recording information, measuring; collecting data; predicting, hypothesizing, raising questions, identifying problems and issues, planning investigations, observing, comparing, sorting and classifying, accessing and recalling information (DBE, 2011). Therefore, I strongly agree with the above sentiments and explanations; that natural science is more than a practical subject.

2.3. Curriculum assessment Policy Statements (CAPS)

According to DBE (2011), the general aim of the curriculum policy statements is to give expression to the knowledge, skills and values worth learning in South African schools. This curriculum aims to ensure that children acquire and apply knowledge and skills in ways that are meaningful to their own lives. In this regard, the curriculum promotes knowledge in local contexts, while being sensitive to global imperatives. To equip the learners, irrespective of their socio-economic background, race, gender, physical ability or intellectual ability, with the knowledge, skills and values necessary for self-fulfilment, and meaningful participation in society as citizens of a free country; providing access to higher education; facilitating the transition of learners from education institutions to the work place; and providing employers with a sufficient profile of a learner's competences.

Furthermore to that, the aims of CAPS include creating a teaching and learning environment that allows learners to attain skills and knowledge in such a way that their lives would improve for the better (DBE, 2011). The focus was on knowledge from real life issues that forms part of the learners' everyday living in their communities and all over the world. Moreover, it prioritises social constructivist approach to learning science (Luckay and Laugksch, 2014). Moreover, the curriculum policy statements (CAPS) has the following principles: Social transformation-with focus on provision of equal opportunities" for all population groups; Active and critical learning – emphasis is put on active and critical approach to learning; high knowledge and high skills; Progression (content and context of each grade shows progression from simple to complex); Human rights, inclusivity, environmental and social justice; Valuing indigenous knowledge system (DBE 2011). With high knowledge and high skills, the minimum level of knowledge is set in a particular grade (DBE, 2012).

2.4. What is practical work? (Definition of practical work)

Practical work was called laboratory work in North America. It was used to refer to various hands-on activities or investigations involving scientific equipment or apparatus at primary and secondary schools (Hofstein, 2015). This concept 'practical work' was intertwined with inquiry or discovery with science curriculum development and used as an umbrella to cover various kinds of activities in science classes. Whereas Millar et al. (1999) related practical work more broadly as all those kinds of learning activities in science which involve students at some point to handle and observe real objects or materials. In my view practical work helped the learners to remember what they did best as compared to when taught in a traditional way where the mastery of the content was the only aim.

Therefore, from the notions mentioned above, I aligned myself with the two authors' (i.e Millar et al, 1999 and Hofstein, 2015) statements mentioned above because they both spoke about activities which involved handling and using materials or apparatus, however one might ask this question about practical work. Is practical work laboratory work or practical experiment? It is imperative in the context of this study to define practical work and indicate the different names that can be attached to it? Moreover, practical work is specifically referred to as those teaching-learning transactions in which learners are given ample opportunities to practise the processes of investigation (DoE, 2007). These would involve any hands-on and minds-on practical learning opportunities, where learners practise and develop various process skills such as questioning, observation, hypothesising, predicting and the collection, recording, analysis and interpretation of data. The handling and using of materials is similarly to hands-on and minds-on of the learners, of which I agree to that. It is also important to bear in mind that there is a growing body of scholarship that is problematical; the commonly accepted and variety of forms of science practical activities, and that casts doubts on its effectiveness as a teaching and learning strategy (Jenkins, 1999; Millar et al., 1999).

According to Tsai (2003), practical work in school of science means laboratory-based experience. Whereas other authors like (Ottander and Grelsson, 2006, White, 1996, Kask and Rannikmäe, 2006; Donnelly, 1998 and Stoffels, 2005) also share the same notion and see practical work as hands-on or minds-on practical learning opportunities. DoE (2007) also hold the same notion. Hence I could say, in my opinion, practical work could be laboratory work or experiment that encompasses all the (hands-on or minds-on) activities involved based on experienced. Lunetta et al., (2007) also attested to the fact that practical work is a learning experience in which students interact with materials or secondary sources of data to observe and understand the natural world. Hence, I am of the idea that natural sciences teacher should approach practical work not as procedural scientific enquiry but rather as substantive scientific knowledge so that learners should learn to acquire skills and knowledge rather than protocol. Practical work is usually recognised as an essential part of school science teaching and learning (Hofstein and Lunetta, 2004; Hofstein et al., 2013; Wellington and Ireson, 2012). Moreover, it is argued that science teachers see the use of practical work as an essential part of the school of sciences education (Donnelly, 1998).

Abrahams and Millar (2008) indicated that practical work is an effective tool in getting the students to remember the practical aspects of a phenomenon, whereas Shaha (2011) argued that practical work is an innate component of science education, although it was taken for granted by most teachers, especially in practical subjects like natural science. As an experience natural sciences teacher, I also agree to the notion that sometimes teachers took practical work for granted for the mere fact that it was not inclusive in the assessment of the learners then, therefore, it was worthless and time consuming for them. According to Stoffels (2005) practical work refers to those teaching and learning activities which offer learners opportunities to practice the process of investigation. He further indicated that it also involved hands-on or minds-on practical activities or tasks. I noted numerously where learners learnt through using their hands and minds unaware and they learnt content that was never easily forgotten. Therefore, I strongly agree with the above author by saying that the involvement of both the hands and minds of learners makes the learning to be easily assimilated and acquired. Hence, practical work simplified the work of the teacher.

2.5. Types and the nature of practical work.

Practical work can be classified into four types: confirmatory, inquiry, discovery, and problem-based (Hofstein, 2015). All the types of practical work could be one of a combination of inquiry, confirmatory, or problem solving, or discovery in nature. Moreover, the nature of the subject demands that students should learn science to develop inquiry and problem solving skills. However, DoE (2012) stated the types of practical work which include: demonstrations, observations, illustrations, investigation, projects, assignments, case study etc. According to my understanding, the types of practical work in CAPS (DoE, 2012) can be grouped or classified due to their specific purpose e.g. discovery class may include: projects, and assignments which means a way of finding new things for themselves. Whereas the inquiry class may also include: investigation, observations, and case study which means seeking knowledge, hence the problem-solving class can include: demonstrations, observations, and illustrative which mean seeking solution. Practical work could be used in a variety of ways in school sciences. In a general sense, practical work refers to 'prac' or 'pracs' used in the science learning and teaching (Wallace, 2015). Practical work can have its specific forms, i.e. the practical work could include: teacher demonstrations and the experiments conducted by both the teacher and the learners cooperatively or individually (Hofstein, 2015). This acknowledged the fact that practical work would be easier when the learners are immensely involved, in manageable small groups or individually.

There are various kinds of practical work that are prescribed in the curriculum assessment. These include: observations, scientific investigation, scientific enquiry, illustration, demonstration, experiments, projects, models, problem solving, case study, fieldwork, drawings, paintings, constructions, interviews, laboratory work, assignments etc. These types of practical work enable the teacher to involve the learners and they could work in pairs or in groups while the teacher might be a complete observer or silent observer. Teachers are guided by the CAPS policy document which stipulates clearly the type of practical work that must be done per grade per term in natural science in the senior phases (DoE, 2012).

According to DBE (2011), demonstrations, observations, models, investigations, assignments, projects and illustrations were the commonly prescribed practical work in the senior phase. However, from my past experience as a natural sciences teacher, I have noticed and realized that demonstrations were the most preferred type of practical work and favored by most natural science teachers. Furthermore to that, they prefer to do the practical work while learners are observing and listening, reason being that they are not good in facilitation. So they rather demonstrate than facilitate the activity.

2.5.1 Observation.

It is an act where a person has to put an eye on a particular event or occurrence or a phenomenon. Observation is an essential data gathering technique as it holds the possibility of providing the researcher with an insider perspective of participant dynamics and behaviors in different settings (Maree, 2013). Whereas observation was used as a vehicle for field notes using all the five senses i.e sight, hearing, touch, taste, and smell (Creswell, 2012).

2.5.2. Models.

Learner were to build familiar shape or object using materials collected from the surrounding or even bought from the shops. These are models for making some objects or shapes that the learners are tasked to do using their own hands and own materials. The teacher would award marks for those models which were used in the final promotional report. This is the School Based Assessment (SBA) mark which embraces both summative and formative assessment marks for the learner. SBA was the School Based Assessment which counted for all work done before the final examination.

2.5.3 Investigation.

It is a formal systematic assessment to examine and ascertain facts of an event or a phenomenon. It is when learners try to find information that can help them to make a wise and an informed decision about the problem posed in order to give accurate solutions (Mudau, 2013).

2.5.4 Illustration.

It is 'facts verification of concepts' where a teacher or learners has to show case through explanations. Every learner is entitled to an opportunity to do or to perform in order to show understanding of a concepts or an experiment. Frost (2010) indicated in UK that, practical works are undertaken in three classifications as: Illustrative practical work - are designed to illustrate a particular scientific phenomenon; exercises to develop practical skills and techniques and to promote the interest of the learners and teachers of the case in my two different cases. Illustrations at some point in this study were used jointly with demonstrations to pursue a certain purpose of the practical work.

2.5.5 Research

According to creswell (2008), research is a process of steps used to gather and analyze information to increase our understanding of a phenomenon. In this study research was used as a type of practical work where learners were to engage themselves to find out the solutions of a given problem.

2.6. The purpose of practical work.

According to Hodson (1993), practical work performs an important role in teaching and learning process in natural science education. Practical work is considered to be a broad concept which includes any activity that requires students to be actively involved. The general purposes of practical work in science education have changed a little bit towards the knowledge and beliefs about learning and teaching sciences. The practical work is offering a unique learning and teaching experiences more especially in natural science (DoE, 2011). According to Hodson (1993), there is no involvement of learners. Because the author does not mention how the learners should be involved and from my experiences as a natural sciences teacher, the learner must be involved using both minds and their hands (i.e. using all their five senses). Therefore, in that regard practical work could culminate, promote and develop manipulative and cognitive skills associated with scientific inquiry (Jenkins, 2007). Lunetta, et al. (2007) state that well planned and effective practical activities at varied levels of inquiry allow learners to manipulate ideas as well as materials in the laboratory. Such activities would require learners to be physically and mentally engaged in ways that are not possible in other science areas of education.

These mental and physical involvements of learners encourage the development of various skills among learners. According to Brattan, Mason and Rest (1999), the following innovative skills are developed through practical work: The safe handling of chemical materials; conducting of standard laboratory procedures correctly; ability to monitor chemical properties, events or changes and the systematic and reliable recording and documentation thereof; competence in the planning, design and execution of practical investigations; ability to handle standard chemical instrumentation; ability to interpret data derived from laboratory observations and measurements; ability to conduct risk assessments.

The intension in this study was to explore ‘the doing of practical work’. Kask and Rannikmäe (2006), indicated that the purpose of practical work is to enable learners to acquire and practice process skills. This was also attested by Perkins-Gough (2007), Pekmez et al. (2005), Ottander and Grelsson (2006), Kapenda et al. (2002), Gott and Duggan (1996) and Hodson (1990). Hence, practical work can be offered with the purpose of developing and giving students an opportunity to practice process skills. Practical work can also be offered with the purpose of “enhancing the mastery of subject matter” (Perkins-Gough, 2007: 93). This view is also reported in the Department of Education documents (2005, 2007), Kask et al. (2006) Pekmez et al. (2005), Ottander and Grelsson (2006), Kapenda et al.

(2002), Gott and Duggan (1996) and Hodson (1990). Hence, practical work could be conducted with the purpose of enhancing the learning of scientific knowledge (Hodson, 1990) or substantive understanding as it is called (Gott and Duggan, 1996).

There are five top reasons for teachers to conduct practical work with learners, which include: to assist concept acquisition and development; to teach laboratory skills, insight into scientific attitudes; such as curiosity, open-mindedness, objectivity, and willingness to suspend a judgment (Hodson, 2005). Practical work improves learners' scientific knowledge and their knowledge of science as a form of enquiry which has led many science educators to argue that science education should be combined and integrated into totality. Hence, I agree with Hodson (2005) with the sentiments that students be taught to carry out their own scientific enquiries and so acquire scientific knowledge for them. Clearly, practical work had a central purpose and role in any such vision of science education. Practical work of a more open-ended, investigative kind could develop learners' tacit knowledge of scientific enquiry.

The doing of practical work in this study was to develop skills, knowledge, and positive attitudes which were required to engage in a full range of goals such as, stimulation of curiosity and motivation of learners in the learning and teaching practical activities. The purpose of practical work was also to inculcate and inrease the interest of the teachers in natural science in particular, especially on the aspect of pedagogical content knowledge. The acquired practice for process skills helped learners and promote a logical and reasoning method of thought. It encouraged teachers to ensure that learners master and gain the insight and expertise of the practical skills and that it has a high validity. Hence, is commendable that practical work helped the teachers to make accurate observation and description of the planned activity. It also helped the teachers to make a timely and a thorough pre-planned activity. There is no involvement of learners so as to avoid embarrassment. Practical activities influenced the substantive understanding of both the learners and the teachers in all the three cases I have observed.

The purposes of practical work in science education have changed as views of science knowledge and beliefs about teaching and learning have changed. The positivist movement dominated at the start of the 20th century and hands-on ‘cook book’ type activities were encouraged to confirm that science content (Lunetta, Hofstein & Clough, 2004). However, in the latter half of the 20th century the focus shifted towards an understanding of the way in which the body of scientific knowledge is established. This shift culminated in science curricula which promoted the development of manipulative and cognitive skills associated with scientific inquiry (Jenkins, 2007) and a greater emphasis on the nature of science (Lunetta et al., 2004). Practical work also assisted in helping learners in the acquisition and the development of the concepts to motivate, by stimulating interest and enjoyment of the subject.

The purposes of the practical work have been elaborated in science education which includes: acquiring conceptual and theoretical knowledge, developing an understanding of the nature and methods of science, and engaging in expertise in scientific inquiry (Hodson, 1996). Practical work assisted in teaching laboratory skills and gave insight into the scientific method and to develop expertise in using it. Furthermore, the purpose of practical work was to develop certain scientific attitudes such as: curiosity, open-mindedness, objectivity and willingness to suspend judgment. Teachers could also highlight the knowledge and skills which can purposefully be developed in learners by using practical work. The school of science has two distinct purposes which were to develop the scientific literacy of all students as a preparation for active citizenship; and to provide the foundation for further study of science for those students who may wish to pursue careers in science field that required this practical work (Donnelly, 1998). All the students were in preparation for active citizenship and to provide the foundation for further study of science. Practical work has an important role to play in this, though it cannot carry the whole load and must be used alongside other teaching approaches. More specifically, practical work was essential for giving students a ‘feel’ for the problematic measurement, and an appreciation of the ever-presence of uncertainty or measurement error.

From the above discussion there is little doubt that practical work has a purpose in the teaching and learning of natural sciences. However, within the context of the CAPS, even though there are various purposes of practical work, the overarching purpose of practical work is to develop process skills and substantive understanding with the ultimate goal of developing problem solving skills. This is based on the explanation of practical work in the Department of Education documents policy and guidelines (DoE, 2011).

2.7. The teachers' views and beliefs about the practical work.

Teachers in the developed and developing countries view practical work as the crux of science learning in education (Abrahams & Millar, 2008; Kapenda et al., 2002). Teacher view the role of practical work as developing student understanding of the nature of science (Lederman, 1992). Scientific knowledge is viewed as a fixed body of knowledge which needs to be identified and appropriated to the view that science knowledge is changing, socially constructed and subjective (Lederman, 1992). Practical work is also viewed as a tool for teaching about experimental design. Practical work is the essential feature of the science education. From the above sentiments, I am of the suggestion that the combination of the two definitions of practical work by Lederman (1992) and Kapenda et al., (2002) could be the best to define practical work as the tool and also the crux of teaching and learning natural sciences.

Teacher's beliefs of teaching and learning science often have a pervasive influence on their classroom practices (De Vos, 1998). Beliefs are the best indicators of the decisions individuals make throughout their lives (Pajares, 1992). Furthermore to that, Bandura (1991) describes beliefs as preeminent indicators of the decisions people took throughout their lives. It is argued by many that the beliefs of teachers influence their views of teaching during classroom practice (Pajares, 1992). Policy reports set forth the goal of scientific literacy, however, the intended tasks of the implementation falls upon the teacher and it is essential to take cognisance of the teacher's views and beliefs about learning and teaching (Lumpe et al., 2000). The beliefs of teachers must not be ignored if the recommendations of policy were to result in enduring change in the classroom (Lumpe et al., 2000).

For many teachers, practical work provides the evidence for existing scientific knowledge and developing new knowledge (Dudu et al., 2012). In addition, traditionally, teachers viewed the use of practical work as illustrations and consolidations of the understanding of science concepts (Abrahams, I. & Millar, R., 2008). Here, I agree with Dudu, & Vhurumuku, 2012) because the pre-knowledge is of utmost importance in every subject content (practical work). Furthermore to that, some of the teachers viewed practical work as an assessment in teacher education to their overall performance. Practical work was viewed as a prominent and distinctive feature of science education. It is sometimes ironic that teachers' views of the nature of science often determine the format of the practical (Tsai, 1999). Hence, the practical work was also viewed as an important tool for teaching and learning about experimental design.

The existing literature on teachers' conceptions of teaching and learning science has found that the experienced science teachers had developed their own conceptual frameworks and their own teaching practices seemed to be consistent with these developed frameworks (Brickhouse, 1989). Hence, the conduct about practical work with regard to the unqualified natural science teachers was explored. Moreover, in the study conducted by Mudau (2015), investigating the perceptions on the nature of practical work stated that, it is imperative that one situates the nature of practical work and its definition from literature. There are many definitions and explanations of what practical work is from the literature. The DBE (2011) describes practical work as all activities that can be used to develop process skills, as well as substantive comprehension of the content. As such, the definition of the DBE (2011) is not confined to a classroom or laboratory. It is also emphasized that it must be integrated into theory than to be performed independently. However, Motlhabane (2013) indicated that teachers doubt the usefulness of practical work in the content comprehension. Therefore, it will be futile exercise to attempt to assist teachers without first ascertaining their perceptions on practical work.

Furthermore to that, it is utterly difficult to change the teacher's mind set of what works and what does not work, as shown by Tobin (1998). However, in whatever means to show teacher's other ways and reasons of using practical work, it is, therefore, essential that their perceptions are qualitatively emancipated. In addition to that, according to the Department of Basic Education (DBE, 2011), practical work must be integrated with theory to strengthen the concepts being taught. These may take the form of simple practical demonstrations or even an experiment or practical investigation. This is the resolute focus of the revised curriculum, Curriculum and Assessment Policy Statement (CAPS) on the status of practical work. The DBE (2011), further prescribes that students should at least do one practical activity for each term. Further research opportunities on ways and strategies of conducing practical work within contextual inhibitors are suggested.

These are often learner-centered, constructivist approaches that include analysis and discussion of social, technological, and environmental issues. However, some Portuguese studies suggest that, although teachers have developed a discourse that corresponds to the new orientations, they have not changed essential dimensions of their own practices (Abelha, Martins, Costa & Roldão, 2007; Correia & Freire, 2009; Prescott, 2005; Raposo & Freire, 2008; Seixas, 2007; Viana & Freire, 2006). In addition, other studies have identified barriers to curricular innovation, including (a) teachers' difficulties with understanding new concepts and curricular documents, (b) resistance to changing a traditional vision of science education and (c) resistance to adopting new practices in line with a constructivist approach (Galvão et al., 2004; Galvão, Reis, Freire & Oliveira, 2007).

2.8. The aims and the objectives of practical work.

The goals of natural sciences education through effective practical work teaching bring into perspective the scarcity of skills that are associated predominantly, with the natural sciences in which secondary school education plays a crucial role as a preparation and initiation phase into the fields (DoE, 2012). Shortages of critical skills in the fields of science and engineering are common in most developing countries, including South Africa. Education is one of the drivers of the economy through the accomplishment of all the goals pronounced by the national curriculums (Nyoka, DuPlooy & Henkeman, 2014). Indeed practical work is aimed at driving and pursuing the production of the sciences scarce skills which include: scientific skills, enquiry skills, process skills, problem-solving skills, etc.

Accordingly, inquiry-based practical work is aimed at improving learner engagement and learner-centeredness. Inquiry-based practical work involves investigations conducted by learners in contextualised and relevant experiences (Aubusson, 2011). Learners are given opportunities to conduct investigations in ways that were scaffolded to meet the levels of their skills and knowledge (Allchin, 2014). There are three proposed set of aims in science education which include:

- To learn and understand scientific concepts, models, and theories.
- To learn and understand the importance issues in philosophy, history and methodology of science.
- To learn how to do science: to be able to take part in the activities which lead to the acquisition of the scientific knowledge (Hodson, 1992).

Therefore, other aims of practical work include: to develop the scientific knowledge of the students, it also helps students' understanding of the scientific inquiry which is an approach to investigate natural phenomenon. Practical work provides students with insights into scientific practices and can also increase interest in science field and studies. It also develops student's understanding of the logic of scientific inquiry and the nature of scientific knowledge as a curriculum. Practical work is also a tool for teaching about experimental design. Practical is the essential feature in science education. Its use is to develop scientific methods of thought and the aim is to enable pupils to find out through investigation (Gott & Duggan, 1995). Lunetta (1998); suggested that practical work has the potential to enable collaborative relationship as well as positive attitudes towards science. Scientific activities enable learners to interact more among peers and the teacher. Therefore, I have noted that the above notions concur with each other and I also feel the same, that practical work develops scientific method of thought and also enables collaborative relationship and increases positive attitudes of the learners as the latter suggested.

One of the aims of the practical work assumes that the carrying out of learning by doing is unique to science and relate to the need for a laboratory. Furthermore to that, laboratory equipment and the activities carried out are very different from those in the mainstream classroom teaching. This also adds to the interests and emotions of learners (Lunetta, 1998; Hofstein et. al., 2004; Hofstein & Lunetta, 2004). Moreover, practical work develops pupils' manipulative skills. It helps to develop learners' knowledge of the world and understanding of some of the natural phenomenon. Practical work develops the learners' understanding of the scientific strategy to investigate. It helps in developing learners' problem solving skills and enhances mastery of the subject matter; it also builds and develops teamwork abilities of the learners, cultivates the interest in science and learning of science. Practical work also prone the scientific reasoning and develop practical skills among the learners. Hands-on activities discourage rote learning and memorization of the learning content by the learners.

Practical investigations and experiments evaluate each and every outcome in the learning process in natural science. The thinking and reasoning abilities of the learners are also developed through practical work. When teachers use the practical work, they will be able to support cognitive and developmental skills of the learners. The frequent use of practical work in a classroom teaching will speedily facilitate the explanation of models in science subjects. Practical work helps learners to learn 'the how part' of using the scientific apparatus and to follow the standard procedures.

Most of the important aims of the practical work are pooled in order of their perceived importance (Kerr, 1963).

- To encourage accurate observations and careful recording.
- Promote simple common sense, scientific methods of thought.

- Develops manipulative skills.
- Gives training in problem solving.
- Verifies fact and principles already taught.
- Arouses and maintain interest in subject.
- Make physical phenomenon more real through actual experience.
- Elucidates the theoretical work to aid comprehension.

The fact that these aims are still relevant today after so many years, proves that there is a universal consensus with regard to what a Chemistry laboratory should achieve in the long run. This seems to be supported by Buckley and Kempa (1971) who produced an almost similar list of aims that laboratory work should produce. These are: Manipulative skills; observation skills; the ability to interprete experimental data and; the ability to plan and carry out experiments. In a major review on the role of laboratory teaching in school science education, Hofstein and Lunetta (2004) detailed some of the factors that inhibit learning. Among these were the following: The recipe-style laboratory practical used in most schools do not allow the learners to think about the larger purpose of their investigation and the sequence of tasks they need to pursue to achieve those tasks. Assessment is seriously neglected, resulting in the impression that laboratory work does not need to be taken seriously; educators are not informed on best practice; and resources for more practical work teaching style are limited.

The practical work helps the teachers to make accurate observation and description of the planned activity. It also helps the teachers to make a timely and a thorough pre-planned activity so as to avoid embarrassment. Practical activity influences the substantive understanding of both the learners and the teacher. Those activities help in social interaction and organisational climate in the classroom. These activities also shape up the representations of the product or outcome from the class activity. Practical work also inculcates the procedural understanding of the learners. It brings about the enjoyment among the learners experiencing real phenomenon in the teaching and learning. It encourages the teacher to make precise interpretation and analysis of the findings. This is what has happened in Slovenia government. The Slovenia government believed that through inquiry and problem-based hands-on activities, laboratory and field work make it possible not to transfer the knowledge on higher order cognitive levels and to teach experimental and practical skills, but also to ignite an interest in Science among students (Sorgo & Spernjak, 2009).

Hattingh et al., (2007), argues that practical work has the potential to contribute to meaningful learning in science if it is conducted frequently. Learners can gain understanding of the existing scientific knowledge and concepts from teacher-determined practical work. Practical work aid in bringing theory (what is explained in textbook) to life or real contexts (Krefting, 1991). It could also be best suitable for the acquisition of cognitive skills which is another way to improve learning and enhance additional connection between theory and practice (Clark, 2006). The practical work in science includes a number of different kinds of activities, and the main purposes of these activities is to develop skills, knowledge, and positive attitudes which is required to engage in a full range of goals, such as, stimulation of the curiosity and motivation of learners.

2.9. Situating practical work in the context of South African curriculum (CAPS).

Practical work in the context of South African curriculum (CAPS), is situated in the National Curriculum Statement in the senior phase which gives the expression to the knowledge, skills and values worth learning in South African schools (DBE, 2011). This curriculum (CAPS) in natural science aimed at ensuring that children acquire and apply knowledge and skills in ways that were meaningful to their own lives. Therefore, natural sciences teachers are to be competent with regard to pedagogical content knowledge of the subject. Hence, the CAPS promote knowledge in local contexts, while being sensitive to global imperatives (DBE, 2011). The policy prescribes the practical work as part of final promotional assessment of which natural science teachers are compelled to implement by law. I believe that this inclusion added more value for practical work in progression of the learners at the end of every term.

There are three specific aims of natural science in grade seven, namely: specific aim number one: ‘Doing science’, specific aim number two: ‘knowing the subject content and making connections’, specific aim number three: ‘understanding the uses of Science’ (Department of Education, 2011). However, the focus of the study was on the specific outcome number one, which is ‘Doing science’.

Specific aim one: ‘Doing science’

It meant that the learners should be able to complete investigations, analyse problems and use practical processes and skills in evaluating solutions. Learners should plan and do simple investigations and solve problems that need some practical ability, attitudes and values which underpin this ability. Respect for living things, was an example learners should not damage plants; if they examine small animals they should care for them and release them in the place where they found them (DBE, 2012). It was also related to the development of the cognitive and process skills associated with the design and implementation of scientific investigations which required learners to become familiar with scientific process.

Learners were able to act confidently on curiosity about natural phenomena, to investigate relationships, and also to solve problems in scientific, technological and environmental contexts and understanding. In the context of this study we dealt with practical work which was related to the learners’ surroundings and that is where some of the teachers, in some instances, were improvising due to lack of resources (DBE, 2011 & DoE, 2012).

Practical work was also prescribed in CAPS but the implementation process for assessment and approaches might be problematic to most of the natural science teachers especially the unqualified ones (DoE, 2012). There were practical tasks like, investigation, assignment, case study, project, etc. that are prescribed per grade per term per phase (DBE, 2011). Every learner had an opportunity to do practical work once per term and is inclusive in the final assessment (DBE, 2011). The general aim of the curriculum, in South Africa, is to ensure that learners acquire and apply knowledge and skills in ways that are meaningful to their own lives. The curriculum also promotes knowledge in local context, while being sensitive to global imperatives (DoE, 2012).

The curriculum as outlined in the content and the CAPS also showed evidence and emphasis on practical work, although teachers tend to rely mostly on curriculum materials such as textbooks and teachers' guides in caps just like in any other curriculum policy (DoE, 2012). This is because of the examinations and some of the competitions are mostly based on the curriculum materials and that is why many teachers depend on textbooks as a basis for teaching (Yoon, 2008). The teacher was able to realise and see the potential of the learner, and can also give the assistance to the learner after realising the weaknesses. Caps (DoE, 2012) prescribed a fraction of twenty five percent of the practical work every term, as said in the first chapter of the study. Repetitive practical work nurtures and enriches the knowledge and mastery of the learning content by the learner. Teachers are able to detect their shortcomings and correct them as they do more often of the practical work in a classroom situation.

Doing practical work frequently helped to alleviate inferiorities, anxiety among teachers, in view of instilling interest, love, enjoyment and good practice among others. (Hodson 1990). The development of pedagogical content knowledge in natural science teachers would be of a greater importance and it would bring an improvement in how they conduct practical work. The development of the cognitive and process skills is associated with the design and implementation of scientific investigations. The curriculum also require teachers to assess learners not only on all written tests and examinations but also demanded that teachers engage the learners in a variety of practical work for the purpose of assessment that contribute towards a minimum pass or promotional requirements.

2.10. The role of the teacher in facilitating the practical work.

The role of the teacher in a classroom is more important in that, instead of being in the centre of learning as a know it- all, his/her role should include being "facilitator of learning" (Grier-Reed & Conkel-Ziebell, 2009). Furthermore to that, the knowledge is not directly transmitted from teacher to learners, but would be easily received through the teacher`s support (Grier-Reed & Conkel-Ziebell, 2009).

The starting point for improving practical work was therefore to help teachers become much clearer than many are, at present, about the learning objectives of the practical tasks they use. Curriculum assessment policy statement for Natural Science Grades 7 – 9 (DBE, 2011) stated that although it was not considered ideal to improvise equipment, teachers should remember that it is more important for learners to have the experience of carrying out a variety of investigations than to depend on the availability of equipment. Teachers should relate the use of practical work as to prepare pupils to be assessed through practical work. But In spite of all the motivations that establish practical work as an essential component of natural sciences teaching and learning in primary schools, some South African classrooms continue to be dominated by teacher-centered instructional practices that rely heavily on teacher explanations (Ramnarain, 2014; Webb, 2009). This is despite the CAPS syllabus for natural sciences emphasizing the inclusion of practical work instruction by prescribing and recommending practical work activities in school based assessment (School Based Assessment) of the learners. The prescribed and recommended practical work activities serve partly as a tool to make equal opportunities and similar experiences for instruction available to all learners who decide to study physical sciences. However, the fact that some may pass through secondary physical sciences without experiencing inquiry-based instruction through practical work creates a situation of inequitable access to physical sciences education.

