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Dissertation

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with the title:

Teachers' perceptions on the importance of practical work in the teaching and learning of Natural Sciences in Grade 9 at township schools

FACULTY OF EDUCATION

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ABSTRACT

In recent years, learners' performance in science has been unacceptably low. As a result, numerous research studies have been undertaken to understand learners' poor performance in science. A more in-depth view of the problem of poor science performance, as examined in this study, is that students are struggling to transition from the Senior Phase to the Further Education and Training Phase. Most of the studies attribute this failure to the style of teaching employed by Senior Phase teachers, that is, science teachers' lack of self-confidence concerning the Natural Science content knowledge. The National Curriculum and Assessment Policy Statement (CAPS) was introduced to solve the challenges faced in South African education, including Natural Sciences at the Senior Phase. This was expected to have a significant bearing on the learning and teaching of Natural Sciences. The CAPS emphasises the teaching and learning of Natural Science that promotes hands-on approaches by utilising practical work, as well as using it as a tool for assessment. Therefore, South African educators teaching Natural Sciences must utilise practical work as an important pedagogical strategy to improve the scientific skills of learners in this school subject. Since the CAP's debut in 2012, significant research has been conducted to better understand how teachers in the Senior phase of Natural Sciences evaluate the value of practical activity in topic learning. This study investigated the perceptions of teachers on the importance of integrating practical work in the teaching and learning of Natural Sciences in Grade 9. The study was conducted in the Metro East district township high schools of Western Cape. The study utilised a deductive approach based on interpretivism. Social constructivism theory was used as the main theoretical framework of the study. Data to assess the teaching practical work was gathered employing interviews as well as document analysis of three purposively sampled Grade 9 Natural Science teachers' portfolios. Data was analysed qualitatively. The study found that teachers' perceptions on the importance of practical work in the teaching and learning of Natural Sciences were positive even though they used this pedagogy infrequently. The study found that teachers faced many challenges, such as inadequate resources, big classroom size, lack of functional laboratories and time constraints; they could not effectively conduct practical work daily. The findings further revealed that, when teachers conduct practical work, they use only one preferred method of demonstration with guided inquiry. It was found that Grade 9 Natural Science did not plan for practical lesson plans, except for reporting purposes of Continuous Assessment (CASS). Thus, this study recognises the difficulty teachers face and addresses some of the mentioned concerns. It was recommended that adequate resources be provided and that challenges that teachers

encounter when doing practical work in these township schools must be addressed. Teachers' pedagogical knowledge needs to be developed by being properly trained to enable them to carry out meaningful science practical work more often. By using practical work as a teaching technique, learners will have ample opportunities to understand science content, as they will learn by interacting and engaging in hands-on practical activities.

DEDICATION

I am dedicating this thesis to the following special people:

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I would like to express my sincere gratitude to the following people for their support and substantial contribution to the completion of my thesis:

- my supervisor, Dr Kwanele Booi, for providing the needed academic guidance. Without him, accomplishing this huge task could have been difficult. Mr. Siyabulela Sabata, took his precious time to scrutinize this work chapter by chapter.
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- the principal and teachers from sampled schools for participating in the study. Without their cooperation, I could have struggled a lot to complete this study. To everyone who contributed at any stage of this study, May God continue to bless you and make you prosper in life.

DECLARATION

I, Nitia Phiwekazi Boyi, 215076664, hereby declare that this research project titled *Investigating Teachers' Perceptions of the Importance of Practical Work in the Teaching and Learning of Natural Sciences in Grade 9 at Township Schools*, is a product of my effort. This work is original and has never been submitted for examination for academic purposes before. Furthermore, all the cited sources in this thesis have been acknowledged and evidence is given as a list of references.

Date Submitted: 06 December 2023

Signature: NP Boyi

LIST OF ACRONYMS

Acronym	**Explanation**
FET	Further Education and Training
SCORE	Science Community Representing Education
NSC	National Curriculum Statement
CAPS	Curriculum and Assessment Policy Statement
SBA	School-Based assessment
DBE	Department of Basic Education
CASS	Continuous Assessment
GET	General Education and Training
PCK	Pedagogical Content Knowledge
SMT	School Management Team

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CHAPTER 1: BACKGROUND AND INTRODUCTION

There have been concerns about learners' poor performance in sciences around South African schools and this prompted several studies being undertaken to understand the causes and map ways to remedy the situation (Mji & Makgatho, 2013:53). Existing studies provide several reasons leading to learners' poor academic performance in Natural Science. According to Mji and Makgatho (2013), learners experience difficulties when transitioning from the Senior Phase to the Further Education and Training (FET) phase. Most of the studies attribute this failure to the style of teaching employed by Senior Phase teachers (Rogan, 2014), that is, science teachers' lack of self-confidence about the subject content of Natural Science.

Practical work is recognized widely as an essential component in the teaching and learning of science and thereby important in affirming teachers' confidence (Toplis & Allen, 2012). Another definition is by Miller (2004) which views practical work as any learning and teaching that requires the learners to observe and interact with actual objects and materials they are acquiring knowledge from to develop understanding. Lunetta, Hoftein and Clough (2007: 35) view practical work as "the learning experience in which learners interact with materials or with sources of data to understand the real world." Similarly, Hattingth, Aldous & Rogan (2014:75) emphasise that practical activities in Natural Sciences are hands-on demonstrations, investigations, experiments, and scientific projects that use problem-solving techniques that are used to enhance the concepts being taught in the discipline-specific content. The use of practical work in science teaching is intended to develop process skills that learners will need to solve life problems. Thus, practical work is essential in that it makes students aware of their surroundings and provides them with the needed research skills for connecting with physical and chemical processes (Department of Basic Education, 2011). The purpose and approach of practical work have evolved into what is known as scientific inquiry that science teachers should use as the adequate pedagogy that allows learners to develop key scientific ideas through learning how to investigate phenomena and finding answers for themselves, using investigation through practical work (Martin-Hansen, 2012:34).

Literature portrays science teaching as a means of transferring knowledge by the teacher to the learner as well as through peer interaction during the learning process (Vygotsky, 1978:34). This means that learners must play an active role in understanding the work being taught by taking part in the new knowledge (Windschitl, 2014). Research has established that

learners' acquisition of scientific knowledge improves when they are involved in practical work (Braund & Driver, 2012). Furthermore, it is argued that practical work is expected to be a key part of science teaching and learning to provide the required experiences needed for learners to build their understanding of scientific principles in a meaningful way (SCORE, 2008). In this regard, learners are afforded a chance to learn science by undertaking hands-on practical tasks, where they are actively involved in manipulating objects by themselves to develop critical thinking as well as problem-solving skills. Practical work is important as it allows learners to demonstrate what they can do on certain work and even in real life.

However, in South Africa, since 1994, when the country attained independence, various changes have been made to the Natural Science school curriculum. For instance, we witnessed curriculum changes through 2005, with the advent of outcomes-based education, which was later revised into what was called the Revised National Curriculum Statement and further streamlined into the "National Curriculum Statement (NCS)" (DBE, 2011). The latest revision led to the creation of what is currently known as the "Curriculum Assessment Policy Statement" (CAPS). CAPS emphasized the importance of practical work as required pedagogy to strengthen the concepts being taught, thereby guiding teachers on the content they are supposed to teach, including School-Based Assessment (SBA) (DBE, 2011)**.** The curriculum stipulates the number of practical work contributing to the Continuous Assessment mark (CASS mark). This challenges the specific discipline content knowledge and skills and leads to teachers avoiding some important practical work by concentrating only on those experiments prescribed for moderation. According to Treagust (2015), this downplays the role played by practical work as pedagogy in science education because practical work is not included in daily teaching. Teachers should be aware that most examination questions are not only set from the experiments they conduct. Thus, the Science CAPS document places more importance on the use of practical work as a pedagogy and tool of assessment (DBE, 2011). Because every Natural Science content must have a practical application in the real life of learners, it is important for teachers to do practical work in the teaching of most topics. Therefore, as an experienced science teacher, the researcher will join the ranks of township high school teachers to contribute to improving the lesson delivery in Natural Sciences teaching and learning by utilising a pedagogy which promotes hands-on learning. Practical work can serve this purpose very well.

In the current study, the researcher mainly focused on Natural Science teachers who did not incorporate practical work in daily teaching as prescribed by CAPS.

Furthermore, Rogan (2014) provides compelling evidence indicating that the teaching of science in South Africa is devoid of practical work. The author mainly sees this as evidence, starting from the senior phase, where the transition takes place and, therefore, safely assumes that curriculum-aligned texts can force teachers to use pedagogical pathways more, which includes textbooks. Research on science education in South Africa has highlighted several challenges that Science teachers face when doing practical work. According to Ramnarain (2016), the challenge includes overcrowded large classroom sizes. Onwu and Stoffels (2015) identified inadequate science laboratory resources needed for teaching and learning as a challenge that makes it problematic for science teachers to include practical work pedagogy in the daily classroom teaching of Natural Sciences. In this current study, the essence of practical work in the learning and teaching of Grade 9 Natural Sciences at the Metro East district township high schools of Western Cape will be the focus.

1.1. Statement of the problem

The CAPS document in South Africa emphasises much on the importance of practical work as a tool for teaching assessment (DBE, 2011). Therefore, teachers must utilise practical work as a pedagogical strategy for improving learners' scientific knowledge and skills in Natural Science subjects. However, Grade 9 Natural Sciences teachers seem to be overlooking practical work in the teaching, as required by the CAPS document. According to the DBE (2011), most South African schools in townships face challenges with science facilities and equipment needed for the successful teaching and learning of science. With practical work, it is believed that learners should be centred and engaged in the manipulation of tools when doing hands-on practical activities to learn better (Miller, 2004:28). There are also reports that learners appreciate practical work when used properly. Some scholars believe that practical work is very important because of its ability to motivate learners to learn much of the content knowledge in Science (Toplis & Allen, 2012:32). Due to inadequate resources, a functional laboratory (Onwu & Stoffels, 2015:65), and class size (Ramnarain, 2016:91), proper teaching of science through practical work is highly compromised (DBE, 2011). With this in mind, the researcher visited three public township high schools that are disadvantaged and situated closer to the researcher and discovered that Grade 9 science teachers tended to

overlook practical work, which is against the stipulation by the CAPS document. Meanwhile, the study explored teachers' experiences of the importance of using practical tasks as a teaching strategy; their perceptions are important in the way they teach it (Maharaj, Brijlal & Molebane, 2016:61). Hence, it became necessary for the study to explore teachers' perceptions about the value of practical work in the teaching and learning of Natural Sciences in Grade 9 at township schools.

1.2. The rationale of the study

Practical work is emphasised by the CAPS document as an essential pedagogy strategy for the teaching and learning of Natural Science, as well as a form of assessment tool (DBE, 2011). However, science teachers seem to ignore practical work when teaching Natural Science topics as directed by the CAPS document. Similarly, Solomon (1980) believes that science teaching must take place in a science laboratory to reduce misunderstanding regarding the difficulty likely to be faced. Despite such emphasis, teachers prefer using textbooks, particularly in township schools, when teaching Grade 9. Furthermore, science teachers do not allow learners to participate in hands-on practical activities, even though this may bring about experience to improve the scientific and practical skills that will enable them to solve the problems they meet in modern life. Because of this, teachers see no reason to understand the basis of practical work and utilise this teaching pedagogy daily. This study focused on the use of practical work as a pedagogy in science to afford learners a chance to learn the subject content through exploration and engagement, based on hands-on practical work learning tasks. In understanding teachers' perceptions about the importance of practical work in the teaching and learning of Natural Sciences in the Grade 9 curriculum, therefore, teachers' perceptions in using practical work as the teaching strategy and in the implementation of the science school curriculum are important. With teachers being at the heart of education reform and contributing to better quality and the effectiveness of the education system, it should be noted that adequate curriculum delivery heavily depends on teachers (Maharaj, Brijlal & Molebane, 2016:61). Thus, it will be essential for the study to investigate teachers' perceptions about the importance of practical work in the teaching and learning of Natural Science because it is fundamental on the way they teach it.

1.3. Research question

What are teachers' perceptions of the importance of practical work in the teaching and learning of Natural Sciences in Grade 9 at township schools?

Sub-questions:

1. How do Natural Science teachers perceive the use of practical work in teaching and learning in Grade 9?
2. What challenges do Natural Science teachers face when doing practical work in Grade 9?

1.4. Aim

The research study aimed to investigate the perceptions of teachers on the utilisation of practical work in the teaching of Natural Sciences in Grade 9 at Metro East district township high schools of Western Cape.

1.4.1. Objectives

1. To critically examine how teachers perceive practical work as pedagogy for teaching and learning for Grade 9 learners in Natural Science
2. To explore challenges that Natural Science teachers face when doing practical work in Grade 9.

1.5. Literature review

1.5.1 Definitions of science practical work from different perspectives

Several definitions of the term practical work are in use today depending on the context the term is used. Practical work is a term used to connote learning practice that permits learners to learn with science equipment or data sources to comprehend real-world works (Lunetta, Hoftein & Clough, 2007). According to Millar (2004) and Maponya (2018), practical work means any pedagogy that uses practical activities that involve learners in watching or using objects, and materials being studied to develop insights into scientific principles and concepts. The goal of doing practical work is to provide students with hands-on and brain-on learning tasks (Maponya, 2018; Miller 2004). Defining practical work in this way indicates that learners should be kept active in manipulating objects being studied to assist them in understanding and acquiring appropriate scientific knowledge and skills.

Similarly, Sitole (2016:17) says, “Practical work as teaching and learning activities that offer learners chances for investigating phenomena and processes.” Furthermore, Stoffels (2005: 18) notes that science inquiries always encourage learners to engage in “practising process skills” by being ‘hands-on and minds-on’, as learners develop different skills, including observing “questioning, hypothesizing, predicting, collecting, recording, analysing and interpreting data.” It can be deduced that practical work has to be treated as an important method of science lesson delivery in which learners are allowed to develop and practice important process skills that science seeks to nurture. This means, that putting theory into practice of what they have learned and observed in the classroom environment by doing it practically in the laboratory enhances their ability for learning scientific knowledge.

Tsai (2014) avers that practical work is an experience that can be formed in laboratories this means that practical work must be undertaken within the laboratory, making it imperative that a science laboratory be an essential aspect of science education that offers the most appropriate place for learners to be assisted in getting appropriate knowledge. Adding to this view, Solomon (1980) further elaborates that science teaching is best suited to take place in the laboratory because that is where it naturally belongs.

Stakeholders in education all agree on the necessity of fully immersing students in science practical work (Toplis & Allen, 2012:32). Be it either private or public township schools, all Grade 9 learners should be given a chance to undertake practical work in the Natural Science syllabus (DBE, 2011). However, as learning changed, the purpose and approach of practice have now evolved into what is known as scientific inquiry. Martin-Hansen (2012:34) claims that “inquiry-based learning facilitators aim to support students in having the confidence to approach their inquiries so that they can find things out for themselves through appropriate questioning.” This entails that this researcher defines and interprets the concept of scientific inquiry, as it enhances the ability of both the teacher and a learner to understand science in a meaningful way, on how to engage in inquiry through the importance of making use of the teaching strategy of practical work to find answers.

1.5.2 Types of practical work:

1.5.2.1. Demonstrations

Demonstrations are examples of practical work activities where science teachers will assist learners develop concepts when they are given detailed instructions on what to do in practical activity, which is completely determined by the teacher (Pekmez, Johnson & Gott, 2015:3). Therefore, learners will remain focused on the practical lesson when the teacher guides them with using a variety of resource materials in the classroom environment or laboratory to illustrate the practical lesson.

1.5.2.2. Experiments

According to Hattingth, Aldous and Rogan (2014), experiments are the types of practical activities where a set of outline instructions will be given by the science teacher, which learners have to follow to get results and confirm the well-known purpose of the activity that the teacher explains, and link to earlier work.

1.5.2.3. Investigations

Investigations are the types of practical work activities where the science teacher designs practical activity in a way that encourages the learner to discover new information (Hattingth *et al.,* 2014:75*).* In this case, learners go through the scientific process and develop skills by doing when undertaking guided discovery sort of practical work in small hands-on groups. After completing a practical session, learners have to produce a report justifying the conclusions made.

1.5.2.4. Projects/Problem-solving activities

The project or problem-solving type of practical activity focuses on process skills whereby the science teacher supports the learners to plan as well as completing their own "open-

ended" experiments and projects (Hattingth *et al.,* 2014:75). Therefore, learners will become critical thinkers in reasoning scientifically because they decide the questions on how to proceed in practical activity, as well as coming up with strategies for investigating and solving problems in a variety of scientific and technology environments in an everyday context.

For Pekmez, Johnson and Gott (2015), the above-stated types of practical work are not all used by science teachers. Pekmez *et al.* (2015) observe that teachers prefer using demonstrations in science lessons. Nevertheless, practical work is an important element in the teaching and learning of science and various science authors will evaluate its purpose by providing aims for conducting practical work (SCORE, 2008). He put forth the following aims as brought to the fore by science teachers:

- to encourage accurate observation and descriptions,
- to make phenomena more real through experiences,
- to arouse and maintain interest; and
- to promote a logical reasoning method of thought through learners learning scientific skills.

The above-stated aims to reinforce practical work as an essential pedagogy to be used to help learners understand science better. Practical work can further help learners enjoy science (Braund & Driver, 2012). Practical work must be used to motivate learners to do, for this reason; teachers should play an important part in keeping learners focused on practical work.

1.5.3. Practical work as the pedagogy in science education.

Practical work is an essential aspect of effective science teaching and learning at any grade (Miller, 2004). The research shows that practical work can lead to productive learning of science concepts if all learners are engaged in meaningful activities. Therefore, science teachers who act as facilitators, instructors and transmitters of knowledge are required to engage all the learners in practical work by demonstrating and involving the learners in observing, manipulating, and handling materials by themselves to understand the real world. Putting theory into practice of what they have learned and observed in the classroom and

doing it practically in the laboratory enhances their ability to learn scientific knowledge. Meanwhile, this helps the learners to acquire essential skills that will make them understand scientific investigation processes needed to develop the understanding of scientific concepts and simultaneously encourage learners to enjoy learning science (Braund & Driver, 2012). The learning of science using practical work as a pedagogy can be effective when science teachers encourage learners to actively participate in the learning process, thereby they enjoy learning science. When they enjoy learning science, they will understand the practical work conducted, as they are involved in learning in which much of their senses are involved. This will reduce monotony and motivate learners to participate in their learning As they enjoy learning science, their attitude and interest towards science will improve positively because they will get excited and yearn to learn more about science (Braund & Driver, 2012).