The practical work is hands-on and minds-on activity that has become part of the tradition of science education in a number of countries over recent years, including South Africa. Practical scientific inquiry, as a subset of practical work, required both an understanding of conceptual or substantive ideas, the facts, laws and theories of science and procedural understanding of the thinking behind the doing, that requires ‘concepts of evidence’ which is referred to, the design, data handling, measurement, and the evaluation of practical work. These are complimentary to conceptual understanding (Gott and Duggan 1995). The role of the teacher was to mentor, guide, plan, organize, lead, control and direct, facilitate, and to demonstrate all the principles of practical work during hands-on (Tipps et al., 2011).

The teacher in most instances was the chief instructor of the process that is unfolding during the actual practical work process in a classroom context. This unfolded process was s also to continue to make an impact outside the classroom, in the community. Although Kerr (1963) acknowledged the possible role of practical work in preparing pupils for practical examinations, there was also a recognition that it was too much to expect more than a few teachers to admit to using practical work to this end. Evidently, whilst teachers are aware that the National Curriculum considers observation and scientific thinking as important practical skills to be taught, they clearly have an expectation that pupils would have developed sufficient proficiency to enable teachers to prioritize other aims of practical work pertinent to their roles.

2.11. The contextual factors which influence the conduct of practical work.

The factors that influenced the implementation of practical work in a classroom are: classroom norms, task condition, teachers' teaching habits and disposition, learners' learning behavior and disposition (Hitchcock and Huges, 2011). These factors also influenced the climate change in a classroom, where you find some learners having negative attitude towards practical work or the teacher, per se, having negative attitudes towards practical work. Classroom climate was also influenced by the task set up, teacher's pedagogical content knowledge (PCK) of the subject, goals of the practical activity, teacher's discipline of the learners, and discipline of the learners towards the teacher. A very good classroom climate helped to develop student's ideas about data collection and interpretation (Kanari and Millar, 2004).

Classroom climate should enhance both learning and teaching processes. The set up in a classroom should have assisted teachers to be effective in demonstrating and illustrating practical work. The availability of the equipment and apparatus eased the anxiety of both teachers and learner performing practical work, especially the scientific enquiry, investigation. etc., because this was the fundamental in terms of attaining the goals of doing practical work (DBE, 2011). The ordinary classroom turned into improvised laboratory must be well equipped to arouse both the interest of the teacher and the learners. The precautions and safety measures must be put in place, accessible to every learner in the classroom laboratory.

Therefore, learners must be taught how to behave and also how to use this equipment. (DBE, 2011). Learners must never be left alone in the classroom laboratory. The scientific equipment which needs a great high care must be constantly monitored and taken care of by teachers, e.g. mercury. The fire distinguishers must be readily available and serviced so as to be used in case of emergency.

From the above discussion, I concurred with the notions that a teacher and learner discipline, a good classroom atmosphere, adequate laboratory resources, and competency in terms of pedagogical content knowledge (PCK) would be of great help and above all the hands-on and minds –on practices, be carried out effectively and efficiently. Hence, practical work is also used in every quarter assessment (i.e. SBA) as prescribed in senior phase (Grade 7-9) curriculum policy assessment statements (DBE, 2011).

2.12. The distinction of the qualified, unqualified, and underqualified teacher in the context of South African curriculum as related in the study.

A. In the context of South African curriculum.

Any professional teacher was regarded as a qualified teacher after he/she did receive a professional training for the minimum period as stipulated in the legislative policy framework governing education system in our country (NEPA, act 27 of 1996). A qualified professional teacher was the one who holds a three year (or more) recognized tertiary teaching qualification (SAQA, 1998). The relative education qualification value (i.e. REQV 13) is categorized as follows: (M+3) which means Matric/grade 12 with three years of training as a teacher, qualification is regarded as a Diploma, and /or (M+4, which is REQV 14) which a four years of training as a teacher, qualification is regarded as Degree (i.e. B.Ed. or B.A + HED. This HED is, nowadays, called the PGCE (i.e. B.Ed. or B.A + PGCE). It is the national education policy act governing the norms and standard of educators which is accredited by South African Qualification Authority (SAQA).

The NEPA is also regulating the policy of appraisal system of educators. A professional qualified teacher in South African has to have undergone a minimum training of three years to obtain a teachers' diploma or a four year degree with method of teaching (i.e. JPTD, PTD, STD, or B.Ed., B.A. with one year HED inclusive) (SAQA, 1998). Any person who does not meet the minimum requirements stipulated above, was not regarded as a professional qualified teacher. All the teachers were required to be a legitimate registered member of the South African council of Educators which is SACE mandated by the National Policy Frame work on Teacher Education and Development (NPFTED, 2007).

B. In the context of this study.

In this study, any professional teacher was regarded as an unqualified teacher if he or she did not receive a professional training for the minimum period as stipulated in the education laws and policy in a specific subject. Some teachers were allocated natural science subject though it is not his/her field of specialization and did not receive required minimum period of three years, or more of training. The allocation is influenced by the scarcity of science and mathematics teachers that the department of education is experiencing in South Africa, hence the recruitment of foreign teachers.

Underqualified professionally teacher holds an in complete tertiary qualification. However, due to scarce skills teachers, in some instances the department finds itself having no choice but to hire those underqualified teachers inconveniently to render the services of a qualified professional teacher (SAQA, 2012).

Underqualified in terms of teaching qualification it means that, a person has no method of teaching. Like in the previous decades, we had teachers with Primary Teachers' certificate (PTC) which was only two years of training i.e. REQV 12 (M + 2) years of training and this was upgraded to national professional diploma in education (NPDE), where teachers were sent to tertiary institutions to upgrade their qualification from Matric plus two years of teacher training (M+2) i.e. PTC, to matric plus three years of teacher training (M +3) which is NPDE(National Professional Diploma in Education).

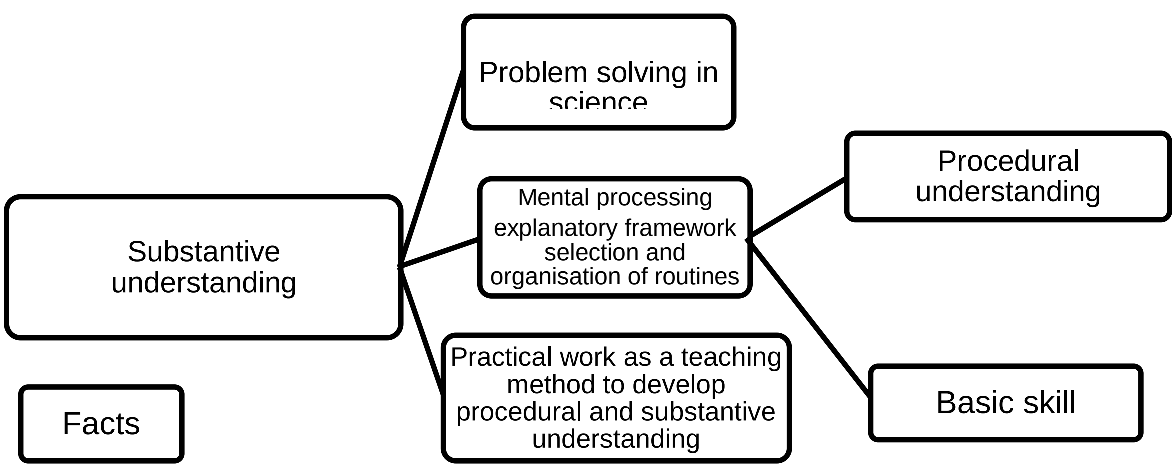
Natural sciences as a subject is the combination of the two subjects which are physical science and life sciences used to be called biology in the old curriculum (DoE, 2011). However, I have a strong opinion that the most qualified teachers for teaching natural sciences must be in a possession of advanced certificate in education (ACE) in natural sciences, or B.Ed. honors with a specialization in natural sciences and above.

2.13. The conceptual framework and the design of the models.

The conceptual frame work in this study was based on the three models which are: Doing of science model, performances model, and Explanatory model, which was drawn from Pekmez *et al.,* 2005. The focus was about exploring how unqualified natural sciences teachers in the senior phase in grade seven facilitate practical work in a classroom context. I used this conceptual framework as an analytical tool to understand and interprete the conduct of the practical work including the ways of knowing (epistemological), the content knowledge (ontological), and data collection and analysis (methodological), and lastly pedagogical strategies/methods of teaching (Pekmez *et al.,* 2005). This provided a researcher with an opportunity on how the teachers define the concept of practical work in their own words, understanding, in and around their contextual setting. The classroom conduct and both the roles of teachers and learners were explored, explained and well understood. The focus of the study was to explore how unqualified natural sciences teachers conduct practical work in the senior phase in grade seven. The study by Pekmez, Johnson and Gott (2005) on teachers' thinking or views about practical work in the context of English national curriculum for sciences in UK and USA, identified the three movements as summarized in the table 2.1 below.

MOVEMENT			
Main characteristics	**Discovery learning**	**The process approach**	**Investigations**
	1. Learners expected to discover things for themselves	1. Motivates the identification of what scientists do and argue that this is what must be taught.	1. The approach was confounded on the focus that pupils should be thinking about what they are doing rather than simply applying the method practiced.
	2. Practical work seen as the means in which pupils will develop their thinking.	2. Content not a priority but a scientific method.	2. The approach develops procedural and substantive understanding.
	3. This is a teaching method which leaves things open for discovery but also offers an opportunity for not discovering them	3. This is teaching method that focuses on skill and neglects content	3. The ultimate aim is to develop problem-solving skills.

Table 2.1: Characteristics of movements influencing practical work



The following models were also used for analysis and explain the thinking of the teachers about practical work:

Figure: 2.1. A performance model (Gott and Duggan cited in Pekmez *et al.,* 2005: 323)

This performance model showed the investigation approach where the teacher has the intention of developing substantive understanding as well as procedural understanding. Practical work was used as an explanatory frame work and selection and organization of mental skills processing. The ultimate aim of the approach was to develop problem-solving skills among the learners.

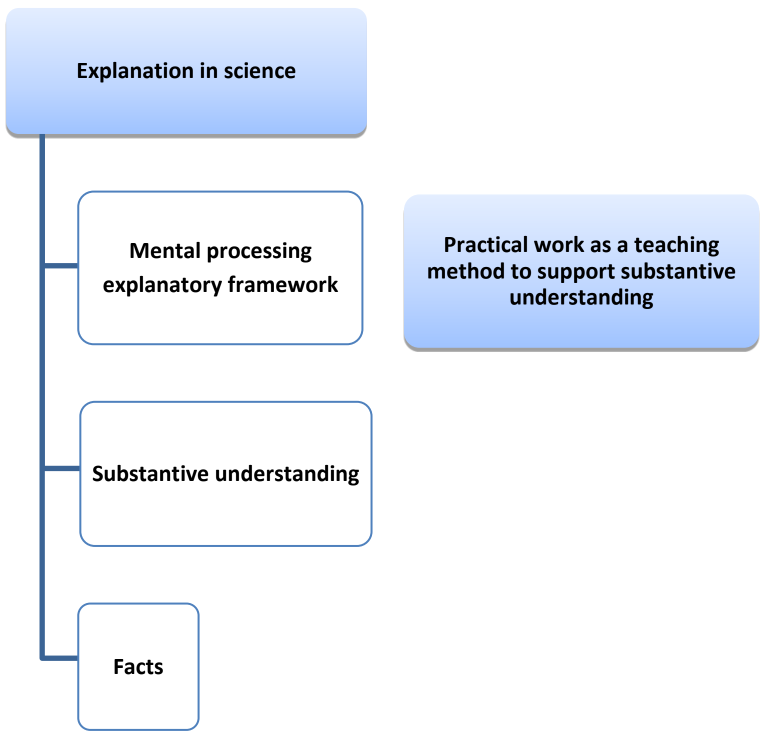


Figure: 2.2. An explanatory model (Pekmez *et al.,* 2005)

The explanatory model depicted the practical work as a teaching method to support substantive understanding and laboratory work as just teaching method towards the end (Pekmez *et al.,* 2005). Practical work was also used as an explanatory framework for the explanations in science.

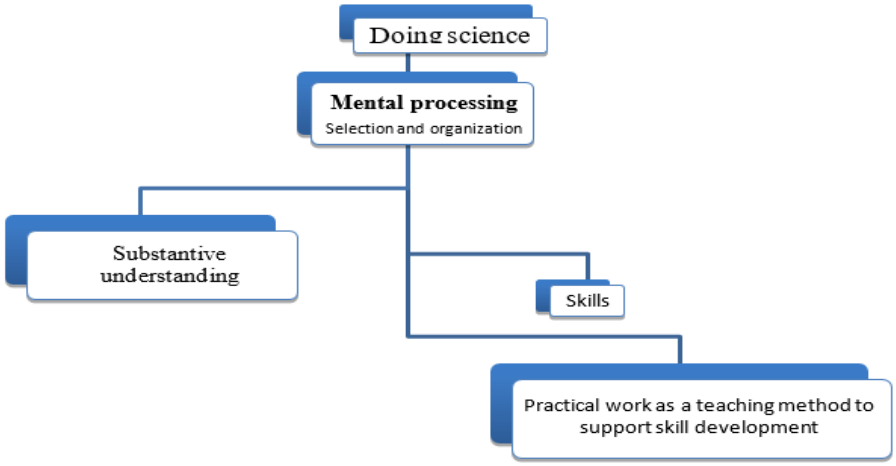


Figure: 2.3. A doing of science model

The doing of science model was used in diagnosing how practical work carried out/ conducted by the natural sciences teachers in the classroom situations. The doing science model was used as a teaching method to support skills development. Pekmez *et.,al* (2005) indicated that in this model natural sciences teachers were concentrating on the skills (doing) rather than the ideas to be understood. The teachers' thought of practical work from the process approach was noticed.

2.14 How the conceptual framework was applicable to the research study.

The above mentioned three models as the conceptual framework in the study, they were used to diagnose how practical work was conducted by the unqualified natural sciences teachers in grade seven (Staver, 2007). (i.e. the performance model, the explanatory model, and the doing of science model). The performance model (figure 2.1) is based on the investigation movement approach. The teacher has the intention of developing substantive understanding as well as procedural understanding. Hence, practical work is used as an explanatory framework and selection and organization of routines (skills) for mental processing. The ultimate goal of this approach is to develop problem solving skills amongst learners. The explanation model (figure 2.2) depicts practical work as a teaching method to support substantive understanding and laboratory work as just a teaching method towards this end (Pekmez et al., 2005). Practical work is used as an explanatory framework for the explanations in science. The doing of science model (figure 2.3) uses practical work as a teaching method to support skills development. Pekmez et al. (2005) indicate that in this model teachers concentrate on the skills rather than ideas to be understood. This model shows a teacher who thinks of practical work from the process approach movement

The conceptual framework influences the achievements of students (Abd-El-Khalick & Akerson, 2009). The teacher was expected to know the common misconceptions and experiences of learners and their prior knowledge so that he or she can introduce the new subject matter from those constructs for students to learn the new subject matter (Eryilmaz 2002; Galus, 2002 and Hausfather, 2001). Therefore, the framework was used as a frame/ term of reference to establish whether the teacher was aware of the common misconceptions regarding the conduct of practical work and, if so, how he or she used pedagogical instructional strategies as well as the nature of the interactions and discourse to create misconceptions dissonance if they manifested during teaching and learning process.

Moreover, the assertions that misconceptions may be created, (Graham et al., 2012; Bayraktar, 2009; Prescott & Mitchelmore, 2005 and Prescott, 2004) during teaching by the teacher or learners were also considered. So, it was not only about diagnosing the awareness but also finding out whether the teacher did have pedagogical content knowledge (PCK) about practical work of which the skills could be transferred to the students during teaching and learning of natural sciences as a practical subject.

2.15. Chapter conclusion.

This chapter discussed and reviewed the relations on the followings aspects: what is practical work/ definition of practical work, types and the nature of practical work, the purposes of practical work, the teachers' views and beliefs with regard to practical work, situating practical work in the South African curriculum (CAPS).The study further discussed the aims and the objectives of practical work, Pedagogical content knowledge of the natural sciences teachers on conducting practical work in natural sciences. Clearer distinction was also given with regard to a professionally qualified teacher, unqualified teacher, under qualified teacher in the context of South African Qualification Authority (SAQA, 2012). This chapter also discussed about the conceptual framework and the design of the model, and how the conceptual framework was applicable to the research study. It also discussed the contextual factors which influenced the conduct of practical work, the role of the teacher in facilitating the practical work.

In the next chapter I present research design and methodology.

CHAPTER 3
RESEARCH DESIGN AND METHODOLOGY

3.1. Introduction.

The purpose of this chapter presents the methodology and design of the study, describing the research approach of the study, the nature of the research study, the context of the study, as well as the techniques and procedures used in data gathering, the strategy of inquiry, and all the instruments were explained. In addition, it presented the ethical considerations for the research study and the rigorous ways in which it ensured validity. The aspect of teacher qualification and professionalism was also described, the piloted study was elucidated, philosophical worldview or paradigm was elaborated. The research approach was a qualitative case study and aimed at exploring on how the unqualified natural sciences teachers facilitated practical work, teacher qualification and professionalism shortly described. Data collections methods described and triangulation was rigorously done. The aspect of the role of the researcher was highlighted, the research population and research sampling was dealt with.

3.2. Research design/approach.

A research design was defined as a plan or blueprint of how one intends conducting the research (Mouton, 2001). It was further defined as a blueprint according to which data was collected to investigate the research question in the most economical manner. The research study was a qualitative study and a case study approach was used as a strategy of inquiry to explore how practical work was conducted in grade seven by natural science teachers. A research design could also be defined as a plan of a research specifying what was to be done and how to do it. It involved the structuring and organizing all procedures of data collection, analysis and reporting in qualitative and quantitative research (Creswell, 2002).

3.2.1. Philosophical worldview/Paradigm.

A research philosophy is a belief about ways in which data about a phenomenon is collected, analyzed and utilized. It was the main purpose of science to process and transform things believed into things known (Galliers, 1991).Worldview is defined as "a basic set of beliefs that guide action" different paradigms are used in a qualitative research and among others are: Intepretivism, post-positivism, ontology, epistemology, constructivism, critical theory (Creswell, 2012) Guba and Lincoln (1994) suggested four underlying paradigms for a research, namely: positivism, post-positivism, critical theory and constructivism. Baroudi (1991) also suggested the three categories, based on the underlying research epistemology, namely: positivist, interpretivist and critical.

Cohen et al., (2007) explain that an interpretive research paradigm is one that accepts that reality is a construct of the human mind. This study was underpinned by the hermeneutic/interactive paradigm. Its focus was on understanding the lived experiences of teachers and their points of view based on their social context. This study made use of several means to understand the nature of teachers' experiences because reality is socially constructed and therefore there were many ways of perceiving that which is seen. The interpretive paradigm, which was also referred to as phenomenological tradition, emphasized that all human beings are engaged in the process of making sense of their lives or worlds. Human beings continuously interpret, define, justify, create, give meaning to, and rationalize our daily actions and behaviors (Babbie & Mouton, 2006). Traditionally, phenomenology was associated with the qualitative design and was, therefore, relevant in this research study. The main aim of the paradigm was basically directed towards understanding of individuals in relation to their own interpretations of reality and the understanding of the society within which meanings to those participants were ascribed to social practices in their vicinity.

The study was underpinned by the interpretivism because it had the roots in hermeneutics, which is the study of the theory and practice of interpretation. This goes along with the qualitative research (Maree, 2013) because a close contact of teachers was required in view of exploring how they conduct practical work in a classroom context. Interpretivists contended that only through the subjective interpretation of and intervention in reality can that reality be fully understood. The study was made possible to understand the views and perceptions of the teachers about the implementation of the practical work.

Maree (2013), also contended that the ultimate aim of an interpretivist research is to offer a perspective of a situation and to analyze the situation under study to provide insight into the way in which a particular group of people make sense of their situation. In this case, the natural science teachers of the sampled schools were interviewed, observed and given an opportunity to say their views in attempting to understand their strengths or weaknesses, of which was indeed there.

3.2.2. Qualitative research design.

This study was descriptive and explanatory. The study therefore adopted a qualitative research design. This design was preferred because of its ability to allow for flexibility in the discourse of the research study. The design also emphasized the lived experiences of individuals, taking their context into account (Neuman, 2000). The choice and preference of this design was further strengthened by the insinuations made by Babbie (2004). Babbie (2004) contended for this design in this nature of studies arguing that an intense study of a particular case can generate explanatory insights. The purpose of qualitative research is to understand, explain and identify behavior and beliefs and the contexts of people's experiences (Hennink, Hutter & Bailey, 2011). Since the purpose of this study was to gain a deeper understanding of the knowledge bases that underpin teacher decision-making and practice related to practical work in their particular contexts, a qualitative research design, guided by the interpretive paradigm, was chosen. Creswell (2008), argued that qualitative is about exploring common experience of individual to develop a theory, exploring the shared culture of a group of people, and exploring individual stories to describe the lives of people. The qualitative design was chosen for conducting this research study because it allowed the researcher to focus the actions performed. It also gave the researcher time to read and listen to the words in all complexes as they occur in a natural setting or in a real-life context (Leedy & Ormrod 2001). It was an explicit data collection and data analysis procedures and the phenomenon was detailed and described in this design. It also has a tentative summary interpretation and summary statements. Fundamentally, in the qualitative methods, the face to face interviews, classroom observation techniques, document analysis were used to collect data.

Qualitative approach was based on a naturalistic approach that seeks to understand phenomenon in a context of a real-world settings and in general where the researcher did not attempt to manipulate the phenomenon of interest. Qualitative research explored traits of individuals and settings that cannot be easily described numerically (De Vos, 1998) and it was concerned with the understanding of the social phenomenon, from the Participants' point of view, than explaining a phenomenon (MacMillan & Schumacher, 2001). The qualitative approach and the interpretive approach highly value the importance of actions and words in the study. The qualitative research approach was chosen because it showed how teachers make meaning of reality through close social interactions.

This qualitative research design was best suitable for this study, moreover, all variables like understanding, meaning, reality, life experiences of the participants which were unknown, indeed were explored (Creswell, 2012). The research characteristics differ in essentials at each stage of the research process of exploring an event, and this helped the researcher in attempting to develop a detailed understanding of the phenomenon (Creswell, 2012). In this case the main phenomenon was the conduct of the practical work and this aided in reflecting on how precisely the facilitation of the practical work can be practiced in the classroom situations. The natural science teachers were interviewed and observed in their natural settings in attempt to make sense of, or interpret how the practical work was conducted in terms of the meaning to them (Denzil & Lincoln, 2005).

3.2.3. Strategy of inquiry.

There are a variety of qualitative research designs which can be selected when conducting an investigation, these include: narrative, grounded theory, case study, phenomenological, critical theory (Leedy & Ormrod, 2001). The researcher here chose the case study as a strategy of inquiry in the study because of its nature to an in-depth exploration of a single or multiple realities. The strategy allowed the researcher to understand, explore, describe and also to interpret the cases (Yin, 2003). A further advantage of employing case study was that it enabled the researcher to study the same phenomenon, but under different conditions. The researcher biasness was minimized through triangulation process of data.

3.2.3.1. Case study as a strategy of inquiry.

A case study design is adopted because it is interactive and allows for the researcher to observe characteristics of an individual (in this case the teacher) within their context (Baxter and Jack, 2008; Cohen et al., 1993). The present study was designed as a case study. A case study as an "empirical enquiry" which was conducted into interesting aspects of an educational activity - in this instance, practical work. Its purpose was usually to inform the judgments and decisions of practitioners or policy makers. An educational case study attempts to explore significant features of the case, to create plausible explanations of what is found, to test for the trustworthiness of these interpretations, to construct a worthwhile argument or story that can be related to any relevant research in the literature and to convey convincingly to an audience this argument or story (Bassey, 1999). A case study was also defined as a design that is suited for the examination of a bounded system, or a case, over time, which employs multiple sources of data found in the setting mellieu (McMillan & Schumacher, 2010).

Case study is also an interactive inquiry that allows a researcher to focus on a single-in-depth and gain insight into practices carried out (Bassey, 1999). This was also supported by Vivar et al. (2007), as he viewed case study as an “in depth exploration of a single case or multiple cases”. A case study is an intensive study of one person or one situation (Woolfolk, 2010). The study concentrated only on the three grade seven natural science teachers who did not have natural sciences qualification (did not specialize in the subject). In this qualitative study, the researcher did not use statistics to analyze data, but the open-ended and some structured questions were used. The concern was not the numbers but the quality of the understanding and interpreting the event. The interviews were used where the researcher had personally made face-to-face interview and observe the three participants at their respective schools with no interference of their personal and school time tables though realizing that practical work naturally demand a lot of time.

The participants were interviewed before offering the lesson and after presentation of the lesson. The participants were observed during lesson presentation and this enabled the researcher to gain a deeper insight and understanding of the phenomenon being observed. The three teachers were purposefully sampled because they have the same identified characteristics. The three of them were teaching natural science in grade seven and did not have qualification in natural science. The research study was non-experimental and only teachers who were teaching natural science in grade seven were involved. A case study had been used to understand and direct the uniqueness and peculiarity of the natural science teachers' case in conducting practical work in grade seven. The dynamics of conducting practical work were explored and investigated.

The nature of the investigation required contact with teachers in their schools to elicit data that enabled the research questions to be answered; therefore, the qualitative case study approach was chosen. It was imperative for this study that close interaction with teachers was established because the teaching difficulties had to be understood from the teachers' viewpoints and classroom practices. Stake (2006) argued that if there was more than one teacher to be considered, a multiple case study method is the appropriate strategy. The triangulation method was used. This was so because teachers worked in different environments with different students. Furthermore, teachers' knowledge was also different as well as their experiences. Hence, each teacher was considered a case. With the teacher as a case, his/her in-depth individual conceptions and how he/she facilitated practical work were analyzed (Thomas, 1998). The study was not about a comparison of the individual participants but the main focus was on how the participants conducted practical work and the descriptions of the phenomenon under inquiry and inferences from classroom practices; hence it was a descriptive multiple case study of three teachers facilitating practical work.

A case study, according to Opie (2004) is an in-depth study of the interactions of a single instance in an enclosed system in which the context surrounding the research is pivotal; this is also attested by (Cohen et al., 2007). The case study approach was well suited to research study which benefited from direct observation and the collection of data in their natural environment (Yin, 2006). A descriptive case study approach (Merriam, 1998) was deemed most appropriate for this research study.

Understanding the context specificity of a case study approach, the intention was to gain an in-depth understanding of the knowledge base of a particular teacher, rather than to make general claims about the knowledge teachers draw when doing practical work. This, however, did not exclude the possibility of claiming some transferability of the findings of this study to similar contexts, and in that sense, it has limited the generalizability (Yin, 2006). The case study helped to ensure that teacher experiences are not explored through one lens but rather from an assortment of lenses (interviews, observations and document analysis) through which data was interpreted. Case study simplifies the experiences and understanding of teachers.

3.3. The role of the researcher in the study.

The researcher was an instrument for data collection, it was, therefore, necessary to focus mainly on the role of the researcher, what were the values, assumptions, beliefs or biases that the researcher did bring into the research process (Mertens, 1998). This aided in an attempt to answer the research questions. Qualitative researchers often changed their role in the course of data collection and they also provide logical extension of findings which enabled other researchers to understand and interpret similar situations and apply those findings in subsequent research practical context. The nature and the roles duration were determined by the situational context concerned. The assumption in the interpretive paradigm was that there should be no single objective truth, and that reality, given its complexity, was open to multiple interpretations (Toerien, 2013). The researcher's subjective views not only influenced, but were integrated as part of the research process. By explaining the position and roles assumed by me, the researcher, potential biases may be identified and addressed which enhances the credibility of the study (Hennink et al., 2011)

The researcher's role in this study was as a complete observer. A complete observer (means no participation/involvement at all)… the observer was only listening in all the three cases, starting from the planning of the lesson plan until the end of the presentation of it.the observer was just observing and listening. The three methods of data collection were used in order to triangulate data during analysis. Participatory researcher requires planning of the dual role, as a participant and researcher (MacMillan and Schumacher, 2010). The researcher in this study only ask questions in the interviews, do classroom observations, and the analysis of documents such as policy documents, work schedules, activity sheet, and recording of data. The policy document for natural science (CAPS) was also analyzed to verify as whether indeed it was speaking to the teachers and learners about practical work. The researcher diarized, and audio-video taped all those conversations between the participant and himself for thorough recording and data interpretation. (all what has been said and done by observed teacher was written down in a diary"… audio-video taped referred to as, all what happened was captured/taped by an audio-visual devices(video camera)

3.4. Research site and setting.

As noted, the study under review was conducted at the schools sampled as the research sites. The natural research site of the study was only for the voluntarily available three primary schools in Lebopo circuit, which are situated around a rural area in Molepo villages, in Polokwane in Limpopo province in the Republic of South Africa. Lebopo circuit is one of the five circuits in Mankweng clusters. There are 33 schools in Lebopo circuit of which nineteen of them are primary and one of these primary schools is where the researcher is a natural science teacher in grade seven. This locality has enabled the researcher to collect data easily, without any difficulty because the schools were located in the same vicinity and there was a viable public transport between them. The setting of this study was in the Department of Basic Education in Limpopo Province.

3.5. Research population and sampling method.

3.5.1. Population.

The population referred to the entire or the total number of possible participants who are working or residing in a particular needed locality/area as the context. The sample studied were comprised of the grade seven natural science teachers, The three will be sampled for a study and the fourth teacher served as the pilot study and participation was on voluntary basis. The population to be sampled was located in Lebopo circuit (which embraces all Molepo villages), in Mankweng cluster circuits, Capricorn district, Limpopo, in South Africa.

3.5.2. Sampling.

Sampling was the process of selecting a fraction or a portion of the population for a study. There are two sampling techniques, namely: non-experimental technique and experimental technique. In this qualitative research a smaller group of information-rich participants are selected and this was represented by the three participants. Sampling is the process of selecting participants from the population and data is collected from small group which is then called, sample. Decisions regarding sources of data need to be described as well as justified. MacMillan and Schumacher (2001), describe sample as a “group of elements or cases, whether individuals, objects or events, that conform to a specific criteria and to which we intend to generalize the results of the population.” In this case, three professional teachers were selected on the basis of their non-experience and none qualification in teaching, particularly practical work in natural science in the senior phase in grade seven at primary schools in Lebopo circuit, Mankweng cluster circuits, Polokwane District, Limpopo province, South Africa. In essence, only three unqualified natural science teachers in grade seven were used in the study. There are different forms of non-probability sampling methods, which include: Snowball sampling, Purposive sampling, Dimensional sampling, Quota sampling, and Convenience sampling.