Additionally, practical work encourages learners to apply step-by-step scientific protocols in investigations by involving learners to actively take part in process skills development through 'hands-on' and 'minds-on', and they develop various skills such as observations, questioning, hypothesizing, predicting, collecting, recording, analysing and interpreting data' (Stoffels, 2005). It also improves the ability of the learners to work in groups while practising cooperative learning strategies when they work together, while attaining practical skills (Dillon, 2011:1). Toplis and Allen (2012) believe that practical work done in-group influences positive fondness and better understanding. Further, it enables learners to learn more science (Toplis & Allen, 2012:32). If the learners are allowed to do practical work in Natural Sciences, they learn the content better by doing the work practically. Hence, the learners in the Senior phase (Grade 9) are expected to do practical work in science daily to assess their practical skills, as required by the CAPS document. The Natural Science section of the South African Curriculum and Assessment Policy Statement emphasizes doing science practically, as opposed to learning theories and facts about science. The following first outcome of the three is relevant, as it clearly states that the learners should be able to complete investigations, analyse problems and use practical processes and skills in designing and evaluating solutions (Department of Basic Education, 2011).

However, the aspect of practical work at township schools as used, for example, on the study will tend to be overlooked due to the challenges that science teachers face when doing practical work. In support of the above statement, Treagust (2015), claims that "the role of practical work in South Africa is underestimated from previously disadvantaged schools." That is, practical work plays a limited role because teachers do not include practical work in

their daily teaching, as required by the CAPS document. Of course, the science teachers will cite reasons why they do not include practical work in their daily teaching.

1.5.4. Challenges in the teaching and learning of practical work in science

The following literature reviewed from studies conducted by different authors will highlight some of the challenges faced by science teachers, which make it difficult for them to effectively include practical work in their daily teaching. For instance, scholars like Onwu and Stoffels (2015) conducted the study using mixed methods research with 53 practising teachers in Venda. The findings of their studies established that "most of the schools have insufficient teaching materials and limited financial resources in schools and that these constraints influence the teaching and learning of science'' (Onwu & Stoffels, 2015:65). Teachers complain about their schools, such as the fact that they do not have enough funds to purchase equipment for practical work. Thus, scarce science material and equipment is a limiting factor which determines the practical work that can be done in these schools (Kapenda, Kandjeo-Marenga & Kasanda, 2016). Furthermore, Kapenda *et al.* (2016) argue that the lack of teaching resources in emerging economies seriously impedes the quality of teaching and learning in science.

1.5.5. Theoretical Framework

1.5.5.1 Social Constructivism Theory

The theory used in this study is the social constructivism theory which was established by Vygotsky in the year 1978. This theory recognises mainly the social relationship, which affects how teachers think and react to changes in a classroom environment (Cross, 2014). Thus, social constructivism theory puts an important emphasis on understanding, firstly, of perceptions of teachers, which are key aspects of hands-on skills and knowledge and are important because they influence what these teachers do in the classroom environment. In this manner social constructivism theory emphasises that learning must be founded on actual-

life adaptable problem-solving, which socially occurs via sharing experiences. That is, the teachers' experience serves as a lens for explaining their actions and those of others. Therefore, it must be realised that the knowledge that the teachers have is aligned with experience and every time experiences change (Maharaj *et al.,* 2016:61). The understanding of teachers' perceptions about using practical working in teaching can assist the researcher in understanding the teachers' behaviour which reflects underlying understanding about the importance of practical work. For instance, the manner in which teachers perceive the importance played by practical work is likely to affect how they use the pedagogy and interact with learners in the classroom when doing practical work.

Furthermore, when social constructivism theory is used, every learner is treated as a different individual with distinctive learning abilities and personal history (Cross, 2014:32). This is the more so in that, they interact with each other influenced by observations and experiments on how they construct their understanding and knowledge within the learning process (Dillon, 2011:1). The social constructivist views learning as an active process whereby learners engage in action with interacting with possible knowledge sources when doing practical work, which supports the scientific inquiry-based learning (Windschitl, 2014). It is during practical activities that teachers and learners can interact constructively, leading to learners developing expected interrelationships with teachers, ultimately, resulting in more learning occurring. According to Vygotsky (1978:34), in terms of a social constructivist "…the knowledge is co-constructed and that individuals learn from one another." In the case of this study, it is emphasized that learners are actively involved by working hand in hand with each other in the learning process to augment their understanding. Teachers who act as the instructors and transmitters of knowledge and learners are equally involved in the learning where one learns from one another (Dillon, 2011:1). This means that, during practical work, the teachers interact with the learners and, through their interactions; they will develop positive relationships, which are necessarily important during the teaching and learning. That is, teachers interact with their learners to develop closeness and trust as well between them. Therefore, classroom interaction is crucial, because it engages learners to interact fully with their peers as well as provide their teachers with a source of material to construct knowledge.

1.6. Research Design and Methodology

1.6.1 Research paradigm, approach, and design

According to Creswell (2013), a research approach refers to a predetermined plan of data collection and analysis to test the research hypothesis. Therefore, the researcher used a deduction approach in this qualitative research to collect the data. The deductive approach focuses much on formulating a hypothesis based on current theory and then devising a research strategy to test it (Creswell, 2013). According to Patton (2012), the deduction approach will assist the researcher in finding the views of the individual experiencing the particular phenomenon from their point of view by using an existing theory of Social Constructivism to analyse the data using a deduction approach. The deductive approach has an advantage in that it promotes vigorous interaction between the researcher and the respondents of the study (Patton, 2012). The reason for choosing this approach was that the researcher would be an objective observer who will not be interfering with the study, but be able to collect a wealth of comprehensive information from a much smaller sample (Patton, 2012). This study was also underpinned by the guidelines of an interpretivism paradigm. The implication raised within this paradigm in the empirical study undertaken is the interaction between the researcher and the participants regarded in their social context (Henning, Van Rensburg, & Smith, 2014). That is, the research interview questions asked from participants' perceptions were interpreted using an interpretivism paradigm.

Hitchock and Hughens (2015) define a qualitative design as the method of collecting data using interviews and documents (teachers' portfolios) from a smaller sample of participants purposively selected. Furthermore, a qualitative design gives a clear representation of the real-life situation as it naturally happens (Hitchock & Hughens, 2015). This means that the qualitative design was chosen due to what was to be accomplished, which is practical aspects were investigated, influencing factors and interest of the researcher.

1.6.2 Research methodology

1.6.2.1. Site selection

A research site is a place selected to conduct a study (Creswell, 2013). Therefore, the researcher conducted the study in public schools in townships that are situated in the Metro

East district of Western Cape Province, which are under-resourced disadvantaged schools. This site was chosen because it is easily accessible or reached by the researcher.

1.6.2.2. Participant selection

According to Creswell (2013), participant selection encompasses a total population from all units to be included in the study, from which the study intends to draw conclusions. In this study, the participants were selected from the Grade 9 Natural Sciences teachers. Purposive sampling was used to focus on specific individualities of the target research population and that allows the researcher to answer to research questions being pursued (Creswell, 2013). Therefore, the selection criteria for the sample were: 1. Natural Science teachers purposefully sampled on the basis that their schools are under-resourced and, 2. Participants were full-time employed teachers from selected schools within the Metro East district township of Western Cape, and finally, 3. Participants were chosen based on having at least two years' experience of in teaching. Furthermore, the advantage of using this technique was for choosing participants with exclusive knowledge and involvements unique to themselves. The participants were selected on their strengths and were rich sources of information relevant to the study.

1.6.2.3. Data collection

Individual Interviews

A semi-structured individual interview was used as a data-collecting technique. Opie (2014) suggests that when framing an interview schedule, the researcher must ask questions that are likely to solicit important data concerning the phenomenon being studied to address research objectives and questions. Semi-structured interviews had the advantage of providing the researcher with an opportunity to expand the participants' responses by probing for more information because of the time made available to extract more information (Opie, 2014).

Therefore, this study utilised a semi-structured interview schedule as the second instrument for collecting data during the interviewing of three Natural Science teachers from different public township high schools in the Metro East district of Western Cape, seeking to investigate their perceptions of the importance of practical work in the teaching and learning in Grade 9 curriculum. Furthermore, the physical interviews were necessary to get participants' views about the research question(s). Each interview session lasted for at most 40 minutes and was audiotaped with permission from each participant, an ethics requirement.

Official documents

The official documents are the documentaries containing data about the organisation where the data is collected, and it occurs at the same time as other interview instruments, including teachers' portfolios (Punch, 2015) as well. Further, official documents can be used as research tools in qualitative studies. The documents were needed by the researcher to substantiate what participants said in the interview for each topic dealt with. The analysis of document contents was done after coding the content into descriptive groupings to form themes. This process resembled that of interview transcripts analysis. Therefore, the researcher used documents in scrutinising the teachers' portfolio checklist in tabular format, which included teaching plans from "schemes of work, lesson plans and records of work for evidence of teaching practical work to the learners in their schools" (Miyoba, 2017).

1.6.2.4. Data Analysis

According to Kombo and Tromp (2016:23), "data analysis is a very important stage of the research because it entails selecting, categorising, comparing, synthesising, and interpreting the data gathered to explain the phenomenon of interest." In this data collected from each individual participating teacher were treated separately and then results were mixed to create themes. The data collected through interviews was coded and analysed qualitatively. According to McMillan and Schumacher (2014), qualitative data methods categorize data and detect patterns based on specific themes. Therefore, qualitative data analysis was appropriately used in this case, since it entails data reduction to a reasonable level, creating

summaries, analysing, and searching for possible patterns. The coding process started from the outset of the analysis by dividing data into manageable chunks. Interviews were audio captured and played repeatedly. The audio-taped data was then transcribed into text form then further translated into the English Language for those who had used their home language, isiXhosa.