3.5.2.1. Purposive sampling.

This method of sampling was used in special situations where the sampling was done with a specific purpose in mind. This purposive sampling method was chosen because the participants have the same defining characteristics that make them the holders of the data needed. Selection of participants was needed if one wished to explore how natural science teachers facilitated practical work. There was a target group for the sampling with specific characteristics. The participants were purposively sampled because the purposive sampling allowed the researcher to focus on a particular identified aspects or characteristics of the participants. The selection or the sampling procedure was earmarked by certain characteristics which include: teaching natural science in grade seven without specialization in natural science, non-racial, non-sexiest. The study was a non-experimental. The drawing of the sample involved the generation of the predetermined number, which were the three natural science teachers at primary schools and fourth teacher who happened to be from my school was used for the purpose of piloting the research study.

3.6. Data collection methods

Data collection procedures involved the gathering of information about the variables in the study (McMillan & Schumacher, 2010). It also entailed where data was to be collected, by whom the data was to be collected, when was it collected, how was it collected, and who was the possible participants. Data was to be collected by using the following collection methods: Interview (pre-interview and post interview), observation procedures, document analysis, such as: - policy document, learners' record sheets, lesson plan preparation, teacher's practical activity plan, teacher's profile, and the researcher's diary.

3.6.1. Interview.

An interview was a two way conversation in which the interviewer asked the participant questions in order to collect data and to learn about the ideas, beliefs, views, opinions and behaviors of the participant. Interviews solicited the data from each participant, as well as information to determine factors that might influence the participant's use of teaching approach, language use, the participant's socio-economic, and contextual environmental. The aim of the qualitative interviews was to see through the eyes of the participant, and they could be a valuable source of information, provided they were used correctly (Maree, 2013). Interviews also helped to obtain rich descriptive data that helped to understand the participant's construction of knowledge and social reality. The forms of interviews that were normally used are: **open-ended interview, semi-structured interview, structured interview, and the focus group interview**.

Open-ended interview and semi-structured interview were applicable and used in the research study. These were face to face interviews that were conducted by the researcher with the grade seven natural science teachers before the lesson presentation and after lesson presentation. Open-ended and semi-structured questions were asked. All what was asked by the researcher and also all the responses of the teacher were written down in a diary and audio taped, further transcribed for reflection and recording purpose. All these, also helped in a thorough transcription and coding of data.

3.6.1.1. Semi-structured interviews.

The semi-structured questions were posed to probe how the natural science teachers factualize their knowledge of theory into practice. These questions aimed at exploring the teachers' values, views, understanding, and interpretation of the practical work. These was organized around an area of a particular interest and in this study, the area of interest was how unqualified natural science teachers conducted practical work in grade seven. Semi-structured interviews allowed considerable flexibility in depth and bound scope. They were organized in such that the participants were free to answer specific questions and they also had to argue about their views and present their actual experience during the conservation.

3.6.1.2. Open-ended interviews.

During open-ended interviews, the researcher used open-ended questions to get the feelings, understanding, and idea of the Natural science teachers about practical work during pre-observation and post-observations. These open-ended questions allowed participants to give free-form answers. They prompted the participants to answer with sentences, lists, and stories. Participants were at liberty to narrate their views, feelings, and experiences. These types of interview questions were very rich and helped in data collection. They helped a researcher to find more answers than anticipated. Questions were usually framed starting words like: how, elaborate, when, etc. Yes or No answers were discouraged. Open-ended interviews often revealed surprising mental models, problem-solving strategies, hopes, fears, and much more of the participants (Maree, 2013). These interviews were normally spread over a period of time and have allowed the participants to propose solutions and provided insight into the event. The researcher's focus was mainly on the participants' own perceptions of the phenomenon being studied (Maree, 2013). To avoid bias, careful verification of data with other data collected from other sources was done and authenticity of the data was also ensured.

3.6.2. How interviews were conducted.

The instrument was formulated in order to unearth as mush information from the participants as possible. The questions were compiled from the experienced receieved from the briefing session of the natural sciences by the subject advisor.

The questions were written sequential from simple to complex. The instrument was divided into two phases of questions. The first phases dealt with teaching experiences, ie. Number of years in teaching field and also number of years teaching natural science in grade seven. Participants were also asked about their subject specialization during their training at colleges or universities. Participants were asked as whether they have any qualification related to natural science as a subject.

The interview schedule was drawn in a way that it catered for a researcher to write the participants< responses to all the questions asked. The researcher first asked the permission from the participant to record the interview, and then after the permission has been granted, the researcher proceeded with the interview recording. Pre-observation interviews were conducted to elicit information about what the teacher was going to do in the forthcoming lesson. After the pre-interviews, the session halted for some few minutes before commencing with the actual classroom observation. After the actual observation, there was also a pause, for some minutes, for the participant to cool a little. Then, post observation interviews began and were given a longer time than the pre-observation interviews because they had to capture more data from the teacher. The interview schedule consisted of a questionnaire, which was used to organize the constructed semi-structured and open–ended questions, to facilitate the interview. The researcher first constructed a questionnaire which was a set of questions that he personally and face-to-face questioned the natural science teachers. According to the researcher (Myself), a questionnaire was a compilation of questions that was used during face to face interview session before and after classroom observation.

The researcher divided the interview schedule into two phases. The first phase had nine introductory open-ended and informal semi-structured questions which were given eight minutes to be answered. The second phase was given twenty six fully open-ended questions that were given to the participants' liberty to narrate their opinions, views and experience. The fact-based questions would be followed by the opinion based questions, in an attempt to make the participants to open up.

Yes, not all that will be planned on paper will go as planned, it could deviate according to the responses of the participants but the researcher will go with a flow without losing focus of the topic. The researcher will be as curtesy as possible but without bribing the participants. The researcher will also ask probing questions that will emulate and necessitate the answering and discussions. After post interview, the researcher will also allow the participant to say their views and feelings about anything concerning the pre-interview, post interview, and generally about everything we talked about.

3.6.3. Observation.

It is an act where a person has to put an eye on a particular event or occurrence or a phenomenon. Observation is an essential data gathering technique as it holds the possibility of providing the researcher with an insider perspective of participant dynamics and behaviors in different settings (Maree, 2013). In this case the teacher was conducting the practical work while the learners were observing. Observation is a systematic process of recording the behavioral patterns of the participants, objects and occurrences without necessarily questioning or communicating with them. Observation is an everyday activity and a vehicle for field notes whereby we use our five senses (seeing, smelling, tasting, hearing, touching) – but also our intuition – to gather bits of data (Maree, 2013).

In the context of this study, observation is when a researcher sat down with a pen and diary in a classroom situation where the practical work lesson is conducted aimed at: to see, hear, notice, and write (record) appropriately and accurately what the participant was doing, how was she/he conducting practical work to the learners or together with the learners. The researcher has done careful and accurate observation by using the audio-video device for post observation and analysis of the data. The focus was mainly on observing the method of teaching, the knowledge of content, the use of apparatus, and how practical work was conducted by unqualified natural science teachers in grade seven. Therefore, the data was reported in the practical work record sheet. From the anecdotal records, most of the basic actions were observed and recorded from the participants. As a qualitative data gathering technique, observation is used to enable the searcher to gain a deeper insight and understanding of the phenomenon being observed (Creswell, 2012). Observation allowed the researcher to hear, see, feel and begin to experience reality as participants do.

3.6.3.1. How observation was done.

The observation schedule was an instrument used by the researcher to record all observational notes as an essential data gathering technique in the study. The classroom Observation held the possibility of providing us with an insider perspective of an individual dynamics or group dynamics and behaviors in different settings (Maree, 2013). The classroom observation focused on events that happened during the lesson. The non-participatory classroom observation, (Cohen et al., 2000), were used to triangulate the data obtained from other techniques used such as interviews and document analysis. As a researcher you learn through personal experience (observation) and reflection (which was part of the interim data analysis). The setting was socially constructed in terms of power, communication lines, discourse and language. As the researcher, you will begin to get involved into the setting, you start to build a relationship with the participants, thus enabling you to employ other data collection techniques with a greater ease (Maree, 2013).

The researcher would construct some concepts to observe during the presentation of the practical lesson. The observer observed the teaching method that was used by the unqualified natural science teachers during actual presentation of the practical work lesson. The observer did also observe how the apparatus were used and how the learners were effectively involved in the actual presentation of the practical work lesson by the teacher. The researcher observed how the outcome of the practical activity were recorded on the record sheet and reported. The observer diarised, audio-taped, record the observations and after presentation he engaged the participants in order to familiarized them with what he observed and recorded, if their inputs and suggestions were necessary and suggestion Denscombe (2007).

3.6.3.2. How observations was recorded.

Before the commencement of the classroom observation, the researcher asked the permission from the participants to record the proceedings of the classroom practice. Once the permission was granted, the researcher started recording the proceeding. The most important part of observation was the recording of data as accurate as possible (transcribing). In recording of observations, the researcher has to capture two dimensions which were: - thick description of what actually has taken place which should not include any value for judgment and the reflection about what really happened during presentation of the practical lesson observed. Observational data researchers usually used the following three recording methods: - Anecdotal recording, running recording, and structured recording. In the study only two recording methods were featured, namely anecdotal and running because the anecdotal records are short descriptions of basic actions observed capturing key phrases that will be objective with no self-reflective notes. The running records enabled the researcher to be more detailed, continuous or sequential accounts of what was observed. These types of records focus not only on the actions but also on the situation, and try to describe the action in the context in which it occurred. Audio-tape, audio-visual, and researcher's diary were used to record all the information for a through transcription of all the three cases that were observed.

3.6.3.3. Types of observations.

Maree (2013), stated that there are four different types of observation in a qualitative research study, these included: complete observer, observer as participant, participant observer, and complete participant. A complete observer is a non-participant observer looking at the situation from the distance (called etic or outsider), whereas the observer as participant gets into the situation, but focuses mainly on his or her role as observer in the situation. The researcher will do observation of the presentation and demonstration of the practical work done by the natural science teacher in grade seven. The researcher therefore would play the role of the complete observer as he want to capture all information at a distance without distorting the data. In everyday life observation is simply seen as looking at things, but however in science, observations were used to generate further explanations and theories about observed phenomena; they require skills associated with collecting and interpreting data and are influenced by the observer's assumptions and domain knowledge (Haury, 2002). Observations play a fundamental role in scientific investigations. In some cases scientific observation was rather a simple activity which was a matter of looking at things and leading to concrete statements about the real world or phenomenon.

3.6.4. Document analysis.

A valuable source of information in a qualitative research can be documents. Documents consist of public and private records that qualitative researcher obtains about a site or participants in a study and these include: teacher's profile, lesson preparation, observation record sheet, policy document, textbook for the grade seven natural science, pace setter, work schedule which curriculum assessment policy statement (CAPS) prescribes. These documents were analyzed as the study continued for their pivotal role. The sources provided valuable information in helping researchers understand central phenomena in qualitative study. The researcher did scrutinize and analyze the practical work provided by the policy documents for natural science in the senior phase preferably grade seven. The researcher reviewed as whether the policy document speaks to the learners as far as the practical work is concerned.

3.6.4.1. Researcher's diary.

It was my mini-memo book that was only capturing the pieces of information collected from the classroom observations, interview, and from any other reliable source that might help in data gathering. The researcher's diary was used on daily basis to record data collected from the interviews and observation. Any information that was of utmost importance to the study was diarized. This helped the researcher to record precisely the exact qualitative data collected in all proceedings and this was coded and direct transcribed in the study.

3.7. How data was analyzed and interpreted.

The preliminary data analysis started from the initial stages of interview and observation. Data analysis followed was a qualitative approach. Data from the interviews, classroom observations, and documents were analyzed and summarized and then presented through tables and figures. The data analysis and the interpretation of data in this qualitative study was an on-going process whereby the researcher analyzed "data interpretively by synthesizing, categorizing, and organizing data into patterns that produced a descriptive, narrative synthesis" Gay and Airasian (2003). Creswell (2008) believed that data analysis process continued while at the same time and this provided enough time to search for the underlying truth by means of establishing categories, themes and differences from the gathered data. During the data collection the researcher gathered, interpreted, and analyzed the collected data as an opportunity arose. The researcher was able to synthesize, organize, and categorize the data while was still busy with the collecting process. Data was also be triangulated at the same time during the data collection procedures.

The inductive data analysis gathered from the semi-structured interviews, open-ended interviews, classroom observations, documents analysis, and diary was employed to compare, contrast and also attempt to identify the similarities between the views and opinions of the participants. Then these qualitative data was analyzed inductively from the gathered raw data to more general perspectives known as themes (Creswell, 2008). The analysis data collected was able to keep track changes in data collection strategies and observational notes. Descriptive interviews summaries were written directly as it was said and done by the participants.

Each explanation of the participants' word for word would be recorded and written strictly as uttered so as to avoid loss of the exact meaning of what was said. All observational notes was transcribed into the study. Therefore, every single event observed and recorded as observational notes during the lesson observations of the participants received equal treatment, just and a fair attention from the researcher. The observational notes were dully diarized and later transcribed in the study, as raw as it was observed. Transcribing and reiterating what has been observed during the observations ensured that non-verbal communication was feasible and the essential information was never loosed.

3.8. Rigor.

It is a cornerstone or a barometer, and a very thorough and accurate rule, or system. It is a lens strictly applied to achieve a just, fair, and a reasonable quality of an outcome or findings.

3.8.1. Triangulation.

Triangulation is the use of multi-method strategies, namely questionnaires, interviews, document analysis and observations that would be used to increase the validity and credibility of the study, as recommended by McMillan and Schumacher (2001). The use of multi-method strategies in qualitative research was used to compensate for any one-sidedness or distortion that may result from individual methods (Starkey, 2012). Cohen et al. (2007) argue that the exclusive use of one method may be bias or distort the researcher's picture of the particular 'slice of reality' being investigated or explored. Hitchcock and Hughes (1995), also affirms/states that using more than one form of data collection to obtain data, is called triangulation. Therefore the researcher used three methods of data collection which included: interviews, observation, and document analysis, to triangulate the data collected.

The use of triangulation in a qualitative research study entailed the involvement and validation of multiple data collection sources and research sites (MacMillan & Schumacher, 2006). The qualitative researchers such as Yin (2009), Creswell (2007), Merriam (2002), recommended this multiple data collection strategy because it enhanced the validity and reliability of the study through the process of triangulation. Furthermore, Triangulation was one of the best important ways to improve the trustworthiness and validity of the qualitative research findings (Yin, 2003). A variety of data collection methods were used in the study. The data collection methods that were used were interviews (one-on-one) with open-ended and semi-structured questions, observation, and document analysis. MacMillan & Schumacher (2006) argued that triangulation was one principle of qualitative research which allows the researcher to examine the collected data in many ways through moving forwards and backwards among codes.

3.8.2. Validity of the study.

Validity is the extent to which an instrument measures what is supposed to be measured, for the appropriateness and accuracy of the findings of the study. Data will be collected directly from the participants, and there might be a tendency of the participants to react to the study, in one way or the other, by supplying inaccurate data because of apathy or willfully. This could happen where participants modify the information and the behavior with full intention of misinforming the researcher or even giving a wrong impression. There is no objective truth or reality that can serve as a definitive yardstick against the study and its conclusions and findings can be measured. This creditability can, however, be checked against the feedback obtained from the responses of the participants. Although careful validation procedures will be employed during the collection and processing of data, it is acknowledged that the outcomes will only apply to a small number of individuals and not generalizing.

According to Cohen et al. (2007), internal validity seeks to demonstrate that the explanation of a particular event, phenomenon or set of data, which a piece of research provided, can be sustained. It refers to the quality of the data and the 'soundness' of the reasoning that is derived from that data. The study was piloted with one teacher in order to increase its internal validity. External validity refers to the degree to which the results can be generalized to the wider population, situations or cases (Cohen et al., 2007). But the findings of this study will not be generalized though. Denscombe (2007), provides the following methods to ensure validity of data collected: - checking data with other sources, checking the transcripts with informant, and looking for themes in the transcripts. There are four different types of validity, namely: content validity, construct validity, face-to-face validity, and criterion validity.

3.8.2.1. Face-to-face validity.

It is the extent to which the instrument "looks" valid. The instrument should appear to measure what it was supposed to be measured. This type of validity cannot be quantified or tested, but any instrument had to be scrutinized by experts in the field to ensure a high degree of face validity. This was applied in this study during semi-structured interviews and observation of the presentation of practical work. During the pilot study the researcher has tried to shape the contact between the participant and himself very serious and this helped the researcher to practice for the coming interviews and observations in the study.

3.8.2.2. Content validity.

It is the extent to which the instrument covers complete content of a particular construct that is set out to measure. For example, if an instrument is developed to measure intelligence, therefore there should be items that cover all the different aspects of intelligence, namely verbal reasoning, analytical ability, etc. to ensure content validity of an instrument, the researcher usually should present a provisional version to experts in the field, for their comments, before finalizing the instrument. The facilitation of the practical work will be explored and content be validated by using same instruments namely observations and interviews. Both, the interview guide and observation schedule, will be forwarded to the supervisor or an expert for the evaluation prior the real performance/use.

3.9. Pilot study

A pilot study is a preliminary trial or a test of research which is essential to the development of an extensive research program. It is the pedestal of the research study and will be a small scale which helps in evaluating and checking the feasibility, time, cost, adverse events, and the effect size in an attempt to predict the appropriateness of the study. It would help to improve upon the study design prior to real performance and reduces the likelihood of making errors. Before the actual research for data collection began, a pilot study was conducted. It is important that the instruments used in the data collection be piloted. The instruments were piloted with several teachers of Science. This was to ensure validity and reliability of data, and to furthermore remove any possibilities of ambiguity and error in the instrument so that the results obtained could be trustworthy. These instruments were also sent to the researcher's supervisor for comments. The pilot study allowed the researcher to anticipate the challenges in the study. This pilot study requested data pertaining qualifications, employment status, post level of the piloted teacher, own experiences of the teacher, the impact of workshop attended as science teacher. The interviews and observations were also piloted in this research study. Babbie (1990), defines a pilot study as a miniaturized walk through of the entire research study.

3.9 How the research study was piloted.

a. Introduction

The observer set down with the principal and explained his plea and the intention to do the pilot study at his school. The principal went through all the letters given to her by the observer and agreed with terms and conditions in the letters. And she informed me that she had no problem with the observer doing the pilot study, as long as the participant could agree, voluntarily so, to be involved in the research study. I asked her to go and inform the natural science teacher first, and the following day she came to me and said that the teacher agreed. I met with the participant and I explained and read all the ethical issues around the study, however, he wanted to know about the state of privacy and confidentiality of the processes, I read again what was entailed in the ethical considerations letter. The researcher assured the participant about the guaranteed privacy and protection and security. Ultimately, he agreed and we set a date to do the pilot study. As a new teacher at the school, I was so lucky to be allowed to do the pilot study while I was supposed to be in my class teaching mathematics in grade six, my periods and the participant's periods were clashing on the time table, but the SMT allowed me to go on with the pilot study. It was the convenient sampling method because the participant was the only teachers teaching natural science in grade seven and he was having no certificate or qualification for natural science.

b. The successes of the piloted research study.

The Principal welcomed researcher's request and the participant voluntarily took the researcher through his pace setter, the researcher and the participant agreed on a date of the class observations, and also of the pre and post interviews. The presentation was successful and the learners enjoyed the lesson and this was evident when the learners were participating fully in the lesson. The aim of the lesson was achieved. Questions during interviews were answered without any fear or favor. The art of interviewing the three participants improved a lot and the fear was eradicated. The researcher really enjoyed the research project.

c. The failures of the piloted research study.

The teacher was teacher-centered and most of the time he was talking. The use of both visual and audio visual was a great challenge to the researcher, as it was for the first time capturing the audience and the presentation by the participant. One other failure was that, while the participant was presenting, if the researcher realized a fault, he would just tell the participant to correct it. There was less involvement of the learners in the presentation. But during the actual observations and interviews of the three participants this error was corrected and the researcher remained a complete observer throughout.

d. Instructional strategies of teaching natural sciences (methods of teaching) used by participant.

The participant was very good in his pedagogical methodology because has been in the teaching field for a long time. He used demonstrative methods a lot which triggered the learners' "interests in the subject matter. He combined the demonstrative, collaborative, and illustrative methods so marvelously.

d. Pedagogical content knowledge (PCK) of the participant.

The participant had more knowledge of the subject matter as it was for long time teaching the subject, although he had no qualification of the subject Natural sciences. He taught the separation methods excellently but he had only a challenge when coming to demonstrate the chromatography and fractional distillation methods. He was unable to demonstrate the color usage in the experiment.

e. Challenges of the piloted research study

The participant did a three to four practical activities though concentrated at one which was sieving methods. He tried to improvise due to none availability of apparatus. He seemed having problems with chromatography method of physical separation hence the non-availability of the resources.

f. Recommendations from the observer.

The observer's recommendation generally, was that there was a huge lack of resources /equipment for the education of the learners, workshop be given to the natural sciences teachers as more often as possible especially to those areas giving tough time to the teachers. That was Planet earth and beyond as elucidated by the participant.

3.10. Trustworthiness of the study.

Krefting (1991), argues that "trustworthiness is the truth value of a research". The research could be trustworthy when it reflects the reality and ideas of the participants (Krefting, 1991). The verifiability of qualitative research is accurately assessed according to its trustworthiness (De Vos, 1998). One of the useful strategies is member checking where the researcher will verify his understanding of what he has observed with the participants (Maree, 2013). Member checking involves giving feedback regarding preliminary findings and interpretation to participants and securing their reaction (Krefting, 1991). The researcher will ask the participants whether the interpretation is a true reflection of their perspectives.

The researcher will summarize, paraphrase, or repeat the participants' words. The researcher here will check with participants through reading to them what they gave him, as answers to the questions posed in the interviews, or from observations for verification. Guba's model of trustworthiness of a qualitative research study identifies four criterions, namely: - truth-value, applicability or transferability, consistency, and neutrality (Guba, 1985).

3.10.1. Truth-value of the study.

Truth-value is concerned with an ability to establish confidence in truth of the findings for the participants (Krefting, 1991). True-value is the most important criterion for the evaluation of qualitative research without the researcher taking sides or influencing the outcomes. This true-value could be achieved by employing triangulation of methods which will be, observation, semi-structured and open-ended interviews in the study. Through observations the researcher will be able to observe and explore what Natural sciences teachers are doing practically in a classroom context. The pre-interview session will give a researcher an idea of what to expect from the observations, whereas, the interviews after observation will assist in verifying what exactly transpired during observations in order not to lose true meaning.

3.10.2. Neutrality of the study.

Neutrality refers to an extent that research findings are solely of the participants and not influences or any biases, motives and perspectives of the researcher (Krefting, 1991). Neutrality is also termed conformability in qualitative research. In this study, the researcher will be as neutral as possible by recording and transcribing exactly the views and opinions of the participants during interviews and observations without any value judgments and this would also be confirmed with the participants.

3.11. Credibility of the study.

Credibility refers to the authenticity of data used in the research (Vivar, et al., 2007). This will be considered in many ways especially by transcribing data for reference to check consistency. Credibility is mostly used to check whether the data collected and processes followed are analyzed and accurate (Landman, 1989). For an attempt to demonstrate that a true picture of the phenomenon under scrutiny is being presented, therefore the researcher will address credibility of the study (Shenton, 2004). Credibility will exist when the research findings reflect the perceptions of the participants under study.

Through persistent observation and triangulation, the researcher will be able to strive for true information and in-depth of the phenomenon under study which is practical work. Furthermore, the researcher, together with participants, will consistently audit the transcribed work from interview and observations for the purpose of insertions and corrections of data collected. This action is referred to as member checking which allows participants to see, read, comment, add, or delete some of the data which was not captured correctly before the data could be taken a final product (Mouton, 2001).

3.12. Chapter conclusion.

The essence of the study as a qualitative case study underpinned by the interpretative paradigm was discussed in this chapter. The research context, focusing on the research setting, research population, research sampling process and the cases was also described. Furthermore to that, the techniques such as interviews and observations to collect data were elucidated. How data was analysed and interpreted was also described in the chapter. In conclusion, details were given of the ethical considerations of the study. The study was also piloted and rigorous ways and triangulation were discussed fully, the aspect of how interviews and observations were done was described. Lastly, the chapter conclusion was described. The next chapter discussed the data analysis and interpretations of the findings, and the chapter summary.

CHAPTER FOUR
DATA PRESENTATION AND DISCUSSION.

4.1. Introduction

This chapter presented the data for each case. The chapter presented, discussed, and made findings from the three cases identified below. The data for each case was discussed, interpreted, and analyzed under the three phases i.e. phase 1, phase 2, and phase 3.

First phase:

Aspects discussed were: definition of practical work, types and the nature of practical work, and pedagogical content knowledge of the teacher related to practical work.

Second phase:

Aspects discussed were: the views and beliefs of the teacher about practical work, the purpose of the practical work, and aims and the objectives of practical work in natural sciences.

Third phase*:*

Aspects discussed include: how practical work was conducted/pedagogical content knowledge of the teacher, and the instructional strategies/methods of teaching practical work in natural sciences.

This study envisages to understand how the teacher's experiences on conducting practical work with regard to pedagogical content knowledge was, teacher views and beliefs, the teacher professional development, and the conduct of practical work as carried out in respect of each unqualified natural sciences teacher. All the three participants were exposed to the same open-ended and semi-structured questions in an interview, and to the same observation protocols. The purpose of this research study was to explore how the unqualified natural science teachers conduct practical work in a classroom contexts in grade seven.

It was for that reason that the current study was done to discover the challenges in conducting practical work. Furthermore to that, the study of this nature could be helpful in professional teacher development and a more improved facilitation/conduct of the practical work in Natural sciences could be achieved. The same theme or strand was treated in all the three participants respectively, although the two participants dealt with the same topic (i.e. Mrs. Bofea and Mrs. Dike), but different from the second one of Mr. Rams. Moreover, the cases were interviewed and observed separately to elicit more insight in their conduct of practical work. Pseudonyms were used in all the three participants as Mrs. Bofea, Mr. Rams, and Mrs. Dike. The main focus of this chapter was to discuss, interpret, and analyze the data in order to answer the following research question which was subsequently unpacked into three research sub-questions.

Research question

How do unqualified grade seven natural sciences teachers facilitate practical work in the senior phase?

Research sub questions: The following research sub-questions were used to unpack the main research question of the study.

a. How do unqualified natural sciences teachers define practical work?
b. What are the views, aims and objectives of unqualified natural sciences teachers with regard to practical work?
c. How do unqualified natural sciences teachers conduct practical work?

Three teachers participated in the study, and their cases were presented individually as they had different contextual factors. Only the elements of the data leading to the answering of the main research question which was further unpacked into the three sub-questions were presented, discussed, and the findings were made in this chapter. The purpose of the research study was to explore how the participants conducted practical work in natural science in grade seven. The focus was on the how part or pedagogy of conducting practical work.

The findings were presented in three phases. During the ***first phase***, the researcher presented the three unqualified natural science teachers' definition of practical work, types of practical work and the nature of practical work, roles of the teacher as related to practical work. Whereas in the ***second phase,*** the researcher presented the views and beliefs about practical work, the purpose of practical work, aims and objectives of practical work. And at the ***third phase,*** the researcher presented how unqualified natural science teachers conducted practical work/pedagogical content knowledge of the teacher, and instructional strategies (methods of teaching practical work in natural sciences).

4.2. Data presentation and discussions.

CASE 1 (Mrs Bofea)

The data and discussions were presented on the following aspects:

Definition of practical work, types of practical work and the nature of practical work, the roles of the teacher as related to practical work. The views and beliefs of the teacher about practical work, the purpose of practical work, aims and objectives of practical work were also discussed. Lastly, the aspects which include: How practical work was conducted or (pedagogical content knowledge) of the teacher and the instructional strategies (methods of teaching practical work in natural sciences) were discussed.

Phase 1

Definition of practical work, types of practical work and the nature of practical work, and the role of the natural *sciences teacher related to practical work in the study.*

Definition of practical work

According to Donnelly (1998), practical work is regarded as hands-on or minds on practical learning opportunities by learners. The notion above is also shared by Stoffels (2005) and the Department of Education (2003; 2005; 2007) as cited in

Mudau (2013) also holds the same sentiments about practical work. Therefore, from the interviews, Mrs. Bofea defined practical work as:

> *Practicalwork? hee!. When you are using the apparatus, mmmhhhhh… using apparatus, ga e include??? (Not including), ke gore ge o re what about kids o ra go reng? (When you say what about kids what do you mean?) Ooh, they are using apparatus when their minds gona mouwe ba nagana gore…. (That is to say what are the learners thinking about*?)

Form the statement mentioned above, Mrs. Bofea just said that practical work has to do with apparatus and hands. One can infer that she could have gone far beyond that if she knew better, but from the classroom observations I noted that the way she grouped five learners in front of the table she seemed to be doing practical work unaware because I belief that once the learners are grouped in pairs and they are hands on and minds on, then practical work is taking place. Tsai (2003) argued that practical work in school of science means laboratory-based experience and this sentiment is also echoed by Hofstein (2015) whereas other authors like (White, 1996; Ottander and Grelsson, 2006) also share the same notion and see practical work as hands-on or minds-on practical learning opportunities. Department of Education documents (2003, 2005, and 2007) also hold the same sentiments about practical work.

> *When you are using hands and doing something with hands.*
> *I think when you do practical work the learners understand more than in theory,,, theoretically. Practical work is when learners* are using their hands to do something.

From the interviews, the above Mrs. Bofea articulated the meaning of practical work in her own words as doing something with hands. Mrs. Bofea’s definition of practical work was not convincing because she spoke about using hands only leaving the minds-on out. However, while the practical work should involve hands on, on one hand, it should also involve the minds-on activities on the other (Watson, 2004). From the above mentioned statement, one can infer that Mrs. Bofea was at least having an idea that, theory should be put into practice, although she did not utter it clearly so. DBE (2011) substantiated that practical work must be integrated with theory to strengthen the concepts being taught. Mrs. Bofea's definition of practical work above was fair. Kask and Rannikmäe (2006) indicate that inquiry based experimental work develops learners' process skills. The moment learners are involved physically, start to use their minds on how to solve the problem in an activity it, meant that practical work was taking place. Hence, the inference that she has little knowledge and understanding of what practical work was. She explained the investigation to the learners but could not engage all of them at the same time during the practical work due to lack of resources. So, learners were supposed to observe and translate the theory into practice.

> *Mmmhhh…. Ke tla ba botsa ka taba ya gore naa…(I will tell them about the issue of…). what are we going to investigate, and there after I say practical work is something learners do for themselves, ra e dira (We do it) practically, and then di observation, and then if can eehh… gee le gore go a kgonega o ka di bonstha ka mokgwa wa di graphs or tables, and di-conclusion(if possible you can also depict in a form of graphs or tables)*

From the statements above, Mrs. Bofea seemed to be confused about what practical work was, she was just saying whatever she had from her mind. Furthermore, Mrs. Bofea also indicated from the interviews, that practical work was something that learners would do for themselves and she also said that practical has something to do with apparatus and hands. Abrahams and Millar (2008) indicated that practical work is an effective tool in getting the students to remember the practical aspects of a phenomenon whereas, Shaha (2011) argued that practical work is an innate component of science education, although it was taken for granted by most of teachers especially in practical subjects like natural science.

In a general sense, practical work refers to ‘prac’ or ‘pracs’ used in the science learning and teaching (Wallace, 2015). From the notions stated above I could infer that Mrs. Bofea was not serious about practical work, and this regard the content knowledge was compromised and indeed practical work was taken for granted.

Types of practical work and nature of practical work.

The types of practical work among others include: demonstrations, observations, illustrations, investigation, projects, assignments, and case study (DoE, 2012). Furthermore to that, practical work could be used in a variety of ways in school sciences (Wallace, 2015). Whereas according to Hofstein (2015), practical work can be classified into four types: confirmatory, inquiry, discovery, and problem-based. From the classroom observations I noted that Mrs. Bofea showed the investigation, and illustration as the types of practical work she was engaged with. Hence, the observation was done by a group of learners next to the table where the practical activity was taking place.

> *We are going to investigate how types of energy is transferred in a thermal system and you must remind that, energy cannot be created nor destroyed but can be transferred from one form to another in a thermal system.*

From the above-mentioned statement, it is evident that the practical work done was an ***investigation***. From the post interview, Mrs Bofea’s knowledge of the types of practical work was not correct based on her responses. Further to that, Mrs. Bofea by her response from the interviews, I could infer that she knew nothing, in as far as the types of practical work, was concerned. From the interview, Mrs. Bofea cited the (Acids and bases, insulating, and thermal system) as the types of the practical work, whereas it is not. Hence, I am convinced that, she did not have a knowledge of the different types of practical work. Pekmez et al (2005) indicated that demonstrations were most frequently done by teachers, this notion is also attested by Hodson (1990). Although the assertions made by pekmez et al (2005) and Hodson (1990) are not evident in Mrs. Bofea.

Researcher: What types of practical activities have you done so far? Mrs. Bofea answered by saying,
Mrs. Bofea said,

-Acid a base.
-insulating.
-thermal system.
Researcher: Which types of practical work do you know? Mrs. Bofea answered by saying,
Mras. Bofea said,

Wa tseba ke tlo bolela ye ya di (you know I am going to talk about this one of) acids ke yeo ke e dirileng (it is what I have done so far). Ooh! Ye, yengwe ye kgane bjale ya term 3. Go ra gore (Meaning) it's two

From the two explanations above, one noted that Mrs. Bofea was in darkness in as far as the types of practical work was about. In the case of Mrs. Bofea those "prac" or "pracs" were not visible and not used (Wallace, 2015). Practical work can have its specific forms, i.e. the practical work could include: teacher demonstrations and the experiments conducted by both the teacher and the learners cooperatively or individually (Hofstein, 2015). In these ways practical work could be useful in the enhancing the teaching and learning activities by the unqualified natural sciences teachers. Mrs. Bofea did not do demonstrations for the learners, but she just gave apparatus to them and then instructed them to prepare a soup and this was the evidence that her other type of practical work was ***illustration*s** where she explained concepts like; independent and dependent variables. Mrs. Bofea preferred conducting practical work as illustrations amongst other approaches of conducting practical work, which was evident from the classroom observations, as she was not involved in demonstrations of the practical work but instead she instructed learners to do the practical work after she explained the names and the functions of the apparatus she brought in the classroom.

The other types of practical work evident from the classroom observation, were demonstrations and observations although the two were performed by the learners since Mrs Bofea was never involved. I am saying this because she could not even bother to see what was happening inside the pot when learner was busy stirring and cooking the soup. Furthermore to that, Mrs. Bofea just asked learners questions while being far away from the learners and could not move to facilitate the practical activity given to the learners so as to guide them. Whereas learners were grouped to demonstrate how soup is prepared, at the same time, learners were to observe what was happening in the pot.

> *We are going to investigate how the electrical potential energy is converted into heat energy.*

Investigation is a method on which practical work is embedded and it was the learner-centered where they were to conduct investigations or experiments (Martin-Hansen, 2003). Investigation is also a hands-on and thoughtful activity to be done by learners. It is also regarded as the use of all the five senses in a learner to collect information about the phenomenon. The nature of practical work in case of Mrs. Bofea was the process approach that developed process skills such as and enhanced their understanding of concepts, laws and theories of natural science, although it was not evident in her lesson presentation.

The role of the teacher as related to practical work in this study.

Mrs. Bofea was just a story teller rather than being involved as a chief instructor/facilitator, guider, mentor, or a director for the learners in the practical work. Hence, the inferences that she was more of a narrator in her presentation. I am saying, her presentation of the practical investigation was learner centered although she did not even bother to facilitate them. I noted that only two pairs of five learners were hands on and minds on in the practical investigation. Lunetta et al., (2007) also attested to the fact that practical work is a learning experience in which students interact with materials or secondary sources of data to observe and understand the natural world.

The role of the teacher in a classroom is more important, in that, instead of being in the centre of learning as,' I know it- all', his or her role should include being "facilitator of learning" (Grier-Reed & Conkel-Ziebell, 2009). Furthermore to that, the knowledge is not directly transmitted from teacher to learners, but would be easily received through the teacher`s support (Mikusa & Lewellen, 1999). Such teachers would be in joint-venture with learners in controlling their teaching and learning, through the inquiry-based projects, through group discussion, and group projects. (Tugurian et. al., 2013). The above notion is clear about the roles of the teacher during practical work but this was not the case in Mrs. Bofea's presentation of the lesson, I could make an inference by saying that she was alienated from the learners and the practical work itself.

From the classroom observation, I noted that Learners were observing how electrical potential energy was transferred into heat energy in a thermal system, although she did not act as a facilitator. She seemed not to be interested in what was happening in the pot, and Mrs. Bofea was not moving side by side to guide or to mentor the learners where they got stuck. Instead, all she did was just asking questions. Hence, her lesson plan was learner centered, I was of the opinion that more learners could have participated although there was a shortage of the equipment, if she was too involved as a facilitator. She could have grouped the learners so that they can interchange roles in the activity. To teach science successfully, teachers needed to have not only good content knowledge but also pedagogical content knowledge (Shulman 1986).

Phase 2:

Views and beliefs of teachers about practical work, the purpose of practical work, and the aims and objectives of practical work.

According to Abrahams, I. & Millar, R., (2008), teachers viewed practical work as illustrations and consolidations of the understanding of science concepts. From the classroom observations it was noted that Mrs. Bofea had also viewed practical work as the illustrations. Hence, she was just explaining without involving herself with the learners in order to guide or facilitate. Practical work is viewed as the key knowledge of science and this was what Mrs. Bofea did not realize. Mrs. Bofea viewed the role of practical work as developing learners' understanding of the nature of science where the learners are able to understand much of the concepts taught (Lederman, 1992). Teachers in the developed and developing countries view practical work as the crux of science learning in education (Abrahams & Millar, 2008; Kapenda et al., 2002).

Mrs. Bofea also viewed practical work as a holistic measure to incorporate theory into practice for a better understanding of the learning content knowledge. This was evident from the classroom observations, she was illustrating for the sake of subject mastery. Mrs Bofea focused much on the content rather developing the process skills and scientific skills of the learners. These are often learner-centered, constructivist approaches that include analysis and discussion of social, technological, and environmental issues. However, some Portuguese studies suggest that, although teachers have developed a discourse that corresponds to the new orientations, they have not changed essential dimensions of their own practices (Abelha, Martins, Costa & Roldão, 2007; Correia & Freire, 2009; Prescott, 2005; Raposo & Freire, 2008; Seixas, 2007; Viana & Freire, 2006). In addition, other studies have identified barriers to curricular innovation, including (a) teachers' difficulties with understanding new concepts and curricular documents, (b) resistance to changing a traditional vision of science education and (c) resistance to adopting new practices in line with a constructivist approach (Galvão et al., 2004; Galvão, Reis, Freire & Oliveira, 2007).

The purpose of practical work.

The purpose of the practical work has been elaborated in science education, which include: acquiring conceptual and theoretical knowledge, developing an understanding of the nature and methods of science, and engaging in expertise in scientific inquiry (Hodson, 1996). Students may often focus on the 'aims' of laboratory activities, but not their 'purposes'. In other words, students try to see or determine the expected results from the activities, per se, but they do not invest much mental engagement in relating other learning experiences to laboratory work

(Hart, Mulhall, Berry, and Gunstone 2000). From the classroom observation I noted that Mrs. Bofea was not sure of what the purpose of practical work was. She was a little confused because she was just reading from the spot on textbook instead of facilitating the practical work.

The purpose of the practical work was to promote and instill the manipulative and cognitive skills amongst the learners when she let them to maneuver during her presentation of the practical work. Because of the involvement of the learners in the practical work, they would be able to understand and observe for themselves what was happening inside the pot and how electrical potential energy was transferred to heat energy in a thermal system. These are often learner-centered, constructivist approaches that include analysis and discussion of social, technological, and environmental issues. However, some Portuguese studies suggest that, although teachers have developed a discourse that corresponds to the new orientations, they have not changed essential dimensions of their own practices (Abelha, Martins, Costa & Roldão, 2007; Correia & Freire, 2009; Prescottt, 2005; Raposo & Freire, 2008; Seixas, 2007; Viana & Freire, 2006). It was noticeable that Mrs. Bofea was similar to the teachers, as referred above, who cannot change their old practice of teaching.

Aims and objectives of practical work

Nyoka, DuPlooy & Henkeman, (2014), attested that there is a shortage of critical skills in the fields of science and engineering which are common in most developing countries, including South Africa. Education is one of the drivers of the economy through the accomplishment of all the goals pronounced by the national curriculums. The main aim of practical work is to unearth all the skills from the learners. In the case of Mrs. Bofea, it was evident that her practical work aimed at teaching learners the investigative skills.

> *We are going to investigate how types of energy are transferred in a thermal system, and you must remember that, energy cannot be created nor destroyed but can be*

> *transferred from one form to another. We are going to investigate through practical work as how transfer of energy is done. We are going to see how heat energy is transferred into kinetic energy in a thermal system. We are going to investigate how thermal system (i.e. potential energy is* transferred into kinetic energy and also to heat energy).

From classroom observation, I noted that her aim seemed to be: to see that learners are able to investigate, how energy is transferred from one form to another since the energy cannot be created nor destroyed. I can infer that, she meant that learners must be able to do investigation on the tasks given to them and get possible solutions. But most learners were very far from the hot plate and the pot and no thorough observations were done by them because of lack of resources and overcrowding. Only two groups, comprising of five learners, each were able to come to the front table to demonstrate and observe. The objective of practical work is to help the teacher to know and master the scientific enquiry strategy in teaching and assessing the learner. Doing practical work frequently helps to alleviate inferiorities, anxiety of both learners and teachers in view of instilling interest, love, enjoyment and good practice among others (Hodson, 1990). I suggest that Mrs. Bofea get used to do practical work more often, to alleviate some of the frustrations and inferiorities I observed from her during the presentation of the practical work.

The challenge faced Mrs. Bofea was that she could not give the learners ample time to explore for themselves as she illustrated a lot. Gott & Duggan (1995) stated that the main objective of practical work is to develop scientific methods of thought and the aim is to enable pupils to find out through investigation. It is a hands-on and thoughtful activity to be done by students. It is also regarded as the use of all the five senses in a learner to collect information about the phenomenon (Gott & Duggan, 1995). This meant that every learner was supposed to be able to: see, hear, feel, touch, and if needs be to taste the materials which were used in practical work they were busy with.

> *Is there any question?, So you can see that in a stove plate we are having potential energy, and when the soup starts boiling re bolela ka (We are talking about) the kinetic energy and you can also see that the heat energy from the stove is transferred to the base of the pot and to the soup which is transferred into the kinetic energy when the soup boils, and here re bolela ka (we talk about) thermal system, le a bo naa! (You see!).*

From the classroom observations, it was evident that Mrs. Bofea wanted to teach learners an observatory and discovery skills.

Phase 3

How practical work was conducted

According to Aydeniz & Kirbulut (2014), argued that, the focus of pedagogical content knowledge (PCK) is not only on the knowledge of a specific theme by a particular natural sciences teacher but also on his or her behaviours, reasons, and actions towards the subject content. From the classroom observations, it showed that Mrs Bofea conducted practical work in a particular way as she was able to keep discipline on the other learners who were not at the observing center and again she was able to pose questions to the observing group of learners so the learners at the observing center were able to answer. The learners were the ones who were demonstrating and observing at the same time. They were also answering the questions which were posed by Mrs. Bofea as they were busy demonstrating and observing how soup is done. Furthermore to that, Otto and Everett (2013), stated that a presentation of pedagogical content knowledge (PCK) is simply a combination of the three facets which include: pedagogy; content; and the context. Therefore, the teacher should also know which parts of learning can be assessed and also which assessment techniques should be applied (Karisan et al 2013).

From the classroom observation I have noted that there were less of procedural skills and substantive understanding of doing practical work. But her lesson presentation was characterized by the mental processing. Mrs Bofea's lesson was characterized by mental processing because learners were asked questions orally and then answered them. There was no organizational routine when the learners were instructed to cook a soup and furthermore, no evidence of procedural understanding were taken by Mrs. Bofea in order to guide learners through step by step procedures of cooking a soup. Firstly, they have to boil water by the electric kettle and the water has boiled, then, they poured water into the aluminum pot together with soup and started to stir the soup to simmer. She asked,

> *What are the input and output? Yaahhh… the input energy is the electrical potential energy and the output is the heat energy re ya kwanaaa? (Are we together?).*

However, from the classroom observations, not all learners were able to see inside the pot hence there should be accurate and correct observations which will lead to curiosity and asking of more questions. This is so because scientific observation is described as an act of recognizing and noting a phenomenon (Jegede and Okebukola, 1994). This brought the emphasize that, all learners be exposed to a fair opportunity to observe but in case of Mrs. Bofea, only a fraction of learners did observe because only two group which comprised of five learners each were able to observe the process of preparing a soup and touch some of the apparatus through their hands (Millar, 2015). The rest of the learners were only engaged through oral questioning to attract and arouse their interest in the practical work that was done.

Mrs. Bofea was doing practical work within the parameters of an explanatory Model because she explained and illustrated more during her teaching. From the classroom observation I observed that Mrs. Bofea explained a lot as she posed questions and learners did not respond.

> *From what you have observed, how was the electrical potential energy transferred into heat energy? Heee banna! guys! electrical potential energy is converted into heat energy when the plate of the stove started to become hot and eventually got red, and we said you cannot create energy akere!(meaning not so!), the energy can be converted, so that electrical potential energy is converted too.*

She chose a group of five learners to demonstrate the practical work where they were going to investigate how the different types of energy are transferred from one form to another, in a thermal system. It was not clear on how she was going to do the practical work as there was no lesson plan to direct the researcher on what was the design of the practical work they were supposed to do and the record sheet to record their observations from the practical work. Lesson plan is regarded as a lens and a record through which a teacher sees the matter by a needle of an eye. The lesson plan as it says, is a plan which helps the teacher to unfold the topic of the day. She just continued to teach while five learners stood in front of the table and later she introduced the apparatus to the learners: hot plate, aluminum pot, extension cable for electricity, a wooden spoon to stir, a cup filled with soup, an electric kettle filled with cold water. Mrs. Bofea told learners that they were going to prepare soup and in that process they were going to investigate how electrical potential energy is transferred into the heat energy and also into the kinetic energy.

The instructional strategies/ teaching methods of the unqualified natural science teacher

The following combination of teaching methods was evident during Mrs. Bofea's practical lesson although, she dealt much on the lecture method, include:

- Illustrative method,
- Lecture method, and
- Questions and answer method

Frost (2010) in UK indicated that, practical work is undertaken in three classifications as: Illustrative practical work is designed to illustrate a particular scientific phenomenon; exercises to develop practical skills and techniques; and to promote the interest of the learners and teachers, as was the case in my two different cases. The teacher designed lessons in such a way that they foster cooperative learning (Sharma 2014). Furthermore, Mrs. Bofea used more of the lecture than self-discovery method, as the learners were to discover for themselves what happened to the soup when it started simmering. This figure below represents the explanatory model in compliance by Mrs. Bofea

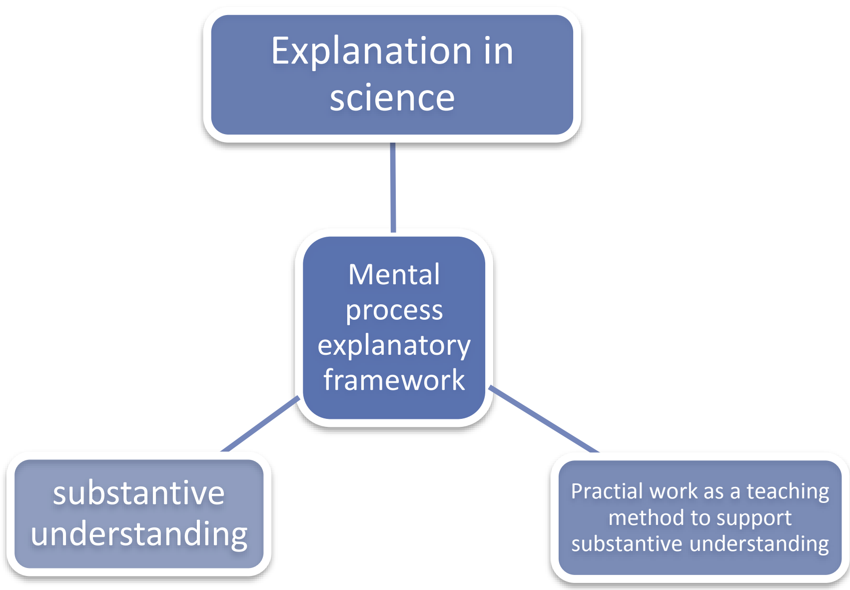


Figure 4.1 An explanation model (Pekmez et al., 2005)

4.3. Data presentation and discussions CASE 2 (Mr. Rams)

Phase 1

Definition of practical work, types of practical work and the nature of practical work, and the role of the natural sciences teacher related to practical work in the study.

Definition of practical work

Usually, practical work has been recognised as an essential part of school of sciences teaching and learning (Hofstein et al., 2013). The above notion was also agreed by many authors including: (Hofstein and Lunetta, 2004; Wellington and Ireson, 2012). However, from the interviews, Mr. Rams defined practical work as:

> *Mmhhhh… I think practical work is just investigation to find a solution to a given problem.*

From the classroom observation, I noted that Mr. Rams used the term ‘practical work’ to refer to as any teaching and learning activity which at some point involved the learners in observing or manipulating the objects and materials they were studying. Lunetta et al., (2007) also attested to the fact that practical work is a learning experience in which learners interact with materials or secondary sources of data to observe and understand the natural world.

> *Nooo, practical I think is when the thing that learners are going to do practical work by themselves to find the possible solution*.

Millar et al. (1999) defined practical work more broadly as all those kinds of learning activities in science which involve learners at some point to handle and observe real objects or materials. The observation or manipulation of objects might take place in a school laboratory, but could also occur in an out-of-school setting, such as the learners’ home or in the field (Bennett, 2003). From the classroom observation, Mr. Rams also used the term ‘practical investigation’ referring to one of the example of practical work because location was not a critical feature in characterizing this kind of activity.

> Eeehhh… when doing practical investigation, because we know some of these things can be toxic or some of these things the learners can be allergic to them. Sooo… we have some rules that when doing practical we have to set up the rules and we find out from the learners who has some allergies, soo... that we can handle them.

Types of practical work and nature of practical work

During classroom observation, Mr. Rams performed demonstration as his best type of practical work. Mr. Rams used demonstration of which metal rod conducted heat the best was intended to create a questioning approach in learners thereby allowing enquiring teaching. However, from the interviews, Mr. Rams mentioned the different types of practical work he already performed,

> *I think eeehhh… I have done investigation, observation, and differentiation. Eeehh… it is the demonstration one, eeeehh demonstration. Sometimes the learner has to demonstrate just like in in any topic like, eeehhh, planet earth and beyond, like learners cannot do demonstration of the revolution*.

Hattingh et al., (2007) argued that practical work has the potential to contribute to meaningful learning in science if it is conducted frequently. Yes, this was evident when Mr. Rams also used the graph to present the data or the answers gathered from the practical work. This had a meaningful learning to the learners, because they were able to interpret the data more understandably. The drawing of the graph required the learners to use the data gathered from the demonstrations and practical work into a graph. Mr. Rams indicated the evidence of mental processing as key characteristics of practical work hence, Mr. Rams developed classroom activities that required the learners to draw the graph using the data collected from the practical work (Stoffels, 2005). According to Stoffels (2005) practical work refers to those teaching and learning activities which offer learners opportunities to practice the process of investigation.

> *Sooo eehh… We are going see and make practical investigation akere! We will be able to investigate that eeehhh*… just look at the materials that are going to be used. This is the spirit burner, le a e bona akere!, water, *Vaseline, three metals rods of the same length and size, stand, drawing pins, match box, and heat conductivity apparatus. So in practical investigation, we can be able to give us that, eehh… look at the paper I gave you, will tell us what materials we are going to use.*

Based on the observation of Mr. Rams' Procedural and substantive understanding of practical work, Mr. Rams displayed competency in this regard (Gott and Duggan cited in Pekmez *et al.,* 2005). His competency fitted appropriately in aligns of the doing of sciences model and explanatory model which were applicable to the conceptual frame work. Learners were able to use their sense of sight, hearing, and touch where they were able to observe those apparatus in use / in action. From this I observed that the nature of practical work was demonstration.

From the statement above, it was evident that Mr Rams was able to show which metal rod conducted heat the best. This depicted an evidence of procedural understanding and process skills as one of practical work's characteristic.

Magnusson, Krajcik, and Borko (1999), also attested that pedagogical content knowledge of the teacher is his or her understanding of how to help learners understand specific subject matter, specifically, including knowledge of how specific subject topics, problems and issues can be organized, represented and adapted to the diverse interests and abilities of learners, and then presented for instruction and in this study the main thing was how practical work was conducted. From the classroom observation, I have noted and witnessed that Mr. Rams was able to show case which metal rod conducted heat the best and this was the evidence of good pedagogical content knowledge he portrayed.

> *Number one, eeehh… ok! Eeehhh… we have to pour water in the heat conductivity apparatus, so we have the water in the heat conductivity apparatus, le a bona? Again we must make sure that the metals rods, iron, brass, and aluminium are cut into same size and same length. He said, (go se be le rod ya go tsena kudu go feta tse dingwe) and again we also make sure that the water that in the heat conductivity covers all the metals rods equally. Are we together? Then Mr Rams told and show learners that the next step is to smear the same amount of Vaseline on all the metal rods.*

Furthermore to, that, Mr. Rams showed excellent in his substantive knowledge and procedural knowledge on how practical work was conducted. It also embraced an understanding of the nature of science, the concepts linked to scientific inquiry and the skills to perform such inquiries (Windschitl, 2004). Moreover, his lesson plan was also teacher centered because he did a lot of demonstration in state of the learners doing the task by themselves. A performance model was not clearly shown (Gott and Duggan cited in Pekmez *et al.,* 2005).

> *As I lit the spirit burner for water in the conductivity apparatus to boil, then you start. We are going to press the watches to start reading until the pin that is meant (chosen) for you falls off the metal rod and take recording, and so on until the last pin falls from the metal rod akere. Then when I put the spirit burner under the heat conductivity you start recording, right start*.

However, Mr. Rams showed an understanding of scientific concepts and explanatory frameworks that organize and connect its major ideas i.e. competency in pedagogical content knowledge, PCK (Shulman, 1987). According to Mr. Rams, nature of practical work in his version was individual or small group of investigative work which was meant for discovery learning where in learners develop their thinking. Mr. Rams knew how to help learners understand specific subject matter by drawing on different knowledge types (Magnusson, Krajcik & Borko, 1999).

The role of the teacher as related to practical work in this study

Mr. Rams played a little role of the chief instructor and much of being a demonstrator hence, his presentation of the practical investigation was teacher centered. From the classroom observation, I have noted that only three learners were hands and minds on in the practical investigation where they were controlling the stop watches as they detected and recorded the explicit time of the falling of the drawing pins from the metal rods. For the teacher to teach science successfully, teachers needed to have not only good content knowledge but also pedagogical content knowledge (Shulman, 1987). Hence his lesson plan was teacher centered I was of the opinion that more learners could have participated though there was a shortage of the equipment, he should group the learners so that they can interchange roles in the activity.

> *Eeehhh… practical activity, needs in fact, the method, I explained, explanation. Each group having their materials. Grouping but due to lack of resources, I have to do a lot of talking in class. Another method is questioning, doing, demonstration, and observation.*

Teachers should remember that it is more important for learners to have the experience of carrying out a variety of investigations than to depend on the availability of equipment (DBE, 2011). Teachers should relate the use of practical work as to prepare pupils to be assessed through practical work. Furthermore, the role of the teacher was to mentor, guide, plan, organize, lead, control and direct, facilitate demonstrate all the principles of practical work during hands- on and minds-on (Tipps et al., 2011).

Phase 2:

Views and beliefs of the teacher about practical work, the purpose of practical work, aims and objectives of practical work

Motlhabane (2013), indicated that teachers doubt the usefulness of practical work in the content comprehension. Therefore, it will be futile exercise to attempt to assist teachers without first ascertaining their perceptions on practical work. Mr. Rams viewed Practical work as a process approach which was developed process skills and this was also enhanced the procedural skills and substantive understanding of the learners. Even if learners were in small groups, this was to say that in a group of five learners, when given a task to perform, there were still those to observe while other or a group leader is performing the practical work because there are different roles to play in a group.

Teacher's views of teaching and learning science often have a pervasive influence on their classroom practices (De Vos, 1998). Teacher liked to demonstrate first to the learners the practical work especially if the theme or the topic was new to the learners. From the interviews I can also infer that Mr. Rams also viewed practical work as a vehicle through which learners can ascertain their different types of skills, which includes among others; the scientific inquiry skill, procedural understating skills, substantive understanding skills, creative and artistic skills, independent thinking skills, and investigative skills. This was evident when he referred to the practical work as a teaching tool to enhance teaching and learning.

> *Mmhhhh… I think practical work is just investigation to find a solution to a given problem. Nooo, practical I think is the thing that learners are going to do it themselves to find the possible solution.*

Mr. Rams viewed believed practical work as crux of science developed. He believed that practical work is the main source of knowledge if done accurately and appropriately. He believed in illustrations and consolidation through cooperative learning. Mr Rams grouped learners to use the information collected from the practical work and represent it in a graph on the record sheet provided. He viewed practical work as the investigation of the given problem in order to find answers or solution to the problem or question, He said.

> *Practical work can be seen as investigating a given problem or question to find a solution.*

This is also emphasized by literature by saying that practical work is also viewed as a prominent and distinctive feature of science education by science teachers (Donnelly, 1995). Because when practical work is done the learners substantive knowledge is enriched and a better understanding knowledge of the concepts is improved.

The purpose of practical work

The purpose of practical work could be to cultivate interest and enjoyment in science and science learning. Perkins-Gough (2007) also indicated that practical work can be intended for the development of teamwork abilities. Hence Mr. Rams grouped learners to investigate which metal rod conducted heat the best. The development of problem solving skills is also the purpose of practical work (Pekmez et al. 2006) and the Department of Education documents (DoE, 2003; 2005; and 2007) also holds the sentiments. From the classroom observation, I noted that Mr. Rams' practical investigation had a purpose of developing learners' investigative skills.

Form the interview I noted that Mr. Rams had an intention of developing the observation skill among the learners by letting them to observe by themselves about which drawing pin fell first, second, and last.

> *We want to see which drawing pin falls the first, Nahhh.. yes, we want to see or find out or investigate, which metal rod conduct heat the best. Mr Rams agreed. Which metal rod conduct heat the best akere! Yes ga re nyake go bona gore go wa pini e fe pele . Yes we want to find out which Metal rod conduct heat the best. Yaah mo e leng go reng the drawing pin is going to fall first, it means that the metal rod conduct heat the best. So what is your prediction (guess), when we predict there is no wrong answer, we just guess akere, but later we verify our facts, aker!*

Kask and Rannikemae (2006) indicated that the purpose of practical work is to enable the students to acquire and practice process skills. Although they were not given chance to touch or feel the apparatus in their activity, all learners were able to observe for themselves as they observed the drawing pins falling from the metal rods, and at the same time the three boys record the falling of the drawing pins, sequentially. Practical work could be used for developing process skills as well as the substantive comprehension of the subject content (DBE, 2011).

Aims and objectives of practical work

Mr. Rams told learners that they are going to see which metal rod conduct heat the best. He demonstrated the process of conducting heat using the three different metal rods. From the observations his main aim was: ***To encourage accurate observations and careful recording, be equipped with manipulative and investigative skills*** (Kerr, 1963). Mr. Rams said,

> *Learners must find for themselves which metal rod conduct heat the best. And investigation is a tool or mechanism through which practical work could be done. We want to see or find out which metal rod conduct heat the best, Mr Rams agreed*.

The role of the teacher is to mentor, guide, plan, organise, lead, control and direct, demonstrate all the principles of practical work during hands-on (Tipps et al., 2011). From the classroom observation, Mr. Rams mentored, organized, and guided learners through the practical investigation until they find the answer to their problem which was to investigate the metal rod that conducted heat the best.

> *Nah, I wanted learners to find out that eeehhhh, as whether, different metal materials conduct heat at the same rate and investigate which metal rod conducted heat the best among the aluminum, iron, and brass. So learners must find out and observe for themselves*.