Meanwhile, the official documents were analysed similarly in the same way the data from interviews were analysed. Data extracted from official documents were presented in simple tables. To ensure descriptive trustworthiness (Kumar, 2012) encourages researchers to state what is observed in the official papers and what is appropriate for the objectives of the study. Further, all the themes that emerged from interviews and document analysis helped to answer the question about how Natural Science teachers perceive the essence of delivering science lessons in Grade 9 using practical work as well as their perceptions of challenges that they face when doing practical work.

1.6.2.5. Trustworthiness of the study

Trustworthiness is an important way used by researchers to convince readers the research findings are worthy of attention (Nowell, Norris, White & Moules, 2017). This notion is also held by Kumar (2012) who argues that the trustworthiness depends on the instruments' capacity to measure what it has been designed for. A trustworthy instrument enables the collection of data that will be used to answer research questions. Therefore, the researcher needed to conduct the study properly by using semi-structured in-depth interviews and document analysis (teachers' portfolios) to ensure that data collected from these instruments will be trustworthy. When the researcher uses more than one instrument to collect data, it will be able to assist with the triangulation of data, which is one of the qualitative strategies. For trustworthiness, Lincoln and Guba (2013) assert that trustworthiness is essential when evaluating data trustworthiness by proposing the following four aspects, which include credibility, transferability, dependability, and confirmability that will be accurate to reflect the assumptions of the qualitative research. These aspects will be described and made applicable in chapter 3 of the study.

1.6.2.6. Researcher's position

The researcher's role in the study was to collect data through interviews and document analysis while scrutinizing teachers' portfolios from Grade 9 Science teachers who taught using practical activities at Western Cape's Metro East district township high schools, which are underfunded. Furthermore, the researcher conducted semi-structured interviews with participating teachers to learn about their perspectives on these specific phenomena (Patton, 2012). Therefore, the researcher was ideally an impartial observer by not participating or influencing the lesson proceedings but typically concerned with producing a wealth of data from a much smaller number of participants who were teachers who taught practical work to Grade 9 classes on their perceptions about the importance of practical work. The researcher designed interview questions and a tabular format for teachers' portfolios. Participants volunteered to participate in the study by signing informed consent forms they handed over to the researcher.

1.6.2.7. Research Ethics

Efforts were made to protect the rights of participant teachers by following the code of ethics, which is defined as moral behaviour, principle, and conscience and acting in good faith while conducting the research guided the by values of participants. Thus, the needs and expectations of all targeted participants were taken into consideration without being unfairly pressurized; participants were informed of their right to abandon the study whenever they wished during the data collection stage (Kumar, 2012). Participants' information was considered confidential, and their identities were treated as being confidential. Therefore, participants remained anonymous throughout the study. The ethical clearance letter was granted by the Faculty of Education ethics committee. Written consent from the gatekeepers, which is the Western Cape Education Department (WCED), was obtained.

1.6.2.8. Contribution of the study

The study will contribute by improving natural science teaching and learning by examining perceptions of teachers on the usefulness of hands-on activities at public township high schools in the Western Cape. This study will encourage science teachers to use practical work as the pedagogy that supports scientific inquiry, as stipulated in the school curriculum. The study will add value to Natural Science lesson delivery using practical work by offering teachers with necessary types of practical work methods (scientific inquiry) by providing them with guidance and a detailed explanation of how to effectively use practical work as an inquiry-based pedagogy. The findings of this study will provide a detailed argument to inform educational stakeholders about the issues township schools confront when applying the principles in the CAPS curriculum on the value of practical work in grade 9 Natural Sciences.

1.7. Structure of the dissertation

This study consists of the following chapters:

Chapter One (1)

This chapter presents an overview of the study.

Chapter Two (2)

This chapter provides a detailed and pertinent literature framework and the adopted theoretical framework underpinning the study.

Chapter Three (3)

This chapter presents the research design and methodology used in this study.

Chapter Four (4)

Chapter 4 provides the findings of the research by drawing up summaries of data generated in the process of data analysis. This chapter presents data analysis, results and their interpretations. The chapter goes on to state the findings

Chapter Five (5)

This ultimate chapter provides findings and conclusions, implications, limitations and recommendations.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The study was introduced in the previous chapter in which the background to the research problem, problem statement, research questions and objectives were put forward. This chapter provides the available literature review on practical work in science from different sources, the importance of the inquiry approach, types and the part played by practical work as pedagogy in science teaching, and the challenges in the teaching and learning science of using practical work. Furthermore, the chapter presents the theoretical frameworks guiding this study.

2.2 Definition of practical work in science from different perspectives

Although different authors define practical work differently, the definitions emphasise its importance in the learning and teaching of Natural Sciences. The first definition to be considered is that by Tsai (2014), who views practical work as an experience formed in the laboratory. This definition limits practical work to laboratory activities because it asserts that the science laboratory is an essential facility in science education that is likely to provide the best setting for teachers to assist learners in acquiring scientific knowledge. Tsai (2014) could have been influenced by Solomons (1980) who elaborates that the teaching of science can best be carried out in the science laboratory because it naturally belongs there. Secondly, Millar (2004) considers practical work to be any learning and teaching activities that allow learners to work with the items and objects being studied to obtain a knowledge of science concepts and processes. Miller (2004) argues that teachers and learners perform practical work to improve the learning of sciences by engaging learners in “hands-on and brain-on activities”. Defining practical work in this work shows that learners must actively be involved in manipulating items under study, since it is effective in developing learners' interest in comprehending the way of learning scientific knowledge. Similarly, Stoffels (2005) treats practical activities as any teaching and learning tasks set by teachers to enhance learners' chances of practising the investigation process. The author further posits that practical work involves learners practising process skills by being ‘hands-on’ and minds, as they develop various skills such as observations, questioning, hypothesising, predicting, collecting, recording, analysing and interpreting data. This definition implies that practical work is seen as a means of teaching and learning, where learners develop and practice process skills. This,

therefore, means that by putting theory into practice of what they have learned and observed in the classroom environment, that is, by doing it practically in the laboratory, learners enhance their ability to critically engage with scientific knowledge. Thirdly, Lunnetta, Hoftein and Clough (2007) define practical work as the teaching experience in which learners interact with materials or with the source of data to understand the real world. This definition emphasises those experiences that learners derive from practical work conducted in the sciences.

2.3. Importance of inquiry approach in the teaching and learning of science.

The importance of practical work cannot be overemphasised. For example, the DBE (2011) categorically states that practical work must be included in the teaching and learning of Natural Sciences for all learners in all South African schools, public or private. This is affirmed by Toplis and Allen (2012:32) who report that researchers, academics, teachers, and curriculum developers all agree on the importance of engaging the learners in science practical work. Faize and Dahar (2011) sum it all up by saying that the teaching of science is incomplete without practical work. Literature shows that the importance of practical work has led to most science curricula globally encouraging science teachers to involve learners in practical activities (Hampden-Thompson & Bennet, 2013; Topics and Allen, 2012). Changes in the teaching and learning of science highlighted the importance of practical work as having evolved into scientific inquiry (Martin-Hansen, 2012:34). According to Martin-Hansen (2012), inquiry-based learning aims to raise learners' confidence to approach their inquiries so that they can find things out for themselves through appropriate questioning. Scientific inquiry seeks to enhance the ability of science teachers and learners to understand science in a meaningful way, as well as how to engage in inquiry through the use of the teaching strategy of practical work to find answers. The inquiry approach centres on practical work, which benefits both the teacher and learner by enhancing their ability to effectively learn the meaningful nature of science and conceptual understanding (Hamidu, Ibrahim & Mohammed, 2014:81). Martin-Hansen (2012:34) suggested the following three types of inquiry to explain the argument supplied: Open inquiry, guided inquiry and coupled inquiry.

Furthermore, the importance of an inquiry approach in teaching and learning has become favoured over traditional teaching methodology in the field of science. According to the literature of Toplis and Allen (2012), recent technological developments have increased the success of applying an inquiry approach in the teaching and learning of science even more.

Wilhem & Beishuizen (2013) assert that in an inquiry approach, learners often carry out a self-directed inquiry by doing experiments to investigate the relations for at least one set of dependent and independent variables. The inquiry approach truly emphasised the active participation and responsibility of the learner as a way of discovering new knowledge whereby learners perform practical work experiments individually or in groups. As a result, knowledge becomes meaningful and effective; hence, it develops individual and more permanent thoughts in understanding when doing scientific investigation. Through it all, the type of inquiry approach that is preferred and most used by science teachers in developing schools is a guided inquiry, where the teacher acts as the facilitator that instructs and plans the practical investigative work by providing the necessary materials for a problem and asking the question to be investigated by the learners (Martin-Hansen, 2012:34). Therefore, the learners' responsibility is to figure out a way to answer the question given to them as well as coming up with own procedure to solve the problem and communicate the results of the investigation. The role of the teacher using the scaffolding teaching method is to guide and work hand in hand with the learners by supporting them during the investigative practical work to achieve the intended learning goals (Hamidu *et al*., 2014:81).