Abrahams and Saglam (2010) suggest that teachers' three broad aims in terms of practical work can be categorized into three domains: procedural, conceptual and affective. From the classroom observation I can infer that Mr. Rams encouraged accurate observation and careful recording and to promoted simple, common-sense, scientific methods of thought.

> *So I am going to ask three learners here who can control the stop watches ke bo mang? O mongwe o tlile go emela brass, o mongwe ya ba wa aluminium and o mongwe ya ba wa iron. ke bomang? Right come. The three learners. You can start stop the stop watches. When I say start you start. So am going to ask the three learners here who can control the stop watches. Ke bo mang*?

Then Mr Rams allocated each of them a stop watch and instructed them to reset it so as it start from zero point reading. This was evident when Mr. Rams had given the learners to draw a bar graph from the time recorded of the falling of the pins on the metal rods which promoted common sense that the first drawing pin to fall, will eventually tell that it is the metal rod conducted heat the best. The aim of the practical work is also to develop manipulative skills.

Phase 3:

How practical work was conducted/pedagogical content knowledge (PCK), and the instructional strategies/ teaching methods of the natural science teacher

From the classroom observation, it was evident that Mr. Rams preferred conducting practical work as demonstrations. He presented various reasons for conducting practical work either as a group work or by demonstrating. Mr. Rams has a rich pedagogical content knowledge (PCK) of which his understanding of the ways for the transformation of disciplinary content into forms that are comprehensible and accessible to students (Shulman, 1987). Amongst others he indicated that the amount of equipment as well as the disciplinary issues influences whether if it will be group work or demonstration. However, besides all the reasons he gave, the data showed that he generally preferred conducting demonstrations. The teacher Pedagogical content knowledge helps the learners to develop knowledge of basic science procedures and utilise them to engage in the science content (Miller et al., 2014). This was evident from the interviews as mentioned by Mr. Rams that,

> *Eyahh….heeii!, mmhhh….,sooo… sometimes, eeehhhh… they have to handle the materials that we are going to use with care because some are fragile, some of the things are poisonous, sooo.. I usually tell them that eeehh..You have to handle these materials with care and if they need love, they are given love first.*

But during Mr. Rams' lesson presentation, he did not make much of the learner involvement as stated from the interviews statement above. Only three learners were in touch with the apparatus and the rest observed and answered oral questions. Many learners participated at the end of the lesson in a form of class work.

> *So from our findings we are going to draw a bar graph on our record sheet provided to you. You know how to draw a bar graph akere! So our bar graph will have the X-axis here and the Y-axis. Then the X-axis will show us the three different types of metal whereas the Y-axis will show us the time in minutes, akere! Therefore you will draw the three bars on each metal rods verses the time taken by pins to fall. This is how you are going the represent the findings of our practical investigation on the bar graph.*

Teaching science successfully, teachers needed to have not only good content knowledge but also pedagogical content knowledge (Shulman, 1987). Mr. Rams' pedagogical strategy was demonstrative and investigative. The student centered pedagogy attested by the central government in China was important to the learners (Wei, 2010) instead it was teacher centered. From the interviews Mr. Rams also stated that in subject like natural science theory must be put in practice hence the involvement of the learners is much recommend, Furthermore to that, Mr. Rams' pedagogical content knowledge (PCK) was a critical factor that had an effect on the teaching and learning (Karisan et al 2013).

> Yaahhh, eeehhh… theory and practicals are matter related because you teach them what is going to happen or the see for themselves. They need practical and see for themselves what is happening, they give reasons of what is happening when are doing the practical part of it.

The findings indicated the commonality to that of the teacher investigated by Stofels (2005) who preferred to conduct demonstrations. Mr. Rams confined to a performance Model and a doing of science model combined in his presentation of practical work. But In spite of all the motivations given from the briefing and workshops, that practical work as an essential component of natural sciences teaching and learning in the senior phase, some South African classrooms continue to be dominated by teacher-centered instructional practices that rely heavily on teacher explanations (Ramnarain, 2014; Webb, 2009).

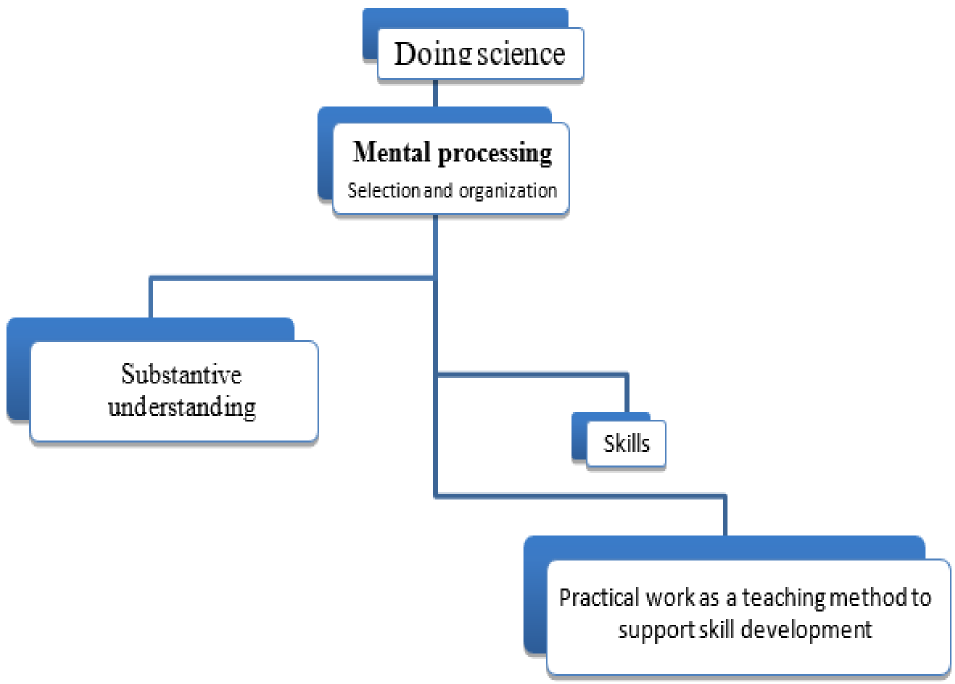


Figure.4.2 A doing of science model

The practical work conducted was affected by several factors. The large class size did not allow for the formation of groups of manageable sizes. The group of 10 learners per group was too large for all learners in the group to be directly involved with the practical work. Not all learners were, therefore, able to acquire skills as required from the practical work but all learners were able to draw a bar graph representing the findings. Mr. Rams was satisfied by the availability of resources

> *Nooo… this one, eehh besides, eehh…, this lack of resource, I think yahhh… but it is also a problem that lack of resources because learners need to be grouped in manageable groups, and I think these groups could work more effectively, sooo… because of the lack of resources, we work with big groups and that is where lies a problem.*

From the classroom, I observed that the lack of adequate supply of equipment etc. did not allow for groups to be made smaller, shortage of equipment resulted in Mr. Rams being teacher-centered because learner were not divided into small groups. The group was too large thus preventing each learner in the group from being fully involved in the practical investigation. It was evident from the instruction sheet and the practical observational reports which contained the possible solutions to the given problems that the teacher used the practical work to enhance the substantive understanding of a particular concept. Because one of the instruction sheets had the graph to represent data collected from the investigation as well as all the "HINTS" needed and apparatus learners had to use and a full description of what to do, and they were asked to investigate "Which metal rod will conduct heat the best". Moreover, the pedagogical content knowledge is a procedure offering learners specific methodology or principle with the focus on how the learners learn together with the "context and resources" forming part of learning (Starkey, 2012).

The instructional strategies of the teacher (methods of teaching) natural sciences

According to Price & Nelson (2007), teachers' procedural understanding and knowledge is the 'knowing how part of teaching the subject matter' or a particular topic. The above notion was evident in Mr. Rams' knowledge of the procedures applied in his practical work and clearly answered one of the questions in the interview,

> *Yes we want to find out which Metal rod conduct heat the best. Yaah mo e leng go reng the drawing pin is going to fall first, it means that the metal rod conduct heat the best. So what is your prediction (guess), when we predict there is no wrong answer*, we just guess akere, but later we verify our facts

Halai & Khan (2011), argued that a single methods in teaching the subject content will not bear fruit, instead a combination of instructional strategies should be employed in order to cater learners’ different abilities and needs is the foundations to attain . Mr. Rams used a combination of instructional strategies which include:

- Demonstrative;
- Investigative;
- Self-discovery method;
- Lecture method;
- Inquiry-based method,
- Descriptive method, and
- Cooperative.

Mr. Rams depicted the aspects of hypothesising (guessing/ predicting) as he has a huge knowledge of the subject content. He demonstrated the practical work very well although he was teacher centred. Furthermore to that, it is through the scientific inquiry that knowledge is being developed (Kock et al 2013).

4.4. Data presentation and discussions.

CASE 3 (Mrs Dike)

Phase 1

Definition of practical work, types of practical work and the nature of practical work, the role of the natural sciences teacher as related to practical work in this study.

Definition of practical work

Mrs. Dike defined the practical work as a teaching and learning tool of which learners understand better the learning content and they are easily able to relate and put theory into practice. Mrs. Dike defined practical work as the activities which involved the hands together with the minds of the learners. Moreover, practical work is specifically referred to as those teaching-learning transactions in which learners are given ample opportunities to practise the processes of investigation (DoE, 2007).

> *Practical work mmhhh… what I do understand most about practical work is that you do things practically so, you display concrete things and not in a theoretical way. You must do it*

> *in a practical way so that the learners understand it in a better way, doing practical in your own hands.*

This was evident from interviews in which Mrs. Dike explained practical work as a powerful method of learning and practicing all the activities in science, she also stated that practical work is all the teaching and learning activities in science education which involves hands-on of the learners when observing and manipulating materials (Millar et al., 1999). This is what Mrs. Dike did when rolling an apple on the floor so that the learners can observe. Mrs. Dike asked learners to feel and touch the apple and let them to roll it on the floor so that they could have a closer observation of what is taking place while the apple was rolled. This was an evident from the interview as Mrs. Dike defined practical work as tool of unearthing different types of scientific skills in natural science.

> *Do that in practice using your own hands and minds for developmental purpose which prepares learners for the real world outside the school premises.*

The handling and using of materials is similar to hands-on and minds-on of the learners (Jenkins, 1999; Millar et al., 1999). This sentiment is also shared by Kask and Rannikmäe, (2006); Donnelly, (1998) and Stoffels, (2005). Mrs. Dike also approached practical work not as procedural scientific enquiry but rather as substantive scientific knowledge so that learners would learn to acquire skills and knowledge rather the protocol. As Mrs. Dike rolled an apple on the floor, learners were also given chance to roll it by themselves and observed the movement of an apple until it stopped. Practical work is usually recognised as an essential part of school science teaching and learning (Hofstein and Lunetta, 2004; Hofstein et al., 2013; Wellington and Ireson, 2012). Agreeing to that and of the opinion that, practical work is of utmost importance in the learning of natural sciences.

Types of practical work and nature of practical work

From the interview Mrs. Dike made mention of variety of types of practical work she was aware of. Mrs. Dike listed the types of practical work that she was comfortable with during her lesson presentations. However, DoE (2012) stated the types of practical work which include: demonstrations, observations, illustrations, investigation, projects, assignments, case study etc. according to my understanding the types of practical work in CAPS (DoE, 2012).

> *It's the demonstration, investigation, and observation. Like growth… investigating the growth part of a plant. How long does it takes to grow, many days the length of the plant, the colour of the plant when exposed to the sunlight and the one not exposed to the sunlight. Like when we investigate how the transference of pollen grains is taking place from the ripe male (another) cone to the ripe female (stigma) cones until fertilization has taken place to produce a new zygote.*

This is what was portrayed by Mrs. Dike in her practical work. Mrs. Dike used demonstrations and observation more than any other types of practical work.

> *Demonstrations and observation are the types of practical work I like most. Most of my lessons preparation for practical work, I like using demonstrations and observation jointly so that learners can have an opportunity to see, investigate, and find solution or answers to the problem or phenomenon.*

Mrs. Dike's ideas of the nature of practical work are fundamentally based on the notion that practical work is a teaching tool as well as a learning tool. The teacher considers practical work as the teaching tool that offers learners an opportunity to develop process skills (Stoffels, 2005). Practical work is also an approach that enhances learners' understanding of content. Hence, these ideas partially fit within the parameters of the investigation movement (Pekmez et al., 2005).

> *According to the law of conservation of energy, before we go to the kinetic energy, let's define law of conservation of energy. All learners responded, "Energy cannot be created nor destroyed but it can be transferred from one form to another." Yes guys go ra gore you cannot create the energy nor to destroy the energy in that apple. You cannot create nor destroyed the energy but can be transferred from one form to another. Are we together guys?*

This is partially so because there was no intention of developing problem solving skills. Learning situation as the nature of the practical work offers learners an opportunity to practice the process of investigation. Teaching and learning activities in science should involve students, at some point, in handling or observing real objects or materials they are studying. Practical work can be classified into four types: confirmatory, inquiry, discovery, and problem-based (Hofstein, 2015).

> *Demonstrations, well when I do the demonstrations, well I demonstrate and I take it gore these learners they do understand most (go phala ge ke no) rather than when i present in a theoretically way*.

The roles of the natural sciences teacher related to practical work in the study.

As I have noted from the classroom observation Mrs. Dike portrayed the role as the demonstrator rather than a facilitator. Mrs Dike was also a bit of an illustrator because she had a lot to explain whereas her learner was minimally involved.

> *Potential energy is the energy stored in a system. But an apple is not a system akere! Yahhh re botse Mashosho. Mashosho replied, "Potential energy is the energy that is waiting to be released." Yes we said potential energy is the energy that is awaiting to be released akere!, yahh then o di ri leng? She has ate the apple akere! O e kgemile? Noo o e jele, then go ra go re the energy has been transferred. Fine, fine then kinetic energy. According to the law of conservation of energy, before we go to the kinetic energy, let's define law of conservation of energy.*

Noted from the interview, the above notion attest to the fact that. Mrs. Dike's lesson presentation was balanced by the fact that both the teacher and the learners were involved, mentally and physically.

Views and beliefs about practical work

Phase 2:

Views and beliefs about practical work, the purpose of practical work, aims and objectives of practical work

Mrs Dike viewed that practical work in natural science is for making the subject enjoyable and development of students' experimental skill (Ramnarain, 2014).

> *From the food that they have ate, then that is the theoretical. And there after I asked one learner to move around so for that particular learner to be able to move around it is because he has the energy in him. This energy is kinetic energy (movement) but before kinetic energy the boy was at rest possessing stored energy which is called potential energy.*

Dudu et al., (2012) also attested to the fact that teachers' focus when teaching science was on the mastery of the subject matter than practical work. For many teachers, practical work provides the evidence for existing scientific knowledge and developing new knowledge. Traditionally, teachers view the use of practical work as illustrations and consolidations of the understanding of science concepts. Practical work was viewed as a prominent and distinctive feature of science education. It is sometimes ironic that teachers' views of the nature of science often determine the format of the practical (Tsai, 1999). Mrs. Dike believed that learners must be involved in doing all the theory into practice because she believed learners learn more when they see, hear, touch, and they will never forget.

> *Eish normally I want to… to engage learners, question and answer I prefer that ke kgona go bona go re we are on the same page, unlike ke e ba teacher centred. Mara g eke thoma go ba learner-centred ke kgona go reng? Alright I pose questions most of the time, ooohh in practical yahh even in practical yes question and answer method. For example in Acids and base. What is this? Is it acid or a base? Learners must experiment, and discover for themselves, that is discovery method is used*.

Mrs. Dike also shown the urge that theory must be put into practice because learners learn easily and enjoy when they are doing things by themselves. From the classroom observation I saw how she asked learners to throw the ball in the air and she ordered them to make observations of what was happening and why. The learners observed and reported to her later back in the classroom. Observation is an essential data gathering technique as it held the possibility of providing the researcher with an insider perspective of participant dynamics and behaviors in different settings (Maree, 2013). In this regard observation helped learners to realize things when the ball came back on the ground. The gravitational force was the answer.

Mrs. Dike also viewed that practical work as integration of theory into practice to strengthen the concepts being taught (DoE, 2011). She was optimistic that learners needed,

> *To hear, see, touch the materials they are working with or investigating so as to enable them to respond more informative when recording their finding from the given practical tasks in a classroom context which will relate to the real day to day outside world experiences they would encounter in life.*

She cited an example of throwing any object in the in the sky and she did ask three of the learners to throw an apple in the sky where the apple eventually came back on the ground. She said,

> *What cause an apple not to remain in the sky?*

The purpose of practical work

The purpose in this context refers to the intentions of Mrs. Dike doing practical work. Kask and Rannikmäe (2006) indicate that the purpose of practical work is to enable learners to acquire and practice process skills. From the classroom observation, Mrs. Dike gave the learners to roll the apple on the floor so that they practice the demonstrative skill, and to promote simple, common sense, scientific methods of thought (Kerr, 1963)

> *You cannot create the energy, go ra gore the energy in that apple will stay the same until transferred to another form of energy. Right lets continue. Then when the apple is on the table, what kind of energy does it possess? Kinetic energy." Kinetic energy? Nooo… Makgoba. It is potential energy correct. As the apple moves neh? What is that energy? Yes the kinetic energy, because the potential energy in the apple*

> *is decreased and transferred to kinetic energy a ke re but not completely transferred to kinetic energy.*

From the classroom observation, Mrs. Dike demonstrated how the energy is transferred from one form to another. She wanted to elucidate the theoretical work to aid comprehension by showing rolling movement of an apple as compared to the state of being at rest (Kerr, 1963). The learners were able to comprehend the energy transfer. The purpose of practical work aided on bringing theory into practice (what is explained in textbook), to be brought into life or on real contexts (kerschner, 1991). Practical work is also suitable for the acquisition of cognitive skills which is another way to improve learning and enhance additional connection between theory and practice (Clark, 2006). Further to that, it enables learners to take part in the activities which lead to the acquisition of the scientific knowledge (Hodson, 1992). Mrs Dike let learners to observe in order to acquire the above mentioned skills. I therefore agree that learners learn best when involved in practical work.

Aims and objectives of practical work.

One of the aims of practical work allotted by Mrs. Dike as stated in her responses from the interviews, said:

> *The aim of the practical work is to explore and move from the stage of unknown to known and instill the love of the matter. The main objectives are that I want the matter to be well assimilated.*

From the interview, Mrs. Dike said that when she planned this practical work she had one aim in her mind which is for the learners to transfer the theory of the content knowledge into practice. Practical work develops scientific methods of thought and the aim is to enable pupils to find out through investigation (Gott & Duggan, 1995). Practical work involving investigations aimed at contextualising the relevant experiences (Aubusson, 2011). Learners are given opportunities to conduct investigations in ways that were to scaffold to meet the levels of their skills and knowledge (Allchin, 2014). It also helps learners' understanding of the scientific inquiry which is an approach to investigate natural phenomenon. Therefore, I have noted that the above notions concur with each other and I also feel the same, that practical work develops scientific method of thought.

> *For the subject matter to be well, well assimilated or well understood. The aim is that I want the learners to move from the unknown to known. I want to instill the love of. I usually tell them that we do science every day… they even nicknamed me "science" hehehehe… (She giggled).*

Mrs. Dike provided learners with insights into scientific practice and can also increase interest in science field and studies. Lunette (1998) suggested that practical work has the potential to enable collaborative relationship as well as positive attitudes towards science. Scientific activities enable learners to interact more among peers and the teacher.

How practical work was conducted.

Phase 3:

How practical work was conducted/ pedagogical content knowledge, and the instructional strategies/ teaching methods of natural sciences teacher related to practical work

Mrs. Dike was confined within the parameters of performance model and explanatory model (Pekmez et al., 2005). She demonstrated the rolling movement in order to show how the transfer of chemical potential energy to kinetic energy took place. She also used an explanation of what happens to an object thrown in the sky but does not remain in the sky, reason being that the object would return on the earth, is because of the gravitational force. The above notions demonstrated how good Mrs. Dike's understanding ways of how to teach a particular topic was. Mrs Dike's pedagogical content knowledge (PCK) was evident to that of (Shulman, 1986). Mrs Dike has shown the knowledge of the topic and also depicted competency in teaching the subject matter/ content (Woolfolk, 2013).

The explanatory model depicts the practical work as a teaching method to support substantive understanding and laboratory work as just teaching method towards the end (Pekmez et al., 2005). According to Price & Nelson (2007), teachers' procedural understanding and knowledge is the 'knowing how' part of teaching the subject matter or a particular topic. This was also showcased by Mrs. Dike when she made the learners to understand why the soccer ball cannot stay in the atmosphere for ever because of the gravitational force. Practical work is also used as an explanatory framework for the explanations in science.

> *Firstly I have to find out if they have previous knowledge about what is to transpire and if they do have that, then I take it from there then I introduce the new topic. Like let say for example when I say: did you have some breakfast? And the learners replied "yes" and then the energy, the energy… where do you get the energy from?*

From the classroom observation, I can infer that Mrs. Dike conducted the practical work as demonstration, and also as illustrations. This was explicitly shown when Mrs. Dike explained why the objects are attracted by the force of gravity when thrown in the sky. The learners were able to observe Mrs. Dike throwing the apple in the sky and asked them why that apple cannot be withheld in the sky. Through their little thinking they tried to answer by saying that the initial mass of every object is attracted by the earth's gravitational force. What Mrs. Dike was doing is attested by Magnusson, Krajcik, and Borko (1999), stating that the pedagogical content knowledge of the teacher is his or her understanding of how to help learners to understand specific subject matter. Mrs. Dike asked,

> *What type of energy is in this apple? akere we said we must eat so that we can have the energy in our body. Would anyone explain what potential energy is? Yes,*

Potential energy is the energy stored in a system. But an apple is not a system akere! Yahhh re botse. Potential energy is the energy that is waiting to be released. Yes we said potential energy is the energy that is awaiting to be released akere!, yahh then o di ri leng? She has ate the apple, then the energy has been transferred.

Mrs. Dike used practical work in a variety of formats. These formats include among others, the recipes, open-ended investigations, skills training, teacher demonstrations to promote discussion about phenomena, to raise questions, and to solve problems (Watson, 2004).

Instructional strategies/teaching methods of unqualified natural sciences teacher related to practical work.

Halai & Khan (2011), emphasise the fact that teachers should not depend on a single method when teaching the learners. Further to that, these strategies are for the betterment of the learners in their diversity (Conklin, 2007). A combination of different teaching methods is an added advantage for both the teachers and the learners. Mrs. Dike used a combination of the following teaching methods as observed from the classroom observations,

- Demonstrative;
- Questions & answer;
- Illustrative and
- Discovery.

4.5. Teacher academic qualification

The three teachers participated in the study were from the Limpopo department of education. All teachers were permanent members of staff at schools in the rural area. Each teacher was in possession of an academic qualification that warranted him/her to teach (SAQA, 2012). That is, they needed to be teaching natural science in grade seven. However, they were supposed not to have natural science as their specialization in their qualification. An unqualified natural science teacher was the central and focal point in the study. The level of training and qualifications of the teacher might have an influence on how the teacher's conducts in respect of practical work (Rogan and Grayson, 2003).

Case 1: Mrs. Bofea.

She had the secondary teacher's diploma (STD) specialized in physical science and mathematics. She had no advance certificate in education (ACE) in natural sciences.

Case 2: Mr. Rams.

He had senior primary teacher's diploma (SPTD) specialized in Sepedi, English, Afrikaans, and mathematics. He is also registered for an advance certificate in education (ACE) in natural sciences and he wrote his examination at the end of the academic year.

Case 3: Mrs. Dike

She had senior primary teacher's diploma (SPTD) specialized in English, Sepedi, physical science, and mathematics. She has registered for the last three modules of advance certificate in education (ACE), in natural science.

4.6 CHAPTER CONCLUSION

The chapter presented, discussed and made findings from the three participants identified above to answer the research question. All the three participants were exposed to the same open-ended and semi-structured questions and to the same observation protocols. The same theme or strand was treated in all the three participants respectively although the two participants dealt with the same topic (i.e. Mrs. Bofea and Mrs. Dike) but different from the second one of Mr. Rams. Moreover, the participants were interviewed and observed separately to elicit more insight in their conduct of practical work. It is noticeable that most natural science teachers did not change their old practices even in this study; it was also evident among the three unqualified teachers observed. Pseudonyms were used in all the three participants as Mrs. Bofea, Mr. Rams, and Mrs. Dike.

CHAPTER 5

SUMMARY OF FINDINGS, DISCUSSIONS, CONTRIBUTIONS TO THE STUDY, RECOMMENDATIONS, SHORT COMINGS AND CONCLUSION.

5.1. Introduction

The aim of this research study was to explore through a number of instruments which include: interviews, classroom observation, on how unqualified natural science teachers conduct practical work in the senior phase, in grade seven in a classroom context. This was done at the three sampled primary schools in Lebo circuit around the Molepo vicinity in Mankweng cluster circuits. The main focus was to explore how unqualified natural science teachers conduct practical work, what was their understanding with regard to pedagogical content knowledge, which instructional strategies were used. However, they were also to define what practical work was and list the types of practical work.

5.2. Main research question and sub-research questions.

Research question: How do unqualified grade seven natural science teachers facilitate practical work in the senior phase?

Sub questions:

a. How do unqualified natural sciences teachers define practical work?
b. What are the views, aims and objectives of unqualified natural sciences teachers with regard to practical work?
c. How do unqualified natural sciences teacher conduct practical work?

Underneath, follow how the collected data has answered the research questions in all the three cases.

5.3. How do unqualified natural sciences teachers define practical work?

5.3.1 Case 1 Mrs. Bofea

There was evidence of teacher's content knowledge that was inadequate to teach natural science in Grade seven. In some instances it could be seen that their knowledge was way above what was required to teach the natural science class. Therefore, the study has revealed that Mrs. Bofea's responce to the definition of practical work, was very poor, showed and necessitated a need for a professional pedagogical developmental intervention from her seniors, subject advisors and the department of education. Because, according to literature, practical work was considered to be a broad concept which include any activity that required students to be actively involved (Hodson, 1993). But Mrs Bofea just said practical work has to do with apparatus and hands, she could have gone far beyond that if she knew better. Hence, the inference that she had little knowledge and understanding of what practical work was. Millar et al. (1999) defined practical work as a powerful method of learning and practicing all the activities in science and also stated that practical work was all the teaching and learning activities in science education which involved hands-on of the learners when observing and manipulating materials. So Mrs. Bofea's definition of practical work was very poor.

5.3.2 Case 2 Mr. Rams

The study found out that Mr. Rams had sufficient knowledge of what practical work was. Mr. Rams defined practical work as just an investigation to find a solution to a given problem or question. Mr. Rams also attempted to give a specific definition of an explorative investigation, saying that the process of exploring an event was somehow helpful in an attempt to develop a detailed understanding of the phenomenon (Creswell, 2012). The study found that Mr. Rams sometimes wanted each learner to individually define the practical work by an activity that he did with them at the end of the lesson. Woolfolk (2010) also attested the fact that practical work was defined as an intensive study of individual person (natural science teacher in particular or one situation).

Although Mr. Rams pointed out that practical work in planet earth and beyond, theme was a huge problem to him to explain or rather to demonstrate to learners in classroom situation through practical work. The study revealed that Mr. Rams used the term ‘practical work’ which he referred to as ‘any teaching and learning activity’ which at some point involved the learners in observing or manipulating the objects and materials they are studying (Maree, 2013). Mr. Rams had a clearer knowledge of how to define practical work. Therefore, Mr. Rams was very outstanding in defining practical work.

5.3.3 Case 3 Mrs. Dike

Mrs. Dike defined practical work as a powerful method of learning and practicing all the activities in science and also stated that practical work was all the teaching and learning activities in science education which involved hands-on of the learners when observing and manipulating materials (Millar et al., 1999). Mrs. Dike also defined the practical work as a teaching and learning tool of which learners understood better when learning the content and they were easily able to relate and put theory into practice. Mrs. Dike defined practical work as the activities which involved the hands together with the minds of the learners (Lunetta et al., 2007). Mrs. Dike defined practical work as tool of unearthing different types of scientific and process skills from the learners. The study revealed that Mrs. Dike defined the practical work clearly in her own words which was very simple for the learners to understand it better. She said, practical work is exactly doing practice using your own hands and minds for developmental purpose which prepared learners for the real world outside the school premises. Therefore, Mrs. Dike was also excellent in defining practical work.

5.4 What are views, aims and objectives of unqualified teachers about practical work?

5.4.1 Case 1 Mrs. Bofea.

a. Views.

The study showed that Mrs. Bofea’s viewed practical work as a means and maintains interest in the subject in the hope that it motivated more learners

(Osborne, Simon & Collins, 2003). In many countries practical work was viewed an essential feature of the teaching and learning of science and considerable time and money was spent on teaching science through practical work and it was, therefore, important to be clear about the aims of practical work (Osborne, Simon & Collins, 2003). That was why many teachers viewed practical work as an essential feature of science education (International Journal of Science Education, 25 (10), 1171-1204.)

b. Aims.

Mrs. Bofea was not sure of the aim of the practical work she presented. The study noted from the interview that she could not even articulate the aims of practical work, moreover, she had no lesson preparation prepared for the practical work done.

c. Objectives.

Mrs. Bofea could not tell the objectives of the practical work during the interview, but during the beginning of the lesson presentation she told learners that they were to investigate how the electrical potential energy was transferred to the heat energy in a thermal system. This was also evident that she had little knowledge in as far as the content was concerned.

5.4.2. Case 2 Mr. Rams.

a. Views

The study found that Mr. Rams viewed practical work as a means for making the subject of natural science more enjoyable and development of students' experimental skill (Ramnarain, 2014). Mr. Rams presented a wonderful practical work lesson. He viewed practical work as a teaching tool to support the substantive knowledge. Dudu et al., (2012) also attested to the fact that teachers' focus, when teaching science, was traditionally on the perspective of mastering the subject matter rather than the practical work. But the study revealed that Mr. Rams did not teach for the sake of subject matter but he inculcated investigative skills in the learners. This was evident from the classroom observations and interviews where Mr. Rams demonstrated with the aim of instilling scientific skills and not for the sake of subject mastery. Ramnarain (2014) also elaborated that some natural science teachers believed that their explanations were better than when they were facilitating the practical work to enhance the comprehension of concepts by students. The study revealed that Mr. Rams had more adequate content knowledge of the subject matter which he used to present the practical work explicitly and procedurally so.

b. Aims.

From the interviews, the study revealed that Mr. Rams knew about the aim of his practical work. He said the aim was to investigate which metal rod conduct heat the best. This taught us that Mr. Rams went into the classroom knowing what his aim was for the assessment of the learner.

c. Objectives.

The objectives of his practical work simplified as to find as whether, different metal materials conduct heat at the same. He was very quick to respond to the question during the interview session and this showed that Mr. Rams had sufficient knowledge of the subject content.

5.4.3 Case 3 Mrs. Dike.

a. Views.

The study noted that Mrs. Dike viewed as a process approach which developed the process skills and this enhanced the procedural skills and substantive understanding of the learners. Even if learners were in small group, they were able to do different roles in their group, some were observing, while one was subscribing the notes while other or a group leader was performing the practical work. The study revealed that Mrs. Dike still wanted to demonstrate first to the learners when doing the practical work especially if the theme or the topic was still new to the learners. For many teachers, practical work provided the evidence for existing scientific knowledge and developing new knowledge. Furthermore, the study found that Mrs. Dike still viewed the use of practical work through illustrations and consolidations of the understanding of science concepts. From the classroom observation, Mrs. Dike viewed practical work as a prominent and distinctive feature of science education (Tsai, 1999). Mrs. Dike put an emphasis on science as the crux of practical work and she believed that practical work was best presented as illustrations and consolidation.

Mrs.Dike also showed the urge that theory must be put into practice because learners learn easily and enjoy when they were doing things by them. Mrs. Dike also viewed that practical work as integration of theory into practice to strengthen the concepts being taught (DoE, 2011). The study revealed that Mrs. Dike viewed practical work as a process approach which developed the process skills and this was also enhanced by the procedural skills and substantive understanding of the learners. Teachers still wanted to demonstrate practical work especially if the theme or the topic was still new to the learners. For Mrs. Dike, practical work provided the evidence for existing scientific knowledge and developing new knowledge among the learners.

b. **Aims.**

Mrs. Dike confused the aims and the objectives during interviews but from her lesson plan it was clearly stated as: the aim was for the learners to be able to investigate how energy was transferred from one form to another.

c. Objectives.

Mrs. Dike’s objective was for the subject matter to be well, well assimilated or well understood, to explore and experiment, and to discover for themselves.

5.5. How do unqualified grade seven natural sciences teachers facilitate practical work in the senior phase?

5.5.1 Case 1 Mrs. Bofea.

The study revealed that Mrs. Bofea facilitated practical work through illustrations amongst other approaches of conducting practical work which was evident from the classroom observations as she was not too involved in demonstrations of the practical work but instead she instructed learners to do the practical work after she explained the names and the functions of the apparatus she brought in the classroom. The study showed that Mrs Bofea facilitated practical work in a particular way as she was able to keep discipline on the other learners who was not at the observing center and again she was able to pose questions to the observing group of learners so the learners at the observing center were able to observe and answer her questions. Mrs. Bofea used a lot of question and answer method, her lesson presentation was characterized by teacher centeredness and I am saying this because she could not even go nearby the observing group to see what was happening in the pot. As a facilitator, a teacher should move around and also observe how the learners are doing in practical work so as to guide them to be focus on their investigation. The study also found that the teacher has little knowledge of the subject matter and how practical work should be facilitated.

The lesson was teacher centeredness as she did a lot of reading from the prescribed spot on natural science textbook than to facilitate. Only a group of five learners were able to observe and demonstrate and at the same time. They were also answering the questions which were posed by Mrs. Bofea as they were busy demonstrating and observing how soup was done. She lost focus of the audience and spent a lot of time talking to the other leaners who were not in a group to observe so as to keep them busy. The study also found that the teacher was a little beat confused as to what to do as a facilitator. Most of the learners were not concentrating on the practical work performed by the chosen five learners because they were unable to see and observe what was happening in the pot. Mrs. Bofea explained to learners that they are going to investigate how electrical potential energy was transferred into the heat energy and also into the kinetic energy.

Learners were able to show case how electrical potential energy was transferred to heat energy. Mrs. Bofea has too much mother tongue interference during her actual teaching and this influenced learners' content knowledge and hers. I was not clear on how she was going to do the practical work as there was no lesson plan and record sheet for learners to write what they have observed from the practical work hence she had no direction and lost focus. The teacher needed an assistance from her senior teacher, or the HOD of natural science, or the subject advisor of natural science, and/or the department of education. Therefore Mrs. Bofea's practical lesson was poorly conducted and she lacked the professional pedagogical development on how to conduct practical work, and to be developed through on implementing the strategies of teaching practical work.

5.5.2 Case 2 Mr. Rams.

The study found that Mr. Rams was very excellent in facilitating the practical work. He was able to elaborate how the process was going to be unfolded by first naming all the apparatus that were to be used in the practical activity. Mr. Rams wanted his learners to understand the roles and the right procedure to follow. The study also found that Mr. Rams had explicitly show cased the knowledge of the different types of apparatus for the practical work to be performed. The teacher also shown that he knew the content knowledge in practical work. Rams displayed the safety measures during practical work presentation he indeed done the explanation of the routine procedures of all the apparatus. The teacher gave the learners the aim of their practical work so the learners were quite aware of what was expected of them. They were to investigate which metal rod conducted heat the best. Mr. Rams involved all learners differently because he gave the learners on the floor a record and instruction sheet while the three boys stood up to do the recording of the falling drawing pins and record the time subsequently so. The findings indicated the commonality to that of the teacher investigated by Stofels (2005) who preferred to facilitate practical work as demonstrations. Mr. Rams used a performance Model and doing of science model combined in his presentation of practical work. The study also revealed that Mr. Rams' nature of practical work has the characteristics of investigation movement, Discovery movement, and Process movement. Mr. Rams acknowledged that group work assisted in terms of developing learners substantive understanding skills but it was not a type of practical work and it could be a method or a way in which a practical work could be done. This emanated from the probing question asked him during the post interview session about the purpose of practical work. Mr. Rams facilitated both the demonstrations and investigation as type of practical work in his lesson presentation. Furthermore to that, the study found that Mr. Rams used demonstrated by putting drawing pins clued by Vaseline on each metal rod. Furthermore, the study revealed that Mr. Rams preferred the investigative demonstrations as he wanted the learners to use procedural skills in their practical work. The learners had to follow some rules and guidelines when the draw the bar graph on the sheet provided for them to draw the finding of the practical investigation. Mr. Rams let the learners to find out for themselves. Mr. Rams explained all the proceeding during Practical work that was to unfold I can infer that his role was to mentor, guide, plan, organize, lead, control and direct. He demonstrated all the principles of practical work during hands-on and minds-on (Tipps et al., 2011). Mr. Rams together with his learners was able to communicate the finding of the investigation through using a bar graph on the graph sheet provided for recording. Mr. Rams and the learners together were able to analyze the results they got from the practical investigation. Mr. Rams understood the value of practical work in teaching and learning process. From the classroom observation the study showed that good practices of professional pedagogy was of utmost importance to Mr. Rams during his presentation of practical work. The facilitation of the practical work was well performed and presented. Therefore, Mr. Rams facilitated the investigative practical work very outstanding and stunning as expected and his learner were able to use the results for better substantive understanding of the investigation on the record sheet provided in a form of graph.

5.5.3 Case 3 Mrs. Dike.

The study revealed that Mrs. Dike facilitated practical work using both the performance model and explanatory model of apple rolling on the floor to demonstrate the transfer of chemical potential energy to kinetic energy. The study furthermore revealed that Mrs. Dike was excellent in demonstrating and explaining what happened when an object was thrown in the sky but does not remain in the sky, reason being that the object would return on the earth because of the gravitational force emanating from potential gravitational energy. Her facilitation was upon the learners to look at the soccer ball thrown in the atmosphere as whether it could stay there for forever. Learners were able to observe the ball as it was coming down onto the floor because of the force of gravity the earth possessed. The explanatory model depicted the practical work as a teaching method to support substantive understanding and laboratory work as just teaching method towards the end (Pekmez et al., 2005). Therefore Mrs. Dike presented her practical work lesson using an explanatory framework for the explanations in science.

The study also found out that Mrs. Dike did not mentioned the safety measures during practical work presentation she intended to do together with all the routine procedures of all the apparatus. It was also noted that Mrs. Dike presented the practical work through demonstrations because she said it was the type of practical work that she believed that the leaners understood best. Furthermore the study revealed that Mrs. Dike could have done far much better than she did if she took care of giving learners an ample time for them to discovery and explore for themselves. The study also revealed that Mrs. Dike in some instances facilitated practical work to develop skills with the intention of enhancing substantive understanding. Therefore Mrs. Dike was good in facilitating practical work.

5.6. Instructional strategies (methods of teaching practical work in natural sciences).

Mrs. Bofea

Mrs. Bofea used Question and answer method, telling method, illustrative method, in her teaching of how potential electrical energy is transfer to heat energy in a thermal system.

Mr Rams

He used a combination of variety of methods of teaching which include: self-discovery method, demonstrative method, question and answer method, telling/ lectured method, descriptive method, cooperative method, investigative method in teaching of energy transfer through the process of conduction.

Mrs. Dike

Mrs. Dike also used a combination teaching methods which include: discovery method, demonstrative method, question and answer method, telling/lectured method, in her teaching of the transfer of energy form one form to another.

5.7. Main contributions of the research study.

- The research study contributed more concerning the professional teacher development with regard to pedagogical knowledge in respect of practical work.
- The unqualified teachers were more eager to further their studies in order to enhance their content and pedagogical knowledge of the natural sciences subject.
- The unqualified teachers realized their good side and bad side in presenting the practical work and this was for the betterment of themselves.
- The unqualified teachers would define practical work in a more scientific and better ways.
- The unqualified teachers would view practical work from the scientific perspective.
- The conduct of practical word by the unqualified teachers could be improved.

5.8. Implications of practical work in the South African current curriculum (CAPS).

From the classroom observation it was evident that unqualified natural science teachers are doing their best to conduct practical work. Doing was a powerful way of learning and it was also often characterized by trial and error. Many unqualified natural science teachers out there would, however, needed support that they were not frustrated when they make an error. A curriculum approach that promoted professional development was needed for the assistance of these teachers. The teachers were faced with many contextual challenges when facilitating practical work. These include: inadequate knowledge base on practical work; unavailability of teaching and learning resources e.g. only one set of equipment to perform the practical work despite the overcrowded classroom in all the three cases, chemicals, computers; heavy teaching workloads; and inadequate support from the school SMTs and the subject advisors.

Classroom arrangements that are flexible could be easily modified when necessary. Often educators or schools do not have much to say about the kind of furniture in the classes, or about space available, but teachers should try to arrange the classrooms in such a way that they allow for flexibility. Learning environment was also about the sense of belonging. Inclusive classrooms make all learners feel comfortable, respect and valued in terms of the physical, social and human space. The educator's responsibility relates to facilitating the learning – helping learners to plan their work. The study has shown that the ideas which teachers have of what practical work entailed and its purpose do not necessarily ensure that they conducted practical work according to their ideas. What became evident in this study was that teachers were doing what they thought was developing procedural understanding whilst they were not. Hence this means that they do not understand what procedural understanding was. This finding was also reported by Kapenda et al. (2002). Pekmez et al. (2005) found that there is need to develop a deeper understanding of the procedural knowledge base amongst both the qualified and unqualified Natural science teachers. This is also reported by Bennett (2003).

5.9. Short coming of the research study.

- Both the teacher and learners were to be observed although the only focus was on the teacher activities rather than that of the learners. From the classroom observations done, only data from the facilitation of the practical work was observed.

- Therefore the study cannot be generalized to the entire teacher population in Lebopo circuit, or district, or province. Because the focus was only on three unqualified natural science teachers teaching in grade seven sampled from the three primary schools in Lebopo circuit in Capricorn district, Polokwane, Limpopo.

5.10. Recommendations from the research study.

The study came up with the following recommendations:

1. Educators should be professionally developed on how to facilitate practical work in order to advance the new ways of teaching and learning as the current CAPS. (Methods of facilitating practical work).
2. Educators should be empowered with pedagogical knowledge for attaining aims and objectives of practical work.
3. Chief subject advisors, senior subject advisors, SMTs HODs, should engage in regular school and class visits in view of mentoring, monitoring, and developing Ns educators.
4. Schools should provide educators with CAPS relevant documents.
5. The DoE should provide more education to educators on the importance of the curriculum as prescribed in the CAPS document.
6. The department of education should provide educators with relevant chemicals, science and mathematics teaching kits, teaching aids or practical apparatus.
7. A well-built and equipped laboratory for all schools is recommended.
8. No briefing session for a day or two, the study recommended a thorough in service training for Natural science teachers.

5.11. Chapter conclusion.

It is suggested that both qualified and unqualified natural science teachers should work and plan together in a school, circuit or cluster in order to help one another on how to teach and conduct practical work. Teachers themselves were encouraged not to be derailed by the contextual factors, but to work within their clusters in sharing the best practices as well as challenges and how to overcome them. It was also encouraged that workshops on different types of practical work for different purposes be derived and this can be done at cluster levels or through science clusters for teachers. For researcher, it was an opportunity to design strategies of doing various types of practical work in under resourced classrooms and overcrowded classrooms. It is also hoped that the ideas presented in the study will add value into the discussions on practical work for other future researchers to do further research about how best the teachers can conduct practical work.

It was evident in the study that there was an attempt to conduct practical work even though it was happening out of the parameters of the framework. Teachers need their confidence to be boosted for them to operate competently as the study has shown that there was a need for conducting practical work (Stoffels, 2005). How the results of the study best represent the majority of science teachers leaves much to be desired but the findings can provoke the understanding of practical work and its implementation. The study has shown that there was a need for the link between the understanding of practical work and teacher practice for the enquiry approach to be a success. Hence it called in for questioning the current methods that were used to inform natural science teachers on how to facilitate practical work. Professional Pedagogical development is highly recommended.

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APPENDICES:

Refer here to your consecutively numbered appendices which contain the proof of registration, permission, consent, assent letters, interview schedule, questionnaire, observation checklist, etc.

Appendix number	**Name of appendix**	Attached YES or NO
A	PROOF OF REGISTRATION	YES
B	OBSERVATION SCHEDULE	YES
C	INTERVIEW SCHEDULE	YES
D	APPROVAL CERTIFICATE, UNISA ETHICS COMMITTEE	
E	APPROVAL CERTIFICATE FROM THE PROVINCIAL DEP. OF EDUCATION	YES
F	PERMISSION LETTER FROM THE PROVINCIAL DEPT. OF EDUCAT	YES
G	PERMISSION LETTER FROM PRINCIPAL	YES
H	PERMISSION LETTER AND CONSENT FORM FROM NATURAL SCIENCE TEACHERS	YES
I	INTERVIEW AND OBSERVATION TRANSCRIP FOR MRS. BOFEA	YES
J	INTERVIEW AND OBSERVATION TRANSCRIP FOR MR. RAMS	YES
K	INTERVIEW AND OBSERVATION TRANSCRIP FOR MRS. DIKE	
L	TURNIT I REPORT	YES
M	EDITORS CERTIFICATE	YES

Please attach each Appendix on a separate

APPENDIX A
PROOF OF REGISTRATION

UNISA university of south africa

0824

MOGALE K C MR
BBC 27
P O BOX 5887
PIETERSBURG NORTH
0750

STUDENT NUMBER : 3114-418-7

ENQUIRIES TEL : 0861670411
FAX : (012)429-4150
eMAIL : mandd@unisa.ac.za

2018-05-29

Dear Student

I hereby confirm that you have been registered for the current academic year as follows:

Proposed Qualification: MED NATURAL SC EDU (90063)

CODE	PAPER	S	NAME OF STUDY UNIT	NQF crdts	LANG.	PROVISIONAL EXAMINATION EXAM.DATE	CENTRE(PLACE)
Study units registered without formal exams:							
DFNSE96			MEd - Natural Science Education (Dissertation)	**	E		

You are referred to the "MyRegistration" brochure regarding fees that are forfeited on cancellation of any study units.

\# Your attention is drawn to University rules and regulations (www.unisa.ac.za/register).
Please note the new requirements for reregistration and the number of credits per year which state that students registered for the first time from 2013, must complete 36 NQF credits in the first year of study, and thereafter must complete 48 NQF credits per year.
Students registered for the MBA, MBL and DBL degrees must visit the SBL's ESOnLine for study material and other

Readmission rules for Honours: Note that in terms of the Unisa Admission Policy academic activity must be demonstrated to the satisfaction of the University during each year of study. If you fail to meet this requirement in the first year of study, you will be admitted to another year of study. After a second year of not demonstrating academic activity to the satisfaction of the University, you will not be re-admitted, except with the express approval of the Executive Dean of the College in which you are registered. Note too, that this study programme must be completed within three years. Non-compliance will result in your academic exclusion, and you will therefore not be allowed to re-register for a qualification at the same level on the National Qualifications Framework in the same College for a period of five years after such exclusion, after which you will have to re-apply for admission to any such qualification.
Readmission rules for M&D: Note that in terms of the Unisa Admission Policy, a candidate must complete a Master's qualification within three years. Under exceptional circumstances and on recommendation of the Executive Dean, a candidate may be allowed an extra (fourth) year to complete the qualification. For a Doctoral degree, a candidate must complete the study programme within six years. Under exceptional circumstances, and on recommendation by the Executive Dean, a candidate may be allowed an extra (seventh) year to complete the qualification.

\# Your study material is available on www.my.unisa.ac.za, as no printed matter will be made available for the research proposal module.
Study material can be accessed on the Unisa website. You must register on MyUnisa (https://my.unisa.ac.za/portal/) for this purpose. You are also reminded to activate your myLife email address since all electronic correspondence will be sent to this email address.

CREDIT BALANCE ON STUDY ACCOUNT: 13790.00-

Yours faithfully,

Prof QM Temane
Registrar (Acting)

0108 O 00 0

UNIVERSITEIT VAN SUID-AFRIKA
PRETORIA
UNIVERSITY OF SOUTH AFRICA

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
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UNISA college of education

APPENDIX B

OBSERVATION SCHEDULE

Part one: General information

<table>
<tr><td colspan="2">Observation Date:</td><td colspan="2">Researcher's name: Mogale Khutso Charles</td></tr>
<tr><td colspan="2">School(pseudonym):</td><td colspan="2">Teacher's name(pseudonym):</td></tr>
<tr><td>Term:
Grade: 7</td><td>Learners :</td><td>Subject:
NS</td><td>Strand/theme :</td></tr>
<tr><td colspan="4">Name of the practical activity:</td></tr>
<tr><td colspan="4">Aim(s):</td></tr>
</table>

Period no.:	**Start time:**	**Time ended:**	**Duration:**

Part two: CLASSROOM INTERACTIONS AND DISCOURSE

Statement	**Researcher's comment**	**Observer's comment**
Evidence of the lesson preparation for the practical activity. To check the aim and objective to be attained in the practical activity.		
The strengths of the teacher in presenting practical activity.		
The outcome of the practical activity attained.		
The results were properly recorded by learners on a record sheet.		
The teaching method(s) used?		
The involvement of learners in the lesson activity.		
The practical activity was learner-centred or teacher centred.		
How the teacher monitored and facilitated the practical activity.		
Time-takers were individually attended to and adequately assisted.		
.Documents used: e.g:- Textbooks, Policy document, observation sheet, e.t.c		

. Apparatus used, if any		
. Teacher content knowledge, pedagogical knowledge and skills.		
. Learners' scientific and investigative skills developed.		
. Precautionary measures were given to the learners in advance and displayed on the wall.		
. There is a well-organized laboratory or the teacher is improvising.		
. If not, is the classroom adequate for teaching and learning e.g. is the space conductive for learning and fit for classroom practice?		
17. Interaction, involvement and opportunity to handle apparatus.		
18. The Learners adapted to the changes, demonstrate good group work skills, and confidence		
19. Were the aims attained?		
20. Engagement of learners in high order thinking		
21. The challenge of the teacher if any:		
22. Any challenges from the learners.		
23. Were those challenges addressed?		

UNISA college of education

APPENDIX C

INTERVIEW SCHEDULE

SEMI STRUCTURED INTERVIEW SCHEDULE.

Phase 1: Pre-observation.

1. Could you please take me thorough about where you have trained for teaching and for how long?
2. How long have you been in the teaching field?
3. Which were your subjects for specialization subjects during your training as a teacher?
4. How long have you been teaching natural science in grade 7 from all years of teaching experience?
5. What is your teaching qualification with regard to natural science/life science? List them.
6. Is there any of your qualification related to natural science?
7. Do you intend furthering your studies or are you currently studying?
8. Which field are you intending to study or which one are you currently studying?

Phase 2: Post observation.

9. What is practical work?
10. How can you explain practical work in your own words?
11. As teachers, we all act *inlico parentis*. How do you make sure that learners are safe?
12. How do you cope?
13. Which precautions and safety measures do you apply when doing practical activities?
14. Realizing your inability in practical activity, how do you relate the pace setter to the work schedule for natural science in grade seven?
15. As unqualified teacher in the NS, how effectively can you teach practical work in natural science?
16. How do you integrate theory into practice?
17. Since your inception in the subject, which skills or areas do you want to be developed?
18. How many practical works are prescribed per term per year in natural science grade 7?
19. Which types of practical work do you know?
20. Which practical activities are you most challenged at.
21. What types of practical activities have you done so far?
22. Are there any specific practical works you like most?

23. Why do you like those practical works if any?
24. Is there any mentoring or support that you are receiving?
25. If given financial assistance, can you pursue your studies in the field of science?
26. How do you conduct practical activity?
27. Which teaching method do you prefer when teaching practical activity?
28. Are there adequate apparatus for the practical work?
29. What do you do before planning your lesson presentation?
30. How do you design a lesson for a practical activity?
31. How many did you and your learners performed so far?
32. Why did you manage to do that number of practical work indicated above?
33. How do you manage your learners during presentation of practical activity?
34. Was there any challenge you encountered during presentation of this practical work and other presented before this?
35. If you were to change the way you have conducted this practical activity, what will you change and why?
36. What are the aims and objectives of doing practical work?
37. What is the aim of the practical activity you have done now?
38. Were you able to attainable the aim of the activity? If not, why?

APPENDIX: D
LETTER OF PERMISSION

10 February.2017

THE DISTRICT SENIOR MANAGER
DEPARTMENT OF EDUCATION
CAPRICORN DISTRICT
LIMPOPO PROVINCE
Tel N0:- 015 2956324

REQUEST FOR A PERMISSION TO CONDUCT RESEARCH STUDY AT THREE SAMPLED PRIMARY SCHOOLS IN LEBOPO CIRCUIT, CAPRICORN DISTRICT, LIMPOPO PROVINCE FROM DEPARTMENT OF EDUCATION.

TITLE OF STUDY: EXPLORING HOW SENIOR PHASE TEACHERS CONDUCT PRACTICAL WORK IN NATURAL SCIENCE IN LEBOPO CIRCUIT, LIMPOPO PROVINCE IN SOUTH AFRICA.

Dear Sir/Madam

I, **Khutso Charles Mogale** am doing research study with Prof. A.V. Mudau, a professor in the department of Science and Technology Education towards a master's degree in Education (M. Ed.) at the University of South African. We are inviting you to participate in a study entitled "Exploring how senior phase teachers conduct practical work in Natural Science in Lebopo Circuit, Limpopo Province in South Africa". The aim of the study is to explore how senior phase teachers conduct practical work in Natural Science especially the unqualified teachers and the novice teachers preferably in grade seven. I hereby write to request for permission to conduct a study from the Department of Education, Capricorn District, and Limpopo Province in Lebopo circuit.

This will enable the researcher to gather the data through interviews and observations that will help him in the investigation. This study will entail the collection of data from the three sampled schools in Lebopo circuit. The study will enable the researcher, participants (grade seven Ns teachers), SMT and the Principals to know the impact of teaching practical work in Natural Science especially grade seven and how this help to motivate teachers and learners in converting theory into practice in their everyday life. There is absolutely no risk in the conduct of the research. The final research findings can obtained by contacting the researcher at: - 0737639451/0729305931, email: - khutsomogale7@gmail.com.

Yours Sincerely
Mogale KC (Researcher)

APPENDIX E

APPROVAL LETTER FROM THE DEPARTMENT (DoE)

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

Ref: 2/2/2 Enq: MC Makola PhD Tel No: 015 290 9448 E-mail:MakolaMC@edu.limpopo.gov.za

Mogale KC
University of South Africa
Pretoria
0001

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH

1. The above bears reference.
2. The Department wishes to inform you that your request to conduct research has been approved. Topic of the research proposal: **"EXPLORING HOW SENIOR PHASE TEACHERS CONDUCT PRACTICAL WORK IN NATURAL SCIENCE IN MANKWENG CLUSTER CIRCUITS,LIMPOPO PROVINCE IN SOUTH AFRICA".**
3. The following conditions should be considered:

3.1 The research should not have any financial implications for Limpopo Department of Education.

3.2 Arrangements should be made with the Circuit Office and the schools concerned.

3.3 The conduct of research should not anyhow disrupt the academic programs at the schools.

3.4 The research should not be conducted during the time of Examinations especially the fourth term.

3.5 During the study, applicable research ethics should be adhered to; in particular the principle of voluntary participation (the people involved should be respected).

REQUEST FOR PERMISSION TO CONDUCT RESEARCH: MOGALE KC

CONFIDENTIAL

Cnr. 113 Biccard & 24 Excelsior Street, POLOKWANE, 0700, Private Bag X9489, POLOKWANE, 0700
Tel: 015 290 7600, Fax: 015 297 6920/4220/4494

The heartland of southern Africa - development is about people!

APPENDIX F

ETHICS CLEARANCE CERTIFICATE FROM ETHICS COMMITTEE (UNISA)

UNISA | university of south africa

UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2017/06/14

Ref#: **2017/06/14/31144187/5/MC**
Name: Mr KC Mogale
Student#: 31144187

Dear Mr Mogale,

Decision: Ethics Approval from 2017/06/14 to 2020/06/14

Researcher:

Name: Mr KC Mogale
Email: Khutsomogale7@gmail.com
Telephone#: 073 854 6628

Supervisor:

Name: Prof AV Mudau
Email: mudauav@unisa.ac.za
Telephone#: 012 429 6353

Title of research:

Exploring how unqualified Senior Phase teachers conduct practical work in Natural Science in Lebopo circuit, Limpopo province in South Africa

Qualification: M Ed in Science and Technology

Thank you for the application for research ethics clearance by the UNISA College of Education Ethics Review Committee for the above mentioned research. Ethics approval is granted for the period 2017/06/14 to 2020/06/14.

The low risk application was reviewed by the Ethics Review Committee on 2017/06/14 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.

The proposed research may now commence with the provisions that:

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
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APPENDIX: G

A LETTER REQUESTING PERMISSION FROM THE PRINCIPAL TO CONDUCT RESEARCH

10 February.2017

THE PRINCIPAL
Subiaco Primary school
Private Bag X9733
Polokwane

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT YOUR SCHOOL

TITLE OF STUDY: EXPLORING HOW SENIOR PHASE TEACHERS CONDUCT PRACTICAL WORK IN NATURAL SCIENCE IN LEBOPO CIRCUIT, LIMPOPO PROVINCE IN SOUTH AFRICA.

Dear Madam,

I, Khutso Charles Mogale, am doing research study with Prof A.V. Mudau, a professor in the Department of Science and Technology Education towards a Master's degree in Education (M Ed.) at the University of South Africa. We are inviting you to participate in a study entitled "Exploring how senior phase teachers conduct practical work in Natural Science in Lebopo Circuit, Limpopo Province in South Africa". The aim of the study is to explore how senior phase teachers conduct practical work in Natural Science especially the unqualified teachers and the novice teachers preferably in grade seven. I hereby write to request for permission to conduct a study from your school as one of the three sampled in Lebopo circuit. Your institution has been selected because of their location in Lebopo circuit which is one of Mankweng cluster circuits, Capricorn district in Limpopo province and the researcher would like to explore how senior phase teachers conduct practical work in Natural Science preferably by grade seven teachers.

The study will entail interviewing and observing grade seven Ns teachers about how to teach practical work in a classroom situation. Document analysis will also be administered to verify as whether the policy documents and observation record sheet do speak to the learner about practical work and the quantity of the practical work is done and prescribed for Natural Science in the senior phase. The study will be of beneficial as it will help the teachers, SMT and the Principals to have cleared understanding and the importance of doing practical work more often by both the teachers and learners as prescribed in the policy. This will be essential and of useful in their daily routine. There is no harm and no potential risk is anticipated. This study will not cause any severe risk or negative physical, emotional, social, cultural or political consequences to the participants. Feedback procedure will entail contacting the researcher if you would like to be informed of the final research findings. Please do not hesitate to contact Khutso Charles Mogale on +27737639451or +27729305931, 0r E-mail:khutsomogale7@gmail.com

Yours sincerely

____

Mogale KC (Researcher

APPENDIX H:

A LETTER REQUESTING AN NS TEACHERS TO PARTICIPATE IN AN INTERVIEW

TITLE OF STUDY: EXPLORING HOW SENIOR PHASE TEACHERS CONDUCT PRACTICAL WORK IN NATURAL SCIENCE IN LEBOPO CIRCUIT, LIMPOPO PROVINCE IN SOUTH AFRICA.

Dear Madam/Sir,

This letter is an invitation to consider participating in a research study, I Khutso Charles Mogale am conducting as part of my research as a Master's student at the University of South Africa, entitled "Exploring how senior phase teachers conduct practical work in Natural Science in Lebopo Circuit, Limpopo Province in South Africa". Permission for the study has been given by the school University of South Africa and the Ethics Committee of the College of Education, UNISA. I have purposefully identified you as a potential and possible participant because of your valuable experience and expertise as related to the nature of my research topic.

I would like to provide you with more information about this project and what your involvement would entail if you should agree to take part. The importance and the positive impact of practical work in Science education is of essential, substantially and well recommended by scientists world-wide. In this interview I would like to have your views and opinions on this topic. This information can be used to improve the implementation of practical work by Natural science teachers and learners in schools and society. Your participation in this study is voluntary. It will involve observation and an interview of approximately 5 minutes during pre-observation and about 20 minutes length during post-observation to take place in a mutually agreed upon location at a time convenient to you. You may decline to answer any of the interview questions if you so wish. Further, you may decide to withdraw from this study at any time without any negative consequences. With your kind permission, the interview will be audio-recorded to facilitate collection of accurate information and later transcribed for analysis. Shortly after the transcription has been completed, I will send you a copy of the transcript to give you an opportunity to confirm the accuracy of our conversation and to add or clarify any points that you wish. All information you provide is considered completely confidential. Your name will not appear in any publication resulting from this study and any identifying information will be omitted from the report. However, with your permission, anonymous quotations may be used. Data collected during this study will be retained on a password protected computer for twelve months in my locked office. There are no known or anticipated risks to you as a participant in this study. If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please contact me at Subiaco Catholic Primary school in Subiaco Mission at Baromeng Village on: +27737639451or+27729305931or khutsomogale7@gmail.com.I look forward to speaking with you very much and thank you in advance for your assistance in this project. If you accept my invitation to participate, I will request you to sign the consent form which follows.