2.4 Types of Practical Work

The types of practical work are the various activities performed during the teaching and learning of science. Therefore, Hattingth, Aldous and Rogan (2014), in their study, posit the four types of practical activities as demonstrations, experiments, investigation and problem-solving or projects. From the literature reviewed, practical work comes in different types, providing the learners with practical engagement and exposure to scientific knowledge. The above-mentioned authors defined thoroughly each type of practical work activity.

2.4.1. Demonstrations

The demonstrations are the types of practical work activities where the science teacher will use demonstrations to help learners develop concepts and they are given detailed instructions on what to do in practical activity, which is completely determined by the teacher (Hattingth *et al.,* 2014:75*)*.). Therefore, learners will remain focused on the practical lesson when the teacher guides them with using variety of resource materials in the classroom environment or laboratory to illustrate the practical lesson.

2.4.2. Experiments

According to Hattingth, Aldous and Rogan (2014), experiments are the types of practical activities where a set of outline instructions will be given by the science teacher, which learners should follow to obtain results and verify the established purpose of the activity, which is explained by the teacher, and linked to preceding work.

2.4.3. Investigations

Investigations are the types of practical work activities where the science teacher designs practical activity in such a way that encourages learner discovery of information (Hattingth *et al.,* 2014:75*)*. That is, learners will be required to go through the scientific process and develop skills by doing when performing guided discovery type of practical work in small groups and they are hands-on. Furthermore, learners at the end of the practical lesson will produce a report through which they can justify their conclusions.

2.4.4. Project/problem-solving.

The project or problem-solving is the type of practical activity that focuses on process skills, whereby the science teacher supports the learners to design and perform their own "open-ended" investigations and projects (Hattingth *et al.,* 2014:75). Therefore, learners will become critical thinkers in reasoning scientifically because they decide the questions on how to proceed in practical activity, as well as coming up with strategies to investigate and solve problems in a variety of scientific, technological, environment in an everyday context.

Several studies, including Hattingth *et al.* (2014) revealed that practical work activities enhance learners' practical skills. Similarly, Dillon (2011) claims that practical work includes groups of learners doing the work practically, which does not include teacher-centeredness

only within practical-based lessons. This suggests that practical work is not deemed practical work if it does not entail a group of students carrying out the work practically by themselves and with the help of teachers. According to Dillon (2011), this improves the ability of the learners to work in groups while practising cooperative learning strategies when they work together while attaining practical skills. Toplis and Allen (2012) believe that practical work has a positive impact on sentiments and comprehension. Further, it enables learners to learn more science (Toplis & Allen, 2012:32). If the learners are allowed to do practical work in Natural Science, they learn the content better by doing the work practically. On the other hand, Pekmez, Johnson and Gott (2015) stated that the above-mentioned types of practical work are not all used by science teachers. Pekmez et al. (2015) found that science teachers preferred to use demonstrations in most science lessons. For this reason, practical work can be viewed as an important factor in science learning and teaching and various science authors will evaluate its purpose by providing aims for conducting practical work (SCORE, 2008). He put forth the following aims, as brought to the fore by science teachers:

- to encourage accurate observation and descriptions,
- to make phenomena more real through experiences,
- to arouse and maintain interest; and
- to promote a logical reasoning method of thought through learners learning scientific skills.

The above-stated objectives seek to reinforce practical work as an essential pedagogy to be used to help learners understand science better. Practical work can further help learners enjoy science (Braund & Driver, 2012). Thus, the goal of practical work is to involve students, and teachers must play an important role in including students in practical work. Table 2.1 shows a summary of a source which discusses practical work.

2.5. Practical work as the pedagogy in science learning and teaching.

Practical work is essential in the teaching and learning of science (Miller, 2004:28). According to Braund and Driver (2012), practical work always contributes to meaningful learning in science by engaging all learners. To use practical work effectively, science teachers are encouraged to act as facilitators, instructors, and transmitters of knowledge so that they can engage all learners in practical work through demonstrations that involve

learners in observing, manipulating, and handling materials by themselves to understand the real world (Hampden-Thompson & Bennett, 2013). Practical work makes it easy for learners to put theory into practice of what they could have learnt and observed in the classroom by doing it practically in the laboratory to enhance their ability to acquire scientific knowledge. According to Toplis and Allen (2012), practical work can enable learners to acquire essential learning abilities, grasp the process of scientific discovery, and gain knowledge of scientific concepts, all, while encouraging learners to enjoy learning science. Practical work is utilised as pedagogy. The learning of science using the pedagogy of practical work is seen as effective when the teacher encourages the learners to take an active part in the learning process; they enjoy learning science (France & Haigh, 2009). A study by France and Haigh (2009) justifies the purpose of practical work as the pedagogy to develop a conceptual understanding, and thinking skills and improve attitudes of learners towards science. There is a plethora of literature confirming that, when practical work is used, learners tend to enjoy learning science by completing practical activities that captivate interest in solving real-life problems (Mogofe & Kibirige, 2013). The reason is that practical work pedagogy appeals to learners' senses, thereby reducing boredom and making them eager to learn more (Braud & Driver, 2012).

Existing literature alludes to practical work activities as an encouragement for learners to apply step-by-step scientific protocols in investigations when they are involved in practising process skills by being "hands-on" and "minds-on" (Mogofe & Kibirige, 2013). Pedagogies based on practical work are applauded for developing generic scientific skills that need learners to be good at handling tools used in the science field of study (Stoffels, 2015). Promoting collaborative work is another fundamental skill that practical work seeks to develop among learners when they work in groups and apply cooperative learning strategies in solving scientific problems (Dillon, 2011). According to Dillon (2011), practical skills correctly learnt during science practical work play a vital role in the future, when learners enter the world of employment. There is a belief that allowing learners to conduct practical work in small groups can arouse pleasant feelings and improve their knowledge of scientific concepts and principles (Toplis & Allen, 2012). Furthermore, practical work is touted as being effective in motivating learners to learn much in science (Toplis & Allen, 2012:32). The authors assume that learners who engage in practical activity in Natural Science have a better chance of understanding the information than those who do not. In South Africa, learners in the Senior Phase (Grades 8 and 9) are expected to carry out practical work in

Natural Sciences lessons to assess practical skills, as specified in the CAPS documents. The Natural Science portion of the South African CAPS stipulates that learners must perform science instead of understanding it theoretically. The first outcome in the CAPS explicitly specifies that learners must complete practical investigations, analyse problems and evaluate solutions using practical methods and skills (DBE, 2011).

However, the aspect of practical work at township schools based on the study tends to be ignored or done inappropriately due to the challenges that science teachers face when doing practical work. This is affirmed by Treagust (2015), who claims, "the role of practical work in South Africa seems to be underestimated in previously disadvantaged schools." In South African schools practical work plays a limited role because little of it is included in the daily teaching of science as stipulated in the CAPS guidelines (Treagust, 2015:48).

2.6. Challenges in the teaching and learning of practical work in science.

The following literature reviewed from studies conducted by different authors highlighted some of the challenges faced by science teachers, which made it challenging for them to effectively include practical work in their daily teaching. For example, Onwu and Stoffels (2015) conducted mixed methods research with 53 Venda teachers of Natural Sciences. The findings of their studies established that "most of the schools do not have sufficient teaching materials and resources in schools and that these constraints influence the teaching and learning of science'' (Onwu & Stoffels, 2015:65). Teachers complain about their schools, indicating that they do have inadequate funds to buy equipment needed to conduct practical work. Thus, the lack of sufficient laboratory resource materials tends to limit how much practical work can be done in these schools (Kapenda, Kandjeo-Marenga & Kasanda, 2016). Furthermore, Kapenda *et al.* (2016) argue that inadequate sufficient resource materials affect the quality of teaching and learning in science in developing countries greatly.

2.6.1 Quality of teaching and learning in science

The quality of teaching and learning in science relies on teachers who facilitate learning by persuading learners to see sense in concepts being taught and to plan appropriate practical lessons that are teacher and learner-centred. This makes it possible for learners to be actively involved in scientific inquiry to find answers by themselves when practising process skills which allows them to be "hands-on and minds-on" to develop specific process skills (Stoffels, 2015:14). The most cited process skills are questioning, hypothesizing, observations, predicting, collecting, recording, analysing, and interpreting data (Maponya, 2018; Stoffels, 2015:14; Mazwayi & Booi, 2018). Therefore, the teacher's role is to plan lessons along the pedagogy of practical work daily. However, it has been found that teachers are more textbook-bound, particularly at township schools (Rogan, 2016). Thus, that hinders learners' understanding and achievement in Natural Science. This often leads to poor performance among Grade 9 learners in Natural Science.

According to Mji and Makgatho (2013), studies claim that learners are having trouble transitioning from the senior phase to the FET phase. What has mostly resulted in this difficulty is the frequently used style of teaching by Senior Phase teachers (Rogan, 2014). Science teachers seem to lack self-confidence and this may be proved by their tendency to teach subject content of Natural Sciences devoid of practical work. Furthermore, for Senior Phase learners, Natural Science is supposed to be taught and learned by providing practical work instead of using theoretical lectures. According to Windschitl (2013), many untrained teachers teach science in abstract ways, making science lessons uninteresting and difficult for students to acquire scientific concepts, skills, and principles. Most scientific professors emphasize the application of theory rather than the frequent use of practical components daily. That is, in Natural Science, teachers focus on the learners' theoretical knowledge. Very little is given to the development of scientific process skills (Hartly, 2016).

2.6.2 Types of assessment given to learners

The types of assessment given to learners most of the time are content-based theory lessons. Teachers in their daily teaching do not frequently use the pedagogy of practical work. If it is used, teachers only conduct prescribed practical work for Continuous Assessment mark purposes. Therefore, teachers only use practical work as a tool for assessing learners formally

each term, not daily, as required by the CAPS policy document. Assessments given to learners are mostly content-based lessons resulting in poor performance of learners, as they do not grasp subject content thoroughly as compared to doing practical work. Theoretical lectures used by teachers undermine the importance of practical work in the teaching and learning of Natural Science (Treagust, 2015:48).

2.6.3. Limited time for teaching and learning using practical work.

Stoffels (2015) emphasises that time is a problematic issue that constrains science teachers from incorporating practical activities into daily teaching and learning of Natural Sciences in South African schools. Treagust (2015) supports the view that the role of practical work in Natural Science is undervalued, particularly by instructors in historically underprivileged South African schools across the country. Similarly, Hartly (2016) notes that the purpose of teaching and learning using practical work tends to be downplayed by teachers who continue to use teaching approaches that promote rote learning in Natural Science in South African schools. This is demonstrated at training workshops where science teachers frequently complain that practical work requires a lot of paperwork to complete, as well assuming that practical work is time-consuming to prepare, conduct and explain to learners. Overall, conducting practical seems to be costly compared to other instructional approaches. For instance, using the models for demonstration purposes takes much more time, planning to make sure that the elements and equipment are tested beforehand.

2.6.4 Teaching and Learning Resources.

The preparation of resources or materials is vital in the learning and teaching of practical work, because of its hands-on nature, where learners are encouraged to complete tasks that require them to use practical knowledge during the practical activities (Kapenda *et al.*, 2016:53). The implication is that without the required materials, it is impossible to successfully teach and study science practical work regularly. The quality of science received by learners in Senior Phase depends on a wide range of factors that subsequently affect teaching and learning resource materials given by the school, which teachers may deem inferior to what they want to teach. The important resources are science equipment as well as consumables, such as chemical mixes and reagents, which are used during the educational

process to improve comprehension and learning of practical work. Therefore, in Public Township schools, it has appeared that there is a shortage of functional laboratories and inadequate resources to effectively support science practical work. Moreover, Stoffels (2005) asserts that learners need practical investigative skills, such as handling materials, observing events, handling observation results and being able to conclude. To achieve this feat, classrooms, laboratories, and resources used in the teaching and learning of Natural Science must be adequate and favourable for learning regularly. Scientific inquiry-based learning, using the pedagogy of practical work, which centres on the learner, requires a lot of scientific materials and equipment. However, because most schools lack critical tools for influencing science information and concepts, many students learn little science because practical work is rarely done daily, Therefore, teaching and learning tend to be more textbook-bound (Rogan, 2014). This means that science teachers are using more content-based lessons in their daily teaching, while practical work is not taking place daily. Teachers only consider practical work as a form of assessment tool.

Concerning the challenges that many science teachers face, it is difficult to include practical work daily. Onwu and Stoffels (2015) identified a challenge of inadequate resources. Further, these authors established in their findings that the majority of teachers lacked the required experience due to poor training, and they operate in big and poorly equipped science teaching spaces (Onwu & Stoffels, 2015:65). Consequently, this led to science teachers, when doing practical work, being constrained to use only one preferred method of demonstration and guided inquiry. This idea is also expressed by the DBE (2011) that states that individual teachers who are determined to conduct practical work will always find a way to do it, especially in schools with limited science equipment. This shows that once again being consistent with the DBE (2011) document calling upon science teachers to decide how to overcome the lack of resources by resorting to presentations, guided inquiry, as well as improvisation. This then means that science teachers should be able to improvise by going the extra mile and borrowing the resources that they do not have from other neighbouring schools so that practical work can take place. Thus, the performance and skills of learners improve when they are taught using practical work (Braud & Driver, 2012). The next review outlines the research on teachers' perceptions of practical work.

2.7 Perceptions of teachers on the importance of practical work in Natural Science teaching

The CAPS document guideline recommends practical activity in the science classroom as one of the most significant teaching and learning strategies that may be used to improve students' scientific skills. Therefore, different authors have examined practical work in science classrooms from diverse theoretical perceptions of teachers. There is a plethora of studies on the perceptions of teachers concerning the utilisation of practical work as pedagogy in Natural Science teaching.

A study was conducted by Kibirige, Osodo and Mgiba (2014) who investigated Grade 7 Natural Science perceptions of teachers in practical work and compared them to available evidence from teachers' portfolios. The study was conducted using the instrument of a random sampling of 27 secondary schools in Limpopo. The findings of the study, which focused on teachers' viewpoints and collected data via questionnaires and portfolios, found that teachers' attitudes toward practical science work were appropriate.

Furthermore, Kibirige, Osodo and Mgiba's (2014) findings of their studies from teachers' perspectives also indicated that a practical work pre-test was conducted before to correct some problems likely to affect the teacher successfully carrying out lessons involving practical work. Teachers did not keep records of practical work, although they were cognisant of the importance of that work. Most teachers were not prepared to assess it practically daily. It was found that teachers' theoretical perspectives regarding practical work were satisfactory, but there was little evidence that they were conducting practical work. The only available evidence of practical work from teachers' portfolios was for continuous assessment purposes.

On the other hand, Stoffels (2015) carried out the study by reviewing the perceptions of Grade 8 Natural Science teachers on practical work in developing countries. Data were collected through classroom observations and questionnaires. This author found that in many developing countries, science teachers spent a limited amount of time supervising practical work. In addition, Stoffels (2015) found that the bulk of science assessments were more traditional (content-based lessons) in teachers' portfolios. In other words, the assessment of learners' performance using practical work daily was largely neglected in most countries by many teachers.

Furthermore, Ramnarain (2016) explored teachers' perceptions of practical work in Grade 8. Data was collected using mixed approaches, including questionnaires, reflective talks, and writing, with 25 Natural Science instructors in Kenya. Ramnarain (2016) noted, in his study, that teachers' theoretical perceptions were satisfactory about practical work but the challenge of large, overcrowded classrooms made it difficult for them to include practical work daily. He further asserts that this resulted in most schools in Kenya with about 64% of the teachers adopting the preferable practical method of demonstration to teach Science.

The literature of the studies shows that they were mostly conducted from perceptions of teachers regarding practical work in science at a lower level of senior phase in Grades 7 and 8. None of the studies in the literature focus more on Natural Science teachers' perceptions about the importance of practical work in teaching and learning at the upper level of the senior phase, which ends in Grade 9, where transition takes place from the Senior phase to the FET phase. Hence, the researcher saw the need to conduct the research seeking to investigate teachers' perceptions on the importance of practical work in the teaching and learning of Natural Sciences in Grade 9 at three different township high schools in the Metro East district of Western Cape, using qualitative research design, mainly semi-structured interviews and document analysis of teachers' portfolio.

2.8. Theoretical framework

A theoretical framework is a structure that is created from existing concepts and tested theories to support the theory to be used in a study (Anfara, 2015; Kivunja, 2018:48). The purpose of a theoretical framework is to explain and present the theory that clarifies the research problem. This study uses two theories, namely, Social Constructivism and Pedagogical Content Knowledge (PCK) for the given reasons.

2.8.1 Social Constructivism Theory

The first theory of the study will be the social constructivism theory, which was established by Vygotsky in the year 1978. This theory recognises mainly the social relationship, which affects the teachers' ways of thinking and how they react to changes in the classrooms (Cross, 2014). Thus, the social constructivism theory puts an important emphasis on understanding,

firstly, that perceptions of teachers must be viewed as the essential components of knowledge, which merely regulate their behaviour within the classroom environment. Social constructivism theory, believes that learning is structured around real-life changing circumstances and, therefore, requires learners to acquire problem-solving skills to solve the challenges that occur socially by sharing experiences. This means that teachers use their experiences to explain their behaviours and those of learners (Miyoba, 2017). Therefore, it must be realised that the knowledge that the teachers have is aligned with practice and will change with their experience (Maharaj *et al.*, 2016:61). Knowledge is important because it influences the perceptions of teachers' understanding and, ultimately, the way they value the use of practical work in teaching (Miyoba, 2017). For instance, the way teachers perceive the function of practical work enhances teaching influences their tendency to use it to assist learners in their classes and how they interact with the learners in the classroom when doing practical work.

Furthermore, social constructivism theory views every learner as a distinct being with distinctive needs and experiences (Cross, 2014:32). This means that they interact with each other influenced by observations and experiments on how they construct their understanding and knowledge within the learning process (Dillon, 2011:1). The social constructivist views learning as an active process, whereby learners engage in action with interacting with knowledge sources personally when doing practical work, which supports the scientific inquiry-based learning (Windschitl, 2014). Vygotsky's theory (1978:34) further states that "the knowledge is co-constructed and that individuals learn from one another." In the case of the study, it is emphasized that learners are actively involved through working hand in hand with each other in the learning process to construct their understanding. Teachers who act as the instructors and transmitters of knowledge and learners are equally involved in the learning, where one learns from another (Dillon, 2011:1). This means that teachers can interact easily with the learners during a practical lesson. The interactions between teachers and learners assist in developing important positive relationships that aid teaching and learning. That is, teachers tend to interact with learners when they want to instil a sense of belonging as well as confidence with the learners. Therefore, classroom interactions are essential as they promote learners to engage with learning material and peers as well as teachers, and this enables learners to construct knowledge.