Yours sincerely

Mogale KC (Researcher) ______________________________

CONSENT FORM

I have read the information presented in the information letter about the study on exploring how senior phase teachers conduct practical work in Natural Science in Lebopo Circuit, Limpopo Province in South Africa. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted. I am aware that I have the option of allowing my interview to be audio recorded to ensure an accurate recording of my responses. I am also aware that excerpts from the interview may be included in publications to come from this research, with the understanding that the quotations will be anonymous. I was informed that I may withdraw my consent at any time without penalty by advising the researcher. With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

_______________________	_______________________
Participant Name (Please print)	Researcher Name: (Please print):
_______________________	_______________________
Participant Signature :	Researcher Signature:
_______________________	_______________________
Date:	Date

APPENDIX I

TRANSCRIPTION OF THE FIRST PARTICIPANT PRESENTATION (CASE 1)

Names used here are pseudo names.

Mrs Bofea started by greeting the learners. Good morning class, learners replied,"morning Mam" class. We are going to investigate how types of energy is transferred in a thermal system, and you must remind that, energy cannot be created nor destroyed but can be transferred from one form to another. We are going to investigate through practical work as how transfer of energy is done. Re ile go bona gore e transfera jwang this energy, akere. We cannot say we created energy. Thermal system is a transfer of electrical potential energy to heat energy. We are going to investigate how thermal system (i.e. potential energy is transferred into kinetic energy and also to heat energy. I want a group of five learners to come forward for the demonstration of the practical. Learners were ordered to do practical activity although there was no first demonstration by Mrs Bofea. She introduced apparatus, we have the following apparatus as you see them on the table, are electric kettle, water, cup of soup, hot plate, aluminium pot, a wooden spoon, electrical cord/ extension. She plugged hot plate on the wall plug and switched it on. What are the input and output? She asked. Learners replied "potential energy and kinetic energy" Yaahhh.. the input energy is the electrical potential energy and the output is the heat energy re ya kwanaaa? Learners replied "yes Mam" then one learner from the first group pour and stir the soup into the pot with warm water. Water did not boil due to malfunctioning of the electric kettle they were using. Mrs Bofea continued with teaching while learners are waiting for a soup to boil. She continued, there are different types of potential energy and what are those? Learners' named them in a quire form:

1. Elastic potential energy,
2. Chemical potential energy,
3. Gravitational potential energy, and
4. Electrical potential energy.

Mrs Bofea asked learners "where does the electrical potential energy comes from in case of our practical activity?" one learner replied " it comes from the hot plate" Mrs Bofea said "No., it comes from electricity that is travelling through the electrical cord to the stove". Mrs Bofea called other learner to order by saying "A fa lena le rene Matala?" Mrs Bofea asked, "from what you have observed, how was the electrical potential energy transferred into heat energy?" learners did not respond, then Mrs Bofea gave them an answer, "heee! banna, electrical potential energy is converted into heat energy when the plate of the stove started to become hot and eventually got red, and we said you cannot create energy akere!, the energy can be converted, so that electrical potential energy is converted tooo…..? according to our practical? It is converted to heat energy. Le a e bona akere? In which way?, e convertible/, in which way or L e e bone bjang gore is converted into heat energy?, ga se ra e creator akere!, electrical potential energy is converted into heat energy. She said,“ it is converted e tswa ele go,,, from an electrical energy in which way? Gape le lena le emego mo pele re tlile go araba ka moka. Iyeeh!, bolelelang godimo, hee!, by switching on the stove, And then when it is on, the hot plate becomes hot, that is where we are having… mmhh thee… re bona kang?, then energy, so where does the heat energy go, hee?. Where does the energy go?,, Segooa o na le rena? Mrs Bofea cautiontise the learner to behave. Mrs bofea repeated the question, “where does the energy go? hee? A go bolele o tee, Morongoa,(name of the learner) when does this energy go, gape go no bolela batho ba tee ka mo, eeh! Kadiaka?” the learner replied, “the energy goes to the pot”. O mongwe o reng? Morongoa!, learner replied, “the heat energy is transferred to the bottom or base of the pot.”mrs Bofea agreed with the learner by saying, “ Eee Le a e bona?” all leartners then said, “Eee Ma’m”. Mrs Bofea asked one of the learner as whether he is listening, ‘le na le rena mouwe naa Mamabua, e tse ka mo morago o lebeletseng? A kere a go buka? “ She told them that,” You must refer from note tsela tsa kgale.”

The first group is ordered to prepare a soup, Mrs Bofea said,”a ke tsebe gore meets a gona a gona a setse a betse naa? Meaning she is not quite sure as whether the water has boiled at that time because they had a problem with a kettle. Can you prepare a soup?, asked Mrs Bofea. E doing e tshela ka moka, meaning just pour it all in the pot, said Mrs Bofea. Other learners was observing while that group of five learners were busy preparing a soup. Mrs Bofea asked, “What is it that you are observing in the pot?” she also checked in the pot. The learners were ordered to keep on starring while Mrs Bofea continued to teach. The leader of the group notified Mrs Bofea that the soup is boiling slowly. Mrs Bofea told learners that,”we are having three types of variables. What are those variables?, learner kept quite. Mrs Bofea repeated her question but learners seemed to forgotten the variables. Mrs Bofea to them that “we have three variables namely: control variable, independent variable, and dependent variable.” Mrs Bofea asked, “Can you please differentiate between the three variables? Distinguish or explain how do they differ, what is a control variable if we can start by referring from our practical?” learner said that a control variable can be decreased or increased. Correct! Mrs Bofea said. What about the independent variable? One learner said that the independent variable is standing on its own not affect by anything. Yuhh.. said Mrs Bofea. She asked about the dependent variable and no one tried to answer. Mrs Bofea explained, “ dependet variables are variable depending other other variables. These variables we dealt with them in term one , do you still remember?, Seakga?(name of the learner) reboletse ka tsona ka term one, Seakga dependent variables ke tsa mohuta mang from our practical? Gape re di dirile ka term one, kgane e re sa di diye le lena?” she tried to emphasise that variables were treated in term one together but the learner do remember. Ok said Mrs Bofea, “what are the variables here in our practical activity? Ke dife, go ya ka diapparatus tsa rena? So that re tle re kgone go ntsha , dependent, independent, and control variables. Hee! Learner were mumbly, e nye? Said Mrs Bofea. Rena le stove, pot, soup, heat in the form of energy, circuit,…. Ge re bolela ka control variable ke variable tseo e leng gore you can change them. Independent variable ke tseo e leng gore tsona di e kemetse k abo tsona self, meaning they cannot be regulated akere! Le a kwa naa, meaning do you understand?, and the dependent variable depend on the other variables. Sooo.. go tla araba lena le lego mouwe grouping.”

Mrs Bofea started posing question around what has been observed on the progress of their practical activity. “What is happening? What have you observe so far?” one learner replied, “the soup is moving and bubbling”. What else? asked Mrs Bofea.”Ye nngwe le bona eng, what else or what have you notice from the beggining?, Mabala! Pick up your voice so that everybody can hear what you are saying.” Mabala replied, “The soup becomes bigger” yesss… mongwe a ka reng? From thre begging ge re thoma mola, go be go diregang? Is there any change?, asked Mrs Bofea. Learner replied, “The soup has changed from powder to liquid.” In which way, ga le bone selo Mokgoba?, le bonang Mahula?, asked Mrs Bofea. Mrs Bofea then changed the group and chose another pair of five learners to come and observe. The next came and observe. Mrs bofea continued to ask them questions while they are observing. What are your observations, Natasha? Asked Mrs Bofea. Natasha replied, “The soup is thick.” Ke ka mokgwa woo a e boneng akere, said Mrs Bofea. O mongwe le o mongwe o bolela yeo a e observang, meaning everyone says what he/she observed, said Mrs Bofea. O mongwe?, asked Mrs Bofea. Then Mrs Bofea asked one of the learner specifically “Maphurane!” and maphurane rplied, “the soup is boiling”. Yees.. ,then “O mongwe o reng?”, asked Mrs Bofea. She continued by asking questions, “ go na le ntwe ye nngwe hle! Bolelang go nang?, what is it that you observed?, ga le bone selo? Eehhh… Mahlatse re botse.” Mahlatse replied, “The powder has dissolved.” Another learner was asked, She answered, “The soup has change into liquid.” Go ra gore ke di states of matter.” Ngobeni ?, asked Mrs Bofea. Ngobeni replied, “The soup is hotter.” Yess.. the soup is now hotter, o mongwe yene o reng or o boning?, asked Mrs Bofea. One learner raise his hand, re botse, said Mrs Bofea. Then the learner answered,”the soup is getting cooked.” Ok dulang fase, said Mrs Bofea.

Mrs Bofea started to remind the learners about what she said at the beginning of the lesson. “Do you still remember gore naa re rile eng ka thermal system, meaning do you still remember what we said about thermal system? We said thermal system is the transfer of potential energy into heat energy. So in the activity is the transfer of heat energy from the stove to the base of the pot, from the base of the pot to the soup inside the pot, and the soup started moving and when it is moving, this movement energy is called kinetic energy. Where is the potential energy stored, according to our practical activity? In thee… in the pot, heehh! In the pot? Nope, in the stove said Mrs Bofea." The learner were asked to name all possible areas where the potential energy comes from, then the res[pond that like this, " electrical potential energy is stored in electricity, and potential energy is also stored in the stove before the stove can be put on, and again potential energy is also stored in a soup inside the pot. " Correct, go ra gore potential energy was stored in the stove, in the soup and in the electricity akere!." Said Mrs Bofea. She further explain that energy is transferred from the electricity as electrical potential energy into heat energy as the stove got hotter, and this heat is also transferred into the pot as heat energy, and when the heat energy reached the soup in the pot, the soup get hotter, it boiled and eventually started moving, thus heat energy is transferred into kinetic energy which is energy in motion. Re a kwanaa?, meaning are we on the same page?, asked Mrs Bofea. Maredi? Re ya kwana naa? , retiriated Mrs Bofea. Mrs Bofea Explained, "ka kinetic energy re bolela ka movement, then ka potential energy re bolela ka di objects tseo di lego at rest, not moving at all. Di kwagetse? Is there any question? Ga gona potsiso? Ok."

Mrs Bofea asked, "According to our practical, can you give me eeehhh.. the independent variables, dependent variables, and control variables? Mmaratha?", then Mmaratha answered, "The independent variable is the stove, the heat energy from the stove is a control variable, and the dependent variable is the soup" in which way is the soup dependent variable?, asked Mrs Bofea. " Ke bo mang ba bangwe ba rego soup is dependent variable?, asked Mrs Bofea. She said to the learners, " Aowaaa..!ga pe a se Mmaratha a le tee yo a arabang ka mo classeng?, lena ba bangwe? Ok what happened to the soup when we increase or decrease the heat of the stove? Mathipa? , " mathipa, replied, "when we increase heat of the stove, the soup starts boiling and moving, and when we decrease the heat of the stove the soup slow down and stops." Natasha, wena what do you say, asked Mrs Bofea. Natasha said, "When we increase the heat, the temperature rises." In this way we are talking about temperature, yesss.. said Mrs Bofea. She also asked, "What is temperature? Learners kept queite for a while, but one learner stood up and say that temperature is how hot or cold the place is. Mrs Bofea congradulated the boy, "Good my boy! , sooo.. when we increase the temperature of the stove, the temperature of the soup also increases. So then temperature of the soup is dependent variable because it depends on the temperature of the stove. Di kwagetse?" Mrs Bofea summarised by saying, " is there any question?, so you can see that in a stove plate we are having potential energy, and when the soup starts boiling re bolela ka the kinetic energy and you can also see that the heat energy from the stove is transferred to the base of the pot and to the soup which is transferred into the kinetic energy when the soup boils, and here re bolela ka thermal system, le a bo naa!. Thank you very much."

OBSERVATION SCHEDULE

Part one: General information

Observation Date: 01/09/2017			**Researcher's name: Mogale Khutso Charles**	
School(pseudonym): messiah primary			**Teacher's name(pseudonym): Mrs Bofea**	
Term: 3 Grade: 7	**Learners :68**		**Subject: NS**	**Strand/theme : Energy and change**
Name of the practical activity: Investigating how potential energy is transferred into kinetic energy in a thermal system.				
Aim(s): To investigate the transfer of energy in a thermal system.				
Period no.: 4	**Start time: 09h27**	**Time ended: 09h57**	**Duration: 30 minutes**	

Part two: CLASSROOM INTERACTIONS AND DISCOURSE

Statement	**Researcher's comment**	**Participant's comment**
.Evidence of the lesson preparation for the practical activity. To check the aim and objective to be attained in the practical activity.	**No lesson plan**	
. The strengths of the teacher in presenting practical activity.	**Moderate**	
.The outcome of the practical activity attained.	**Yes**	
. The results were properly recorded by learners on a record sheet.	**No**	
.The teaching method(s) used?	**Explanatory, discovery , and demonstration methods**	
.The involvement of learners in the lesson activity.	**It was learner centred**	
.The practical activity was learner-centred or teacher centred.	**Yes**	
.How the teacher monitored and facilitated the practical activity.	**A little beat challenge because of some technicality of not boiled water.**	

. Time-takers were individually attended to and adequately assisted.	**Learners were in group participating in group.**	
.Documents used: e.g:- Textbooks, Policy document, observation sheet, e.t.c	**Textbook**	
.Apparatus used, if any	**Electric kettle, hot plate, soup, cup, water, alluminium pot,and electrical extension cord.**	
.Teacher content knowledge, pedagogical knowledge and skills.	**Less content knowledge, but good methods used, she still needs skill development**	
.Learners' scientific and investigative skills developed.	**Still needs to be inculcated**	
.Precautionary measures were given to the learners in advance and displayed on the wall.	**No**	
.There is a well-organized laboratory or the teacher is improvising.	**No**	
. If not, is the classroom adequate for teaching and learning e.g. is the space conductive for learning and fit for classroom practice?	**No**	
17. Interaction, involvement and opportunity to handle apparatus.	**Some learners had an ample opportunity and have touch and handle the apparatus.**	
18. The Learners adapted to the changes, demonstrate good group work skills, and confidence	**No.**	
19. Were the aims attained?	**Yes**	
20. Engagement of learners in high order thinking	**Only gifted learners were able to answer questions pose by Mrs Bofea.**	
21. The challenge of the teacher if any:	**Water did not boil on time seemingly there**	

	was an electrical dysfunction of the kettle.	
22. Any challenges from the learners.	**Learners could not see what was in the pot simultaneously because they had to come in group using only one pot.**	
23. Were those challenges addressed?	**No , lack of resources**	

NB: - The participant did not have chance for comments, she said, its ok. She does want to make comments. All teachers were supposed to hold R & R (rationalization and redeployment) meeting in the staffroom. All teachers were ordered by the principal to attend the meeting without failure.

INTERVIEW SCHEDULE

Phase 1: Pre-interview.

1. Could you please take me thorough about where you have trained for teaching and for how long?
   Kwena-Moloto college of education, for a duration of three (3) years.

2. How long have you been in the teaching field?
   For fourteen (14) years.

3. Which were your subjects for specialization subjects during your training as a teacher?
   Mathematics and physical science as I was doing STD, secondary teachers' diploma.

4. How long have you been teaching natural science in grade 7 from all years of teaching experience?
   Eeeh…. Ke reng? Gape ke dimonths moes, from first term, its eight months

5. What is your teaching qualification with regard to natural science/life science? List them.
   No, maybe talking about ace? No.

6. Is there any of your qualification related to natural science?
   No, it’s only mathematics and physical science.

7. Do you intend furthering your studies or are you currently studying?
   Currently study.

8. Which field are you intending to study or which one are you currently studying?
   BEd. Hons, mathematics.

Phase 2: Post-interviews.

9. What is practical work?
   Practical work?.. hee!. When you are using the apparatus, mmmhhhhh… using apparatus, ga e include???, ke gore ge o re what about kids o ra go reng? Ooh, they are using apparatus when their minds gona mouwe ba nagana gore….. Mmmhhh…. Ke tla ba bots aka taba ya gore naa… what are we going to investigate, and there after I say practical work is something learners do for themselves, ra e dira practically, and then diobservation, and then if can eehh… gee le gore go a kgonega oka di bonstha ka mokgwa wa di graphs or tables, and diclonclusion.

10. How can you explain practical work in your own words?
    When you are using hands and doing something with hands.

11. As teachers, we all act *inlico parentis*. How do you make sure that learners are safe?
    Huh! Ke yona loco parentis yeuwe?mmmhhhh… you must make sure that they are wearing safety clothes, maybe safety glass, dikokoloso, as a teacher you must make sure that chemicals are not dangerous to them. And then you must make sure that the classroom its eeeh… gore e be le ventilation, re tla e bea bjang?

12. How do you cope?
    I think when you do practical work the learners understand more than in theory,,, theoretically.

13. Which precautions and safety measures do you apply when doing practical activities?
    Youuuu… you give them the rules, no wet hands. I must make sure that they have too… don’t switch at the socket, b aba ba pluka. Ga ba swanela gore, le re ke

eng?, the body e be wet, any parts of the body a be wet. And then ba be baa pare… and ba se ke b aba in a barefoot. And then basomise di…. Di objects tseo e le gore they are good conductor of electricity.

14. Realizing your inability in practical activity, how do you relate the pace setter to the work schedule for natural science in grade seven?
No, but maybe if we do not have apparatus, we improve, I work in line with pace seaters.

15. As unqualified teacher in the NS, how effectively can you teach practical work in natural science?
Just referring in the textbook, the way ba bontshitsego ka gona, from steps by step following instruments/steps.

16. How do you integrate theory into practice?
I will take that theory and do it practical so that they can see that we talking about life living.

17. Since your inception in the subject, which skills or areas do you want to be developed?
E na nto tsona tse? E nyaka eng? E nyaka ditopikhi?, le yena ya planet beyond, gee le gore….. e tse variations it is a topic akere, e wela life and living akere, planet,,, earth and beyond as a whole and ka mouwe life and living o tsea topic ya variation.

18. How many practical works are prescribed per term per year in natural science grade 7?
One, one per term.

19. Which types of practical work do you know?
Wa tseba ke tlo bolela ye ya di acids ke yeo ke e dirileng. Ooh! Ye. ye kgane bjale ya term 3. Go ra gore its two.

20. Which practical activities are you most challenged at.
Planet earth and beyond.

21. What types of practical activities have you done so far?
-Acid a base.
-insulating.
-thermal system.

22. Are there any specific practical works you like most?
Mmhhhh…. Yah yona ye ya di acids and base.

23. Why do you like those practical works if any?
A kere, when you are using,, the indicator e le gona go bontshe the acids and the base o di bona interms of colour change.

24. Is there any mentoring or support that you are receiving?
No

25. If given financial assistance, can you pursue your studies in the field of science?
Yes

26. How do you conduct practical activity?
Mmmhhh…. Ke tla ba bots aka taba ya gore naa… what are we going to investigate, and there after ra e dira practically, and then diobservation, and then if can eehh… gee le gore go a kgonega oka di bonstha ka mokgwa wa di graphs or tables, and diclonclusion.

27. Which teaching method do you prefer when teaching practical activity?
Explanatory, discovery, and demonstrations. Thereafter w aba botsa gore o di bona bjang gore this substance ke di acids or base and there after wa di demonstrate.

28. Are there adequate apparatus for the practical work?
No

29. What do you do before planning your lesson presentation?
To understand the topic, read the books, plan and prepare.

30. How do you design a lesson for a practical activity?
Before we have to collect the apparatus, wa di set-uper and thennn…. Wa di ang?

31. How many did you and your learners performed so far?
I think they are enjoying it, they are enjoying the practical, and I think they understand more than when I teach it, doing theoretical.

32. Why did you manage to do that number of practical work indicated above?
I came here in a second term.

33. How do you manage your learners during presentation of practical activity?
Oohh…..eeehhh…. ke nyaka gore but le in groups, grouping.

34. Was there any challenge you encountered during presentation of this practical work and other presented before this?
How can I put it, because that other one e bee se na di challenges ka mokga woo. But the first one e bee se na di challenges ka mokgwa woo because le performance ya bond was good, ka mokgwa wo ba e dirileng. But this one, but this and one, second one, a ke tsebe, I think ba be ba lebetse, some mmmhhh.. re ka se re ke ditopics re tla re keng????, di terms, eee..yuhh..the terms, concepts e be di concepts.

35. If you were to change the way you have conducted this practical activity, what will you change and why?
I think after doing it theoretically, I don't want to take a long,,, there to do a practical, so e be theory-practical theory, do not take a long time.

36. What are the aims and objectives of doing practical work?
Ba bone the transfer of energy and how it is transferred, ba kgona go ntsha those variables

37. What is the aim of the practical activity you have done now?
To see transfer of potential energy into heat energy.

38. Were you able to attainable the aim of the activity? If not, why?
Ee

APPENDIX J

TRANSCRIPTION OF THE SECOND PARTICIPANT PRESENTATION (CASE 2)

Mr Rams greeted learners and distributed the record sheet for the practical work to be done and observed. Mr Rams said, “Good day learners”. Learners replied, “Good day Sir”. Mr Rams started teaching by saying,” In our last lesson, we talked about how heat can be transferred akere! Sooo, we said heat can be conducted through three ways. That is conduction, convection, and radiation, do you still remember neh? Right, soooo…today, we are going to see how heat can be transferred through conduction. We said conduction is well travelled from within products that are good heat conductivity”. Mr Rams continued to teach by saying today we are going to look at how different metal material conduct heat the best. So with me here I have the following apparatus: heat conductivity apparatus, water, Vaseline, spirit burner, three stop watches, match box, stand, drawing pins, three metals rods which are aluminium, iron, and brass. These metals rods are to be fitted and inserted into the heat conductivity apparatus with equal length. “Le a di tseba akere!” he went further explaining to the learners that they are going to look at how heat is conducted in aluminium rod, brass rod, and iron rod, “re kwana akere?” we are going to look as whether these metals conduct heat the same. “re nyaka go bona gore naa? Heat conductivity e tsamaya go swana naa? Akere!”

Mr Rams said, “sooo eehh... we are going see and make practical investigation akere! We will be able to investigate that eeehhh… just look at the materials that are going to be used.” He named the material like before as the following: spirit burner, le a e bona akere!, water, Vaseline, three metals rods of the same length and size, stand, drawing pins, match box, and heat conductivity apparatus. So in practical investigation, we can be able to give us that, eehh… look at the paper I gave you, will tell us what materials we are going to use. The materials that we need for heat conductivity akere! Sooo… I made some corrections and we are going to use the spirit burner. “So ro dira eng ka dilo tse ka moka ga tsona?”. Mr Rams explained all the proceeding during Practical work that was to unfold, “Number one, eeehh… ok! Eeehhh… we have to pour water in the heat conductivity apparatus, so we have the water in the heat conductivity apparatus, le a bona?

Again we must make sure that the metals rods, iron, brass, and aluminium are cut into same size and same length. He said, “go se be le rod ya go tsena kudu go feta tse dingwe and again we also make sure that the water that in the heat conductivity covers all the metals rods equally.arevwe together?” then Mr Rams told and show learners that the next step is to smear the same amount of Vaseline on the all the metal rods. He smeared the Vaseline on the rods and also put the drawing pins on top of the three metal rods smeared by Vaseline. “Mara why go di ra nna, go sa tlo dira wena, Matloga?"asked, Mr Rams. He continued to say, soo… we put drawing pins on the rods with smeared Vaseline, then we boil water…, then we boil the water….., right lets go on , we boil the water then, ok before we boil the water neh!. We have to start our stop watches at zero. Then what we are going to do here is that we boil water and we are going to observe and at different times at which the drawing pins fall from the metal rod first, second, and last. And again we are going to observe which pins is going to fall first from the Vaseline neh?this means that after the water has been boiled, the metals rods will get hot and the Vaseline will melt and the drawing pin will fall.

Then what we are going to do, we are going to observe from which the pins, from which metal rod will the pin fall first, second, and last neh!, then we are going to use our stop watches here, we are going to record whenever the pin falls, we stop the watch and we check from which metals rod will the pin fall first. Re a kwana? So the chosen three learner each one will face his metal rod for recording. Wa mathomo o emisa a recorder time, so we said this pins here we have from my left, it will be your right neh?, from your right will be iron, brass, and the last one here from my left will be aluminium pin, re ya kwana? So three learners must come forward and control the stop watches. So I am going to ask three learners here who can control the stop watch ke bo mang? O mongwe o tlile go emela brass, o mongwe ya ba wa aluminium and o mongwe ya ba wa iron. ke bomang? Right come. The three learners. You can start stop the stop watches. When I say start you start. So am going to ask the three learners here who can control the stop watches. Ke bo mang? The three boys came to the front voluntarily so. Then Mr Rams allocated each of them a stop watch and instructed them to reset it so as it start from zero point reading. You will start when I say start akere! Then re a di le belela ka moka akere.

As I lit the spirit burner for water in the conductivity apparater to boil, then you start. We are going to press the watches to start reading until the pin that is meant (chosen) for you falls off the metal rod and take recording, and so on until the last pin falls from the metal rod akere. Then when I put the spirit burner under the heat conductivity you start recording, right start. Mrs Rams instructed the recorders to start and at the same time instructed the rest of the learners to observe while continueing. Learners were observing. Mr Rams instructed the learners to look at the stop watch, you look at the pins, when it falls, right neh! Alright let us look at our paper (record sheet). So whenever we make an investigation, ge re dira investigation we want to find out something neh! And that is why we look for the questions for the things that we are trying to find out neh! Soo .. What is the thing that we are trying to find here? Re nyaka go bona eng? What it is that we are trying to find out? Re nyaka go bona eng ga botse botse? Learner replied; "We want to find out which drawing pin fall the first?" Mr Rams denied, we want to see which drawing pin falls the first? Nahhh.. yes Rampheri, Rampheri answered: "we want to see or find out which metal rod conduct heat the best" Mr Rams agreed.

Which metal rod conduct heat the best akere! Yes ga re nyake go bona gore go wa pini e fe pele . Yes we want to find out which Metal rod conduct heat the best. Yaah mo e leng go reng the drawing pin is going to fall first, it means that the metal rod conduct heat the best. So what is your prediction (guess), when we predict there is no wrong answer, we just guess akere, but later we verify our facts. Which metal rod will conduct heat the best huh? A learner replied; “brass”ok , so according to her the brass will conduct heat better than the iron and the aluminium. So everyone has his or her own guess. O mongwe le o mongwe o na le gues ya gagwe akere. So the practical task will show us eeeh which one will conduct heat the best. Right soo eeehhh now let us look at the variable. We look at the variable. The things that are going to arm or affect our investigation or practical activity. Mr Rams ordered learner to record the time as the first drawing pin has fallen. The first drawing pin fell from aluminium as confirmed by Mr Rams. So write the time on the chalk board next to the aluminium on top next to the aluminium. Yah the second pin fell from the brass. Write the time on the chalk board next to it. We record the time, that is, the minutes , the seconds , hours everything. Right we look at the things that are going to affect…. Right! We write the things that are going to affect our investigation. Yah the third pin which is the last, fell from the aluminium rod, so write the time on the chalk board. Right let us look at the things that are going to affect our practical investigation. Dilo tseo e elng gore di tlo affecta investigation y arena akere! So we called them ***variables.***

So we have the **independent variable**. Independent variables are the things that we can change. We can change them intentionally. So what are the things that we have change here/ re chantshishitse eng? There are some of the things that we have change here intentionally so , re chentshishitse eng? Learner replied: “ Ye changed the iron rod”. Mr. Rams disagreed. Another learner answered, “ we have changed the metal rod”. Yes we have changed the metal rod so agreed Mr. Rams. Mr. Rams list the second variable as the **control variable.** So control variables are the things that we keep the same. Dilo tseo di swanetsego gore di swane so that we can have a fair test or judgement. So what are the things that we kept the same here. Learner answered; “ The size and the lenghth of the three metal rods must be the same.” Eehhh.. just look at the paragraph on the paper. It says HINT or (what to do). Those are the things to consider. It says make sure that the arms of the metal conductivity rods are out by the same amount. Eehh these metal rods should be out of the heat conductivity by the same amount. Di swanetse gore ditswe ka go lekana. If the length one one metal is bigger or lesser than the other two metal rods, the will be no fair test or judgement. So the length of these three metals rods should be the same. So what else must be kept the same? Tse dingwe tseo di swanetsego gore di swane ke tse di fe? What else? huh! . There was a silent from the learners. Then Mr Rams went on. Eeehhh the second control variable is that we must smear the same amount of Vaseline on the three metal rods. So different amount of vaseline on the metal rods will not give us fair results. What else must be the same? a go sana engwe? What about the size of the pins? So these pins must also be of the same size, di se ke tsa ba tsa fetana. Right from this investigation, which metal rod conduct heat the best? Which one? Gape e le le gona ka mo ka moka ga lena akere Learner replied; “ aluminium rod conduct heat the best”! Yes aluminium is the one that conducted heat the best. So let us look at our findings now. Let us look at the time. So we saw that the drawing pin from aluminium took three minutes forty nine seconds (3,49 minutes) fell down. Then if we round this number to the nearest it will be 4minutes akere! So the drawing pin from the brass metal rod took roughly five (5) minutes akere! And the drawing pin from the iron metal rod took approximately eight (8) minutes akere! So from our findings we are going to draw a bar graph on our record sheet provided to you. You know how to draw a bar graph akere! So our bar graph will have the X-axis here and the Y-axis. Then the X-axis will show us the three different types of metal whereas the Y-axis will show us the time in minutes akere! Therefore you wil draw the three bars on each metal rods verses the time taken by pins to fall. This is how you are going the represent the findings of our practical investigation on the bar graph. Di a kwala akere! Right thank You…

OBSERVATION SCHEDULE

Part one: General information

<table>
<tr><td colspan="3">Observation Date: 01/09/2017</td><td colspan="4">Researcher’s name: Mogale Khutso Charles</td></tr>
<tr><td colspan="3">School(pseudonym): Maphurane Primary</td><td colspan="4">Teacher’s name(pseudonym): Mr. Rams</td></tr>
<tr><td colspan="2">Term: 3 Grade: 7</td><td>Learners : 78</td><td colspan="2">Subject: NS</td><td colspan="2">Strand/theme : Energy and change</td></tr>
<tr><td colspan="7">Name of the practical activity: To investigate if different metals conduct heat the same way</td></tr>
<tr><td colspan="7">Aim(s): To differentiate the heat conductivity of different rod metals</td></tr>
<tr><td>Period no.: 7 &8</td><td colspan="3">Start time: 12h00</td><td colspan="2">Time ended: 13hoo</td><td>Duration: 01hr.</td></tr>
</table>

Part two: CLASSROOM INTERACTIONS AND DISCOURSE

Statement	Researcher's comment	participant's comment
.Evidence of the lesson preparation for the practical activity. To check the aim and objective to be attained in the practical activity.	**Yes a lesson plan was provided to the researcher**	**Yes**
. The strengths of the teacher in presenting practical activity.	**Strong**	**Moderate**
.The outcome of the practical activity attained.	**Yes**	**Yes**
. The results were properly recorded by learners on a record sheet.	**Yes and learner were ordered to draw a graph of results**	**Recorded in as ahomework.**
.The teaching method(s) used?	**Explanatory, demonstration, telling, amswer&questions,**	**Combination of teaching methods**
.The involvement of learners in the lesson activity.	**Minimal involvement**	**Yah learners were involved.**
.The practical activity was learner-centred or teacher centred.	**Teacher-centred**	**both**
.How the teacher monitored and facilitated the practical activity.	**Questioning learners and demonstrating at the same time**	**Teaching and demonstrating.**
. Time-takers were individually attended to and adequately assisted.	**Time takers were visible as some learners were unable to answer some questions**	**Other learners helped time takers by giving correct answers.**
.Documents used: e.g:- Textbooks, Policy document, observation sheet, e.t.c	**Observation sheet, policy document, lesson plan**	**I used textbook, pace setter, policy document**
.Apparatus used, if any	**Spirit burner, three metals rods(alluminium, iron, brass) Vaseline, matches, stand, water, heat conductivity apparater, drawing pins,**	**Spirit burner, three metals rods, Vaseline, matches, stand, water, heat**

	stop watch.	**conductivity apparatus, stop watch.**
. Teacher content knowledge, pedagogical knowledge and skills.	**Has more knowledge of content and pedagogical.**	**I still need skill development program**
. Learners' scientific and investigative skills developed.	**No.**	**Yes , learner are able to differentiate the heat conductivity of metals.**
. Precautionary measures were given to the learners in advance and displayed on the wall.	**Yes, safety measures were displayed on the wall and read to learners.**	**Yah as displayed on the wall**
. There is a well-organized laboratory or the teacher is improvising.	**No**	**No , I just improvise**
. If not, is the classroom adequate for teaching and learning e.g. is the space conductive for learning and fit for classroom practice?	**No**	**No**
17. Interaction, involvement and opportunity to handle apparatus.	**Only three boys held stop watches.**	**No , due to lack of resources.**
18. The Learners adapted to the changes, demonstrate good group work skills, and confidence	**Learners were confidence.**	**Yah they adpted and were confident too.**
19. Were the aims attained?	**Yes.**	**Yah I can say absolutely**
20. Engagement of learners in high order thinking	**Learners were engaged and answered question which were difficult to others learners.**	**Answered difficult questions.**
21. The challenge of the teacher if any:	**Not all learners could come to the front and observe.**	**Lack of resources and overcrowded class of 72**
22. Any challenges from the	**Not able to observe**	**No enough**

learners.	**clearly.**	**resources.**
23. Were those challenges addressed?	**No,**	**None**

INTERVIEW SCHEDULE

Phase 1: Pre-observation.