Therefore, the learners actively act as the information constructors that create their own subjective or objective reality. When new information or something is introduced, the learners continue to test their hypothesis and new knowledge by linking it with their prior existing knowledge that they already have (experiences). This takes into consideration that the learner is not in a blank state '*tabula rasa'* but brings about past experiences and cultural factors to construct new knowledge in a given present situation. Therefore, the above statement indicates that every learner has different constructions and interpretations of knowledge based on their (mind) cognitive representation (Windschitl, 2014).

Vygotsky's (1978) theory claims that "the learning happens with the assistance of other people", hence bringing about the social fundamental aspect of the theory, which is known as the Zone of Proximal Development (ZPD). This aspect refers to many tasks that are difficult for the learners to master and understand alone. It is strongly believed that learners with different skills and backgrounds need to collaborate on the task. According to Toplis and Allen (2012:32), "practical work that is done in groups influences positive fondness and better understanding." For instance, when doing practical work, they need to work together to reach a common understanding in a certain field. Another part of the theory is scaffolding, which is providing the learner with the appropriate help timely. The teacher's role is to allow the learners to come up with their questions, make their theories and test them for viability by assisting and guiding them to develop new insights that link them with prior knowledge but assign the findings and argument to the learners (VAST, 1998). Therefore, social constructivism theory is one of the theoretical frameworks that enable the creation of the data collection instruments, and, subsequently, assists in data analysis. It also framed the form in which findings would be presented in the study. Figure 2.1 below shows the nature of learning in the social constructivism theory framework that guided the study.

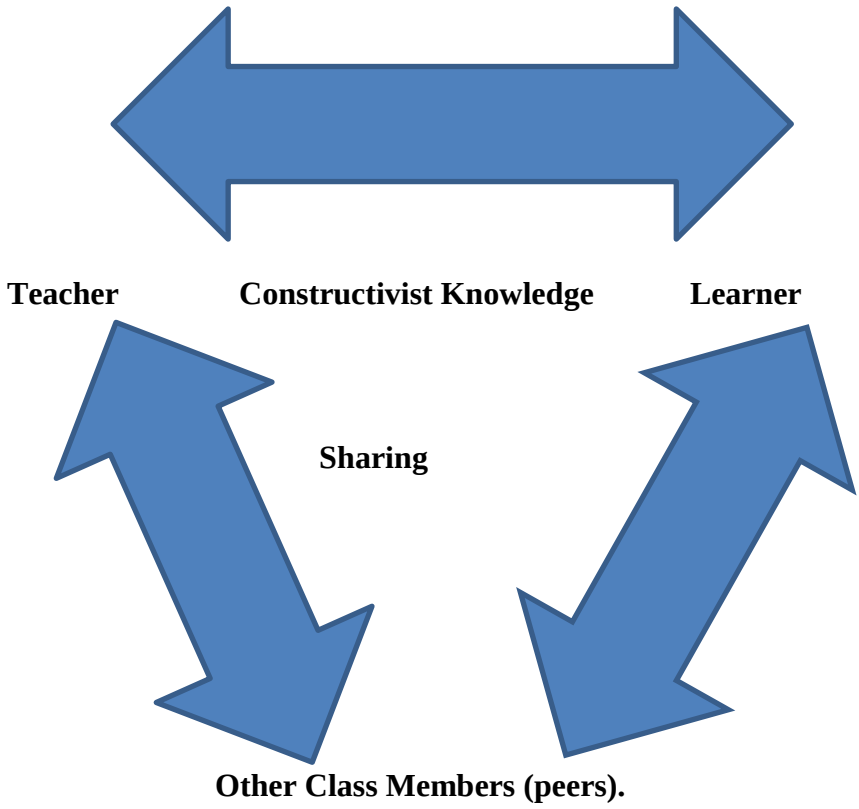

Figure 2. 1. The nature of learning in social constructivism theory (adopted from Vygotsky, 1978)

2.8.2 Pedagogical Content Knowledge

Pedagogical Content Knowledge (PCK) by Shulman (1987) is defined as the knowledge of knowing what teaching approaches fit the content, and, likewise, knowing how elements of the content can be arranged by the teacher for better teaching. This theory is significant to the study as Magnusson *et al.* (1999) suggest framing the study using Shulmans (PCK) when interviewing the teachers about the teaching strategies that they use. It involves the knowledge of teaching strategies that include appropriate conceptual representations to address the learner's difficulties, and misconceptions and foster meaningful understanding by using the best instructional method strategy that masters subject matter knowledge to learners (Magnusson *et al.,* 1999)**.** It is important to recognise that learning does not depend on or involve only the learner as well as alone, but also how the information and knowledge are imparted by the teacher to the learner to allow them to use their prior existing knowledge and

link it with what they are taught, so that they can be able to learn difficult concepts. as well. Teachers use different teaching strategies to teach and allow the learners to fully engage.

However, a practical work teaching strategy was used in the study. This provides a reason for using the PCK theoretical framework in this study. For all three schools of practice during the study, the researcher was a co-teacher and used the PCK as a strategy for collaborative teaching. This arrangement made it easy for them to investigate the perceptions of science teachers about the essence of practical activities. This teaching approach provided learners with ample opportunities to understand difficult concepts by individual teachers in turn. The CAPS (2011) policy emphasizes the need for teachers to strive for high qualification standards that demonstrate anticipated capabilities in skill and knowledge for them to teach Natural Sciences. The policy further puts much emphasis on key knowledge areas such as PCK, which is essential to the successful teaching of sciences. According to Shulman (1987), pedagogical knowledge is included in the seven knowledge forms needed for teaching purposes. These domains include knowledge of a topic, teaching practices, syllabus, learners, educational environments, as well educational goals. Furthermore, Shulman (1987) views PCK as an important blend of subject matter and teaching methods that is exclusively built by educators and is precise to teaching. Therefore, teachers need PCK to know and understand the teaching of science. PCK enables the mixing of pedagogy and content to develop insights into how certain science topics, issues and difficulties are adapted, organised and epitomised to the interests and capabilities of learners and presented for tuition.

Pedagogical Content Knowledge is generally known as the change of subject content and pedagogical knowledge. Magnusson *at el.* (1999) view pedagogical content knowledge as being a distinct combination of subject content, methodical and educational environment. Several studies view PCK as requiring unique qualities that apply to the understanding of science learning and teaching. The CAPS manifesto is an education policy, which advocates for greater science instruction that can lead to increased accomplishment for all learners. Hence, the CAPS document emphasizes the importance of practical work as teaching pedagogy in learning and teaching. Despite a variety of approaches, Natural Science classes have stayed the same. Teachers teach science mostly in abstraction using the traditional approach to science teaching. For more than the past 20 years of reform efforts, the teaching strategies used in scientific courses are the same. Furthermore, while traditional tactics aren't always terrible, they might be overused. This means that teachers often use an approach that is more traditional in their daily teaching than practical work. It becomes a huge challenge for

teachers who depend mainly on a single teaching method. Thus, it is encouraged that successful science teachers should be able to gain from the use of different pedagogical approaches. This is intended for them to understand and reflect on different ways of planning choosing, and teaching science subject matter and using appropriate pedagogy that facilitates evocative learning experiences among learners. This is the central aspect of PCK. The performance of learners in science tends to improve when teachers possess very good subject content knowledge, have good teaching experience and are complemented by a good pedagogical knowledge base. Both strong content and respectable pedagogical knowledge are adequate to advance learner attainment massively. Furthermore, the ability of teachers to improve the content and pedagogical knowledge is essential to learner attainment. By improving how science is taught, teachers will acquire new experiences that will facilitate their learning to teach in different and effective ways. Teachers will also be able to use many pedagogical strategies. Such teaching methods must involve practical work, constructivist approaches, collaborative learning and true science laboratory experiments and projects.

According to Van Driel, Beijaard and Verloop (2011), PCK could be enhanced by exhaustive brief time, skill-oriented training sessions that produce change within teachers due to the professional development of PCK. The study by Van Driel, Beijaard and Verloop (2011) found that it was of paramount importance for prospective teachers to have a sound understanding of subject content from a teaching and learning viewpoint. Another study by Halim and Meerah (2012) epitomises the importance of PCK in science lesson delivery. According to Halim and Meerah (2012), teachers are expected to be able to make accurate observations and improve and implement meaningful teaching methodologies that enhance the development skills teachers will always draw on for excellent teaching of science. That is, teachers who have pedagogical content knowledge are more likely to expand their teaching techniques as well as subject matter and, ultimately, gain more abilities and be influential in the learning of their students (Halim & Meerah, 2012). When teaching using the pedagogical method of practical work learning and teaching of science, it becomes meaningful. Thus, the researcher used PCK as the second theoretical framework in investigating teachers' perceptions about the importance of practical work in the teaching and learning of science.

2.9 The gap in the literature is being addressed.

The study seeks to address the gap in the literature on practical work not being used as pedagogy by science teachers at developing schools. Yet, it is emphasised by the CAPS policy document that it must be performed daily to improve the learners' scientific knowledge and skills in Natural Science subjects. Despite practical work being viewed as demanding, teachers are still reluctant to perform it more often. The study will address this gap to make sure that it encourages Natural Science teachers to use practical work as the pedagogy that supports scientific inquiry that centres both teachers and learners daily. Providing teachers with the necessary types of practical work, methods (scientific inquiry), guidance and a detailed explanation of how to effectively use practical work is an important pedagogy. Furthermore, it addresses the challenges those Natural Science teachers face when doing practical work in the Senior phase, as well as coming up with solutions or strategies, so that practical work can effectively take place and be included daily.