39. Could you please take me thorough about where you have trained for teaching and for how long?
Soweto College of education for a period of three years.

40. How long have you been in the teaching field?
Twenty four years (24yrs).

41. Which were your subjects for specialization subjects during your training as a teacher?
I specialized in three languages that is sepedi, English, Afrikaans, and mathematics. We have additional specialization as Biology.

42. Meaning you specialized in five subjects?
Yes.

43. How long have you been teaching natural science in grade 7 from all years of teaching experience?
Eeeehh… I taught it for eighteen years (18yrs).

44. What is your teaching qualification with regard to natural science/life science? List them.
Currently am just about to complete Ace in natural science.

45. Is there any of your qualification related to natural science?
Not yet.

46. Do you intend furthering your studies or are you currently studying?
Yah, my intention is to further studies.

47. Which field are you intending to study or which one are you currently studying?
Currently not but intending to study science since there is a lack of science and math's teachers nowadays.

Phase 2: Post observation.

48. What is practical work?
Mmhhhh… I think practical work is just investigation to find a solution to a given problem.

49. How can you explain practical work in your own words?
Nooo, practical I think is the thing that learners are going to do it themselves to find the possible solution.

50. As teachers, we all act *inlico parentis*. How do you make sure that learners are safe?
Eeehhh… when doing practical, because we know some of these things can be toxin or some of these things the learners can be allergic to them. Sooo… we have some rules that when doing practical we have to set up. The rules and we find out from the learners who has some allergies, soo.. That we can handle them.

51. How do you cope?
Noo… some of them yes, they are unbearable because of lack of facilities, there are beat challenged but eiihh! Otherwise, I do not have problem with practicals at all.

52. Which precautions and safety measures do you apply when doing practical activities?
Eyahh…. heeii!, mmhhh….,sooo… sometimes, eeehhhh… they have to handle the materials that we are going to use with care because some are fragile, some of the things are poisonous, sooo.. I usually tell them that eeehh.. You have to handle these materials with care and if they need love, they are given love first.

53. Realizing your inability in practical activity, how do you relate the pace setter to the work schedule for natural science in grade seven?
Inability? To do practical? In my side no. I do not think so. Pace setters and work schedule I think they are related.

54. As unqualified teacher in the NS, how effectively can you teach practical work in natural science?
Nooo… this one, eehh besides, eehh…, this lack of resource, I think yahhh..but it is also a problem that lack of resources because learners need to be grouped in manageable groups, and I think these groups could work more effectively, sooo…

because of the lack of resources, we work with big groups and that is where lies a problem.

55. How do you integrate theory into practice?
Yaahhh, eeehhh… theory and practicals are matter related because you teach them what is going to happen or the see for themselves. They need practical and see for themselves what is happening, they give reasons of what is happening when are doing the practical part of it.

56. Since your inception in the subject, which skills or areas do you want to be developed?
Yaahhh…. The area, let say the area especially in natural science is the area of eehh.. Planet earth and beyond. I think I still need a lot of development in that part.

57. How many practical works are prescribed per term per year in natural science grade 7?
Eeeeehhhh… we do one practical for the first three term, eeehhh let say there must beee… ooh! Let say one per term and per year.

58. Which types of practical work do you know?
Eeeehh demonstrations, observations.

59. Which practical activities are you most challenged at.
Eeehh… it is the demonstration one, eeeehh demonstration. Sometimes the learner has to demonstrate just like in planet earth and beyond, like learners cannot do demonstration of the revolution.

60. What types of practical activities have you done so far?
I think eeehhh… I have done investigation, observation, and differentiation.

61. Are there any specific practical works you like most?
(Laughter) hehehe, nonono. I like them all, I enjoy doing practical. I cannot just single-one out.

62. Why do you like those practical works if any?
I enjoy doing practicals and I like them all klaar.

63. Is there any mentoring or support that you are receiving?
Mmmhhhhh, the support, no. I am still seeking the support. In mentoring I am ok.

64. If given financial assistance, can you pursue your studies in the field of science?

Yah, definitely. Yah because we lack teachers in this fields of science and mathematics. I think it will be more helpful to me.

65. How do you conduct practical activity?
Eeeh… practical work need preparation, you have to put the materials together, you have to know when to use which material. Then the designing comes with preparation. Hahaha (he giggled)…eeehhh you need to prepare and plan the investigation (practical activity).

66. Which teaching method do you prefer when teaching practical activity?
Eeehhh… practical activity, needs in fact, the method, I explained, explanation. Each group having their materials. Grouping but due to lack of resources, I have to do a lot of talking in class. Another method is questioning, doing, demonstration, and observation.

67. Are there adequate apparatus for the practical work?
Yes, for this one that we have recently done. But if I wanted to cover all learners at the same time noo… apparatus will not be enough.

68. What do you do before planning your lesson presentation?
I put my materials together, I compile my apparatus, I do pre-testing. When the term starts, we look at the things (Practical work) that you are going to do for the term, you check the pace setter, topics in the textbook and the work schedule.

69. How do you design a lesson for a practical activity?
You check what it is that you want to find out (investigate), you look for the topic and themes/strands.

70. How many did you and your learners performed so far?
Eyyaaahhh… I think, eeehhhh.. I was just average and my learners were also average.

71. Why did you manage to do that number of practical work indicated above?
I have done so many so far,, but the recorded and prescribed ones is three in number. Its thre because they are the prescribed ones but otherwise I have done so many informal practical work.

72. How do you manage your learners during presentation of practical activity?

No, my learners are very discipline, they enjoyed this lesson. So as long as the lesson is well prepared and well planned, learnerswill be disciplined because they want to see what is going to happen.

73. Was there any challenge you encountered during presentation of this practical work and other presented before this?
    Yah heeeii…. At this one because I brought everything,, no. yes challenging is sometimes a contextual factor like lack of apparatus. Just like the thermometer we are using, is not clinical, but is it too challenging to use. We need to buy a new digital thermometer.

74. If you were to change the way you have conducted this practical activity, what will you change and why?
    No, I think if I were to change, the only thing I had to change is myself doing the demonstration but this be done by the learners. But I did it due to the lack of resources.

75. What are the aims and objectives of doing practical work?
    Nah, we wanted to find out that eeehhhh, as whether, different metal materials conduct heat at the same rate.

76. What is the aim of the practical activity you have done now?
    The learners must find out and observe for themselves.

77. Were you able to attainable the aim of the activity? If not, why?
    Yes.

APPENDIX K
TRANSCRIPTION OF THE THIRD PARTICIPANT PRESENTATION (CASE 3)

CASE 3; MRS. DIKE   Names used here are pseudo names.

Mrs Dike greeted learners and she said: I am much disappointed that you did not perform the way I have anticipated. It pains me because you are going to fail. Ka gore I did introspection and maybe something is went wrong I do not know. So I have realised that you did not understand the concepts of kinetic energy and potential energy. And it worries me a lot because these things we do them every day. Did you have some breakfast today? Learners replied: “yes Mam” why did you aet that breakfast? Learners raised their hands to answer. Yes Suprice tell us, Suprice replied, “I was hungry” Ok o mongwe a ka reng? Yes Patience, Patience replied, “I wanted energy”. Yes,,, she wanted energy neh! Where do we get this energy from? Learner replied, “From the sun” some mob of learner wave their heads side by side showing that the answer is wrong. Yes but in the case of breakfast, where does this energy come from? A learner replied, “we get energy from the food we ate.” Yes my girl,, we get energy from the food that we ate this morning. And if we are to explain or if we are to define energy, what will we say? Yes Tebogo. Tebogo replied, “Energy is an ability to do work.”

Mrs Dike asked learners if there is anyone with any kind of a fruit. Learner gave Mrs Dike an apple. Mrs Dike asked: What type of energy is in this apple, a kere we said we must eat so that we have energy. She raised an apple up so that every learner could see it. One learner replied, “Chemical potential energy.” Mrs Dike asked: would anyone explain what is potential energy? Learner replied, “Potential energy is the energy stored in a system.” But an apple is not a system akere! Yahhh re botse Mashosho. Mashosho replied, “Potential energy is the energy that is waiting to be released.” Yes we said potential energy is the energy that is awaiting to be released akere!, yahh then o di ri leng? She has ate the apple akere! O e kgemile? Noo o e jele, then go ra go re the energy has been transferred. Fine, fine then kinetic energy. According to the law of conservation of energy, before we go to the kinetic energy, lets define law of conservation of energy. All learners responded, “Energy cannot be created nor destroyed but it can be transferred from one form to another.” Yes guys go ra gore you cannot create the energy nor to destroy the energy in that apple. You cannot create nor destroyed the energy but can be transferred from one form to another. Are we together guys? Learners replied, “Yes Mam”

You cannot create the energy, go ra gore the energy in that apple will stay the same until transferred to another form of energy. Right lets continue. Then when the apple is on the table, what kind of energy does it possess? Makgoba. Makgoba replied, “Kinetic energy.” Kinetic energy? Nooo… Makgoba. Other learner replied, “Potential energy” Yes potential energy is correct. Mrs Dike rolled that apple on the floor and the moves for a while. As the apple moves neh? What is that energy? Leaners replied, “kinetic energy” yes the kinetic energy, because the potential energy in the apple is decreased and transferred to kinetic energy akere but not completely transferred to kinetic energy. Mrs Dike asked one boy to climb on top of the table. The boy did that. Mrs Dike, Yes look at the boy. What is the type of energy is he possessing now? Learners replied, “potential energy.” Mrs Dike agreed. But once he jumps from the table and walks straight outside the door. So now he is walking towards the door, what kind of energy is that? Learners replied, “kinetic energy, Mam.” So you do understand when we say energy is converted from one form to another. So tell me, learners. How many types of system have we studied? I had one of you saying the energy is stored in a system referring to an apple akere! but there is no system in an apple.

By the way what is a system? One learner replied, “A system is the functioning together of two or more organs”. Perfect Sedibe, perfect my girl then how many systems did we study guys? Lesedi tell us, Lesedi replied, “There are five types of systems” Good my boy, So which are those systems? Learners answered, “Biological system, __that is when a girl eats a banana.

Mrs. Dike asked learner to make mentioned of all the types of systems: mechanical system, electrical system, chemical system, and biological system. 1. Mechanical system, __there should be pedals ….that is when a car ignitiate…..2. Electrical system, and when a torch light…..3. Chemical system,__ when sugar, tea bag and powder milk is poured into boiled water to make a tea. 4. Biological system---- when a boy eats a banana 5. Thermal system, When a soup is cooked on a stove.” Thus correct and the word thermal has to do with heat neh!, thermo means heat. Thermo.. thermal, it has to do with heat. The learner replied; stove… when we boil water the water is heated, while you are still on the stove, when you switch on the stove, a certain energy will be converted (transferred), what is that energy? Learner replied: an electrical energy will be converted to heat energy. Heei it’s a pity I am good in drawing. Mrs. Dike drawn a torch on the chalk both to illustrate how electrical energy is transferred from its form to light energy. When a torch is switched on the electrical energy is transferred to the light energy. The electrical energy travels through the wires to the bulb and the bulb starts glowing. You connect the cells to wires then the energy moves along the wires, inside the wire the current flows to the bulb, and what will happen to the bulb, then the bulb will glow ant that is how energy is transferred from one form to another. Thank you very much my dear boys and girls.. Sir wants to have a word with you.

OBSERVATION SCHEDULE

Part one: General information.

Observation Date: 19/09/2017		**Researcher's name: Mogale Khutso Charles**	
School(pseudonym): Thutong Primary		**Teacher's name(pseudonym): Mrs Dike**	
Term: 3 Grade: 7	**Learners :82**	**Subject: NS**	**Strand/theme : Energy and change**
Name of the practical activity:			
Aim(s):			
Period no.: 3&4	**Start time: 09h00**	**Time ended: 10h05**	**Duration: 1hr 5minutes**

Part two: CLASSROOM INTERACTIONS AND DISCOURSE

Statement	**Researcher's comment**	**Participant's comment**
.1. Evidence of the lesson preparation for the practical activity. To check the aim and objective to be attained in the practical activity.	**Yes aims attained.**	**Aim of the lesson attained**
.2. The strengths of the teacher in presenting practical activity.	**Able to demonstrate.**	**Presented the practical activity to her best ability**
.3. The outcome of the practical activity attained.	**Attained**	**Outcome satisfactory**
.4. The results were properly recorded by learners on a record sheet.	**No**	**No need for recording**
.5. The teaching method(s) used?	**Illustrative, demonstrative, questions&answer, discovery**	**Question&answer, demonstrative**
.6. The involvement of learners in the lesson activity.	**Were involved**	**Learners participated fully. They were so vibrant.**
.7. The practical activity was	**Learner centred**	**Learner centred.**

learner-centred or teacher centred.		**Learners performed. Teacher facilitated.**
.8. How the teacher monitored and facilitated the practical activity.	**Well monitored and facilitated**	**Teacher facilitated learning, rectify mistakes done by learners.**
. 9. Time-takers were individually attended to and adequately assisted.	**Yes**	**Assisted learners who experienced problems in answering questions.**
.10. Documents used: e.g:- Textbooks, Policy document, observation sheet, e.t.c	**Textbook , pace stter**	**Relevant documents were used. E.g policy doc, textbook etc.**
.11. Apparatus used, if any	**Apples**	**Apparatus used and displayed in dignified way.**
.12. Teacher content knowledge, pedagogical knowledge and skills.	**Adequate content knowledge, and methodology**	**Content knowledgeable, variety of skills used for effective learning.**
.13. Learners' scientific and investigative skills developed.	**Investigative skills developed.**	**Learners investigated and posed questions for clarity.**
.14. Precautionary measures were given to the learners in advance and displayed on the wall.	**Already on the walls**	**Yes**
.15. There is a well-organized laboratory or the teacher is improvising.	**No teacher improvised.**	**Teacher improvising. Lab is a classroom.**
. 16. If not, is the classroom adequate for teaching and learning e.g. is the space conductive for learning and fit for classroom practice?	**No, overcrowded**	**Overcrowded.**
17. Interaction, involvement and opportunity to handle	**Most learners able to handle apparatus**	**Learners interacted and some had**

apparatus.		**opportunity to handle apparatus**
18. The Learners adapted to the changes, demonstrate good group work skills, and confidence	**No group were done**	**No groups**
19. Were the aims attained?	**Yes**	**Yes**
20. Engagement of learners in high order thinking	**Yes**	**Engaged through questions**
21. The challenge of the teacher if any:	**Lack of resources**	**Lack of resources**
22. Any challenges from the learners.	**Not all were able to observe**	**Yes lack of resources**
23. Were those challenges addressed?	**No**	**No**

NB: - Mrs Dike was so free to comment on the observation schedule and she did not hesitate. She gave me an ample time even to do probing questions and she answered them explicitly so. I really enjoyed observing and interviewing her. Even the principal was so humble and she even requested that I must come back again to assist if Mrs Dike needed any assistance pertaining natural science in general in the near future. She even came to observe herself also but for some few minutes and she went to the Sgb meeting that was scheduled.

INTERVIEW SCHEDULE

Phase 1: Pre observation interview.

78. Could you please take me thorough about where you have trained for teaching and for how long?
    Yahh.. I trained at Naphuno college of education for three (3) years,I started my teaching career in 1993.

79. How long have you been in the teaching field?
    Mmmhh… 97…. twenty (20) years.

80. Which were your subjects for specialization subjects during your training as a teacher?
English, Sepedi, Physical science and Maths
What was the diploma called?
Senior primary teachers'diploma (SPTD)

81. How long have you been teaching natural science in grade 7 from all years of teaching experience?
Since I started teaching, I was teaching natural science maybe for about sixteen (16) years.

82. What is your teaching qualification with regard to natural science/life science? List them.
I am completing my ACE for natural science in four months to come.

83. Is there any of your qualification related to natural science?
Eeeyyyahhh…

84. Do you intend furthering your studies or are you currently studying?
Eeishh. Yes yes yes.

85. Which field are you intending to study or which one are you currently studying?
Particularly in math's and science department.
What are you doing currently? What are you registered for?
Management sciences on honors that B.Ed honors in management sciences.

Phase 2: Post-interviews.

86. What is practical work?
Practical work? What I do understand most about it is that you do things practically so. Concrete things, you display concrete things and not in a theoretically in a theoretical way. you must do it in a practical way so that the learners could understand much better. Errhh.. uhhmm.. they understand much better if they see, hear, touch things in a concrete way unlike in a theoretical way.

87. How can you explain practical work in your own words?
Do that in practice using your own hands.

88. As teachers, we all act *inlico parentis*. How do you make sure that learners are safe?

I just handle the learners the way I handle my learners, my learners, I mean my kids, my kids at home, uhhmm.. because I do not differentiate the two because they are my kids too. Then I have to see that whatever I applied on my kids, I also apply on my learners here at school.

You treat them as yours?
Yes I do discipline them the way I discipline my kids at home.

89. How do you cope?
Nooo! I cope well ‘cause practical work simplifies my work.

90. Which precautions and safety measures do you apply when doing practical activities?
I have to alert the learners that since well most of the things in science are chemicals, and when we deal with chemicals. I just alert them that they are too dangerous and then they should be handled with great good care. Like mercury for instance, I cannot let the learners to touch mercury with bare hands.

91. Realizing your inability in practical activity, how do you relate the pace setter to the work schedule for natural science in grade seven?
Errhh.. yes, they are related but I have to augment some others things there and there. I just cannot rely on them (pace setter and work schedule) alone.

92. As unqualified teacher in the NS, how effectively can you teach practical work in natural science?
As long as, as long as I bring concrete objects in class, then nothing will come on my way. The only challenge is when I do not have enough apparatus. The aim of bringing concrete things in the classroom is that, so that they could understand just better. The apple was one of the examples of the apparatus I was using in the lesson.

Where did you get that apple?
I asked it from one of the learners ‘cause I did not have mine.

93. How do you integrate theory into practice?
Firstly I have to find out if they have previous knowledge about what is to transpire and if they do have that, then I take it from there then I introduce the new topic. Like let say for example when I say: did you have some breakfast? And the learners replied “yes” and then the energy, the energy… where do you get have energy from? From the food that they have ate, then that is the theoretical. And there after I asked one learner to move around so for that particular learner to be

able to move around it is because he has the energy in him. This energy is kinetic energy (movement) but before kinetic energy the boy was at rest possessing stored energy which is called potential energy.

Can we switch over to K53 Mam?
iiiheee….! (Mrs Dike laughed) Now we are driving.

How do you relate theory into practice in terms of K53?
Heee… eish I teach them first K53. You inspect a car, you start(ignitiate) the car, after starting the car you select gear (number one), then you lift up and release the hand brick, then you observe, you buckle up, ok the machine heat the road.

What make the machine (car) to move?
Ok, I make deep clutch for selecting the gear one and after that I lift up my left foot on the clutch pedal and I accelerate with my right foot then the car start moving.

94. Since your inception in the subject, which skills or areas do you want to be developed?
Scientific terms, yahh I encounter problem with scientific terms. Because they --- they are not familiar ti the learners. Like when we say potential energy, yahh eish they learners are used to the word stored, then I have to go deeper. Like the movement is fine but when you say kinetic then they get a little beat confused…… eyyyahhh.

Generally in natural science which area gives you a problem?
Again the area that gives me a problem is that one of planet earth and beyond ‘cause thus where I encounter problem because I cannot use that is a practical way.like the only is just that the earth and to convince the learners that the earth is round and then the sun is not moving, only the earth is moving aaahhh… that one is a problem. Like the asteroids, I cannot go there and show them that in reality or practically so. Eisshhh it gives me a headcache you know! Eyyyahhh mo ke a switch coder. Maybe ge re ka yam o go batho ba re reng astronology. On me as the teacher it is still theoretical.

95. How many practical works are prescribed per term per year in natural science grade?
Eisshhh … I am not so sure but heeeiii.. they are many. Oooh! You mean the recorded ones? Oooh yes, yes .. the practical tasks neh? It is first term one, second term one, third term one, and fourth term one, oh that is one per term…. yahhh they are four per year.

96. Which types of practical work do you know?
Demonstrations, investigations, then we have got eeeeeh.. observation, last one is exploring and discovery.

97. Which practical activities are you most challenged at?
Exploring, and demonstration but in the part of planet earth and beyond

98. What types of practical activities have you done so far?
It's the demonstration, investigation, and observation. Like growth… investigating the growth part of a plant. How long does it takes to grow, many days the length of the plant, the colour of the plant when exposed to the sunlight and the one not exposed to the sunlight. Like when we investigate the transference of pollen grains between the female and the male cones.

99. Are there any specific practical works you like most?
Demonstrations, g eke demonstrate, well I demonstrate and I take it gore these learners they do understand most go phala ge ke no presenta in a theoretically way.

100. Why do you like those practical works if any?
Because learners understand much better through practical work. because learners observe for themselves or also if given an opportuniry ,,, learners demonstrate by themselves.

101. Is there any mentoring or support that you are receiving?
Nooo , I did not receive any mentoring except now that you(researcher) are here.

102. If given financial assistance, can you pursue your studies in the field of science?
Yes definitely,, definitely.

103. How do you conduct practical activity?
Errrhhh …alright I put all my ingridients and all apparatus. Ke gore I separate them and dipowder dipowdeng, diliquids diliquiding, and solids disoliding, and I categorise them.

104. Which teaching method do you prefer when teaching practical activity?
Eish normally I want to… to engage learners, question and answer I prefer that ke kgona go bona go re we are on the same page, unlike ke e ba teacher centred. Mara g eke thoma go ba learner-centred ke kgona go reng? Alright I pose questions most of the time, ooohh in practical yahh even in practical yes question and answer method. For example in Acids and bases. What is this? Is it acid or a

base? Learners must experiment, and discover for themselves, that is discovery method is used.

105. Are there adequate apparatus for the practical work?
Nope. I prepare and improvise for a lesson especially the practical work.

106. What do you do before planning your lesson presentation?
Put apparatus together, test them first, lesson plan, record sheet, evaluation.

107. How do you design a lesson for a practical activity?
I improvise especially materials.

108. How many did you and your learners performed so far?
Three (3) recorded practical work so far

109. Why did you manage to do that number of practical work indicated above?
As stipulated or prescribed by the policy and regulation.

110. How do you manage your learners during presentation of practical activity?
I group them. There should be a group leader, a scribber, time-taker, reporter and Nna I just facilitate.

111. Was there any challenge you encountered during presentation of this practical work and other presented before this?
Yes lack of resources

112. If you were to change the way you have conducted this practical activity, what will you change and why?
So that I do not be dominant (teacher centred). The lesson be learner centred to give them a chance to experiment and discover for themselves. I want to give them a chance to explore.

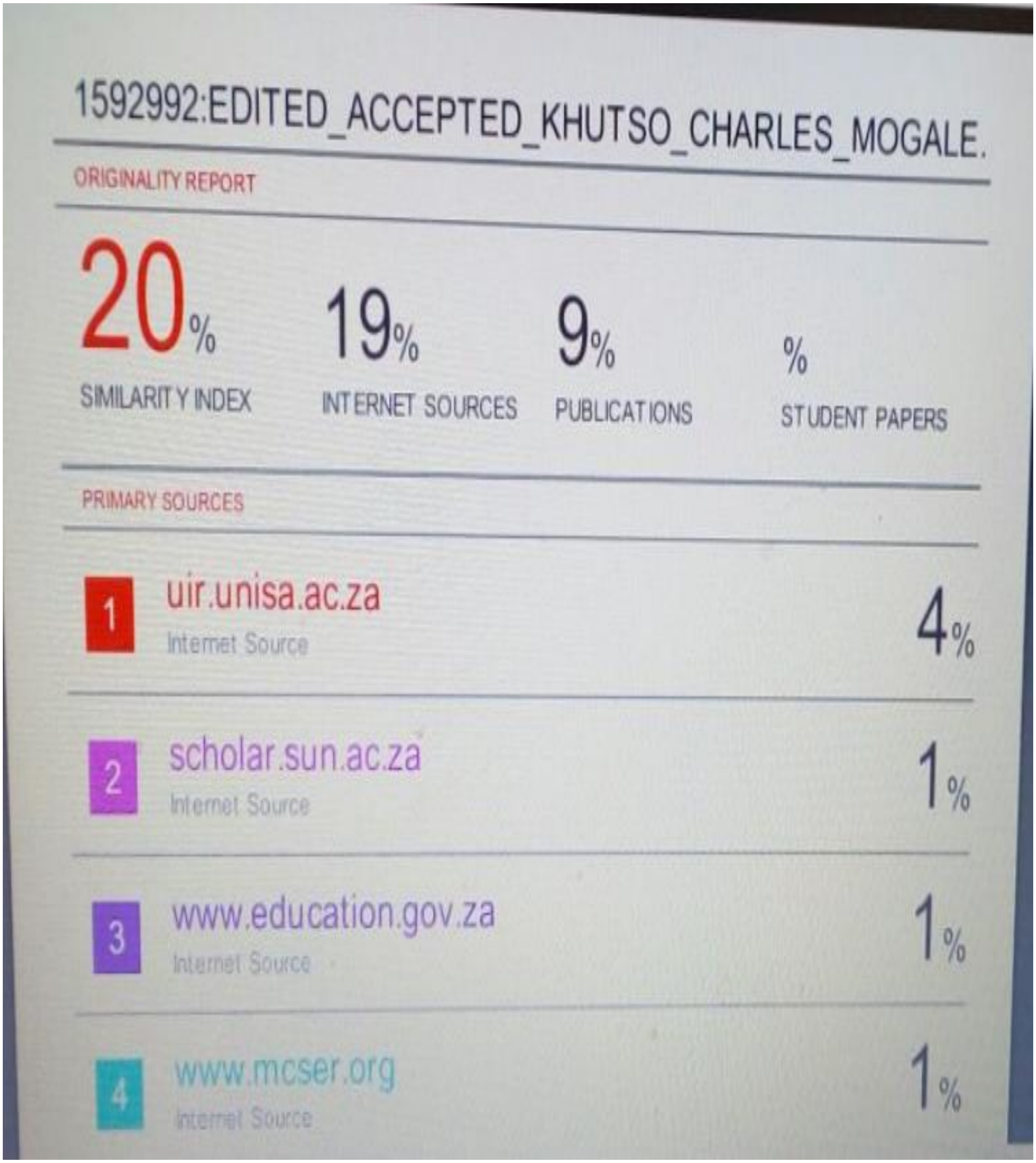
113. What are the aims and objectives of doing practical work?
For the subject matter to be well, well assimilated or well understood. That is the main objective.

114. What is the aim of the practical activity you have done now?
The aim is that I want the learners to move from the unknown to known. I want to instill the love of. I usually tell them that we do science every day… they even nicknamed me “science” hehehehe… (she giggled)

115. Were you able to attainable the aim of the activity? If not, why?
I can say not hundred percent (100%) but yes.

APPENDIX L

TURN IT IN REPORT



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Author:

MOGALE KHUTSO CHARLES

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