2.10 Summary

The purpose of Chapter 2 was to present a detail literature review on practical work as a pedagogy in science and how teachers can maximise its use in the South Africa Natural Science teaching at Grade 9. The literature demonstrated that practical work can be an effective pedagogy in the teaching and learning of science. The theoretical frameworks of Social Constructivism theory and Pedagogical Content Knowledge have been synthesized to form a working framework on issues highlighted in this chapter. Lastly, the literature has identified and outlined the knowledge gap to be addressed in the current study.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

Chapter 2 reviewed the literature and a suggested theoretical framework for the study. Research methodology and design are important aspects of a research study and are dealt with in the chapter. This study explored teachers' perceptions of the importance of practical work in the teaching and learning of Natural Sciences in Grade 9 in Metro East district township schools of Western Cape. This chapter presents an explanation of the application of research design, sampling methods used to collect data, as well as data analysis techniques. The chapter further describes and justifies a measure of trustworthiness as well as the research ethics of the study.

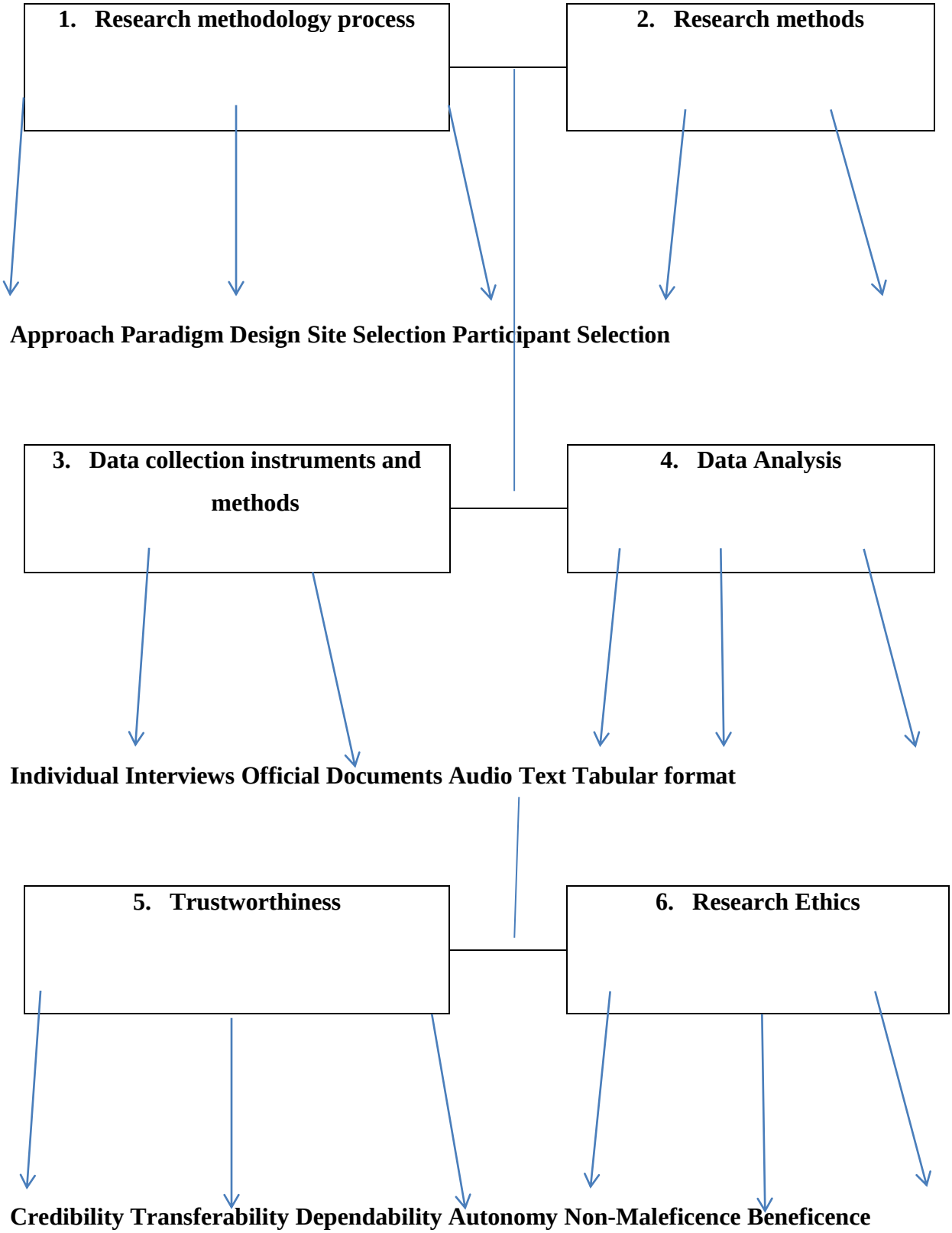

Figure 3.1. Below is a mind map summary of the research methodology process and methods used in the study

The discussion in Chapter 1 indicates that this chapter focuses on obtaining information from participants to answer the main research question outlined below:

What are teachers' perceptions of the importance of practical work in the teaching and learning of Natural Sciences in Grade 9 at township schools?

To address the main research question, the stated research sub-questions guided the study:

1. How do Natural Science teachers perceive the importance of practical work in teaching and learning in Grade 9?
2. What challenges do Natural Science teachers face when doing practical work in Grade 9?

3.2 Research Methodology Process

According to Creswell (2013), research approach is defined as a preconceived plan through which the data is to be collected and analysed to investigate the research hypothesis. Therefore, the researcher used a deductive approach to collect the data. The deductive approach is mainly concerned with developing a hypothesis based on existing theory and then designing a research strategy to test this hypothesis. According to Patton (2012), the deduction approach will assist the researcher in finding the views of the individual experiencing the particular phenomenon from their point of view. One of the strengths of the deduction approach is the active interaction (engagement) of the researcher with the subjects of the study (Patton, 2012). This technique was chosen because it allowed the researcher to be an objective observer who did not interfere with the inquiry, resulting in a plethora of thorough data from a small sample of participants (Patton, 2012). This study of the deduction approach was also underpinned by the guidelines of an interpretivism paradigm. The implication raised within this paradigm in the empirical study undertaken is the interaction between the researcher and the participants regarded in their social context (Henning, Van Rensburg, & Smith, 2014). That is, the research interview questions asked about participants' perceptions were interpreted using an interpretivism paradigm. Being deductive in approach, this study followed the qualitative research design.

Hitchock and Hughens (2015) define the qualitative research design as the method of collecting data using interviews and documents (teachers' portfolios) to a smaller sample of individuals. Furthermore, the qualitative research design gives a clear picture of the real-life

situation as it naturally happens (Hitchock & Hughens, 2015). This means that this choice was influenced by what can be done, which is practical, situational factors and interest. Hereafter, in the case of the study, the research design was used to investigate teachers' perceptions on the importance of practical work in the teaching and learning of Natural Sciences in Grade 9 at Metro East district township high schools of Western Cape experiencing this phenomenon from their point of view.

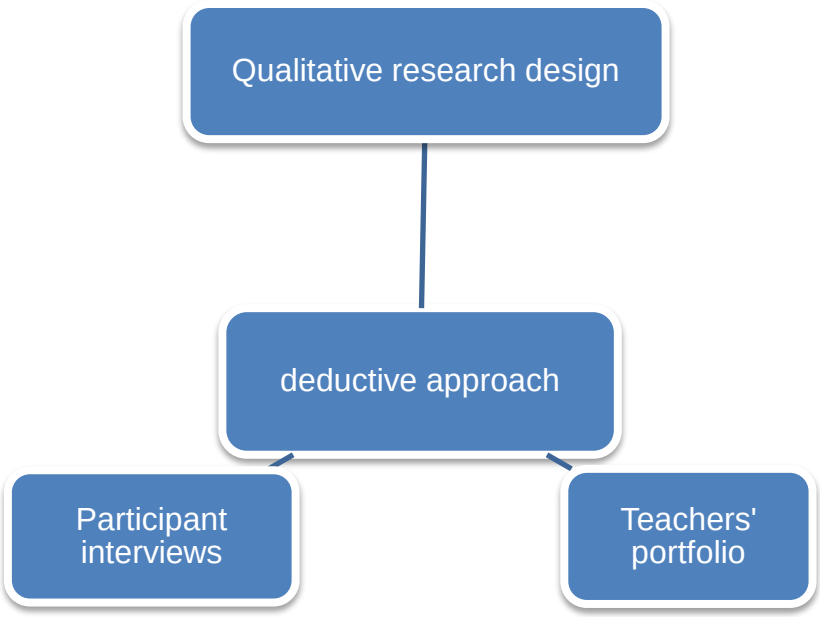

Figure 3.2: Research design

Figure 3.2 shows how the research design was utilised and this included research instruments. The deductive approach was utilised in the study and this comprised interviews with participating teachers and document analysis of teachers' portfolios. The selection of the technique was primarily motivated by the belief that a researcher should be an objective observer who neither participates in nor influences the subject of study.

3.3 Research methods

3.3.1. Site selection

A research site is a place where the researcher selects to conduct the study (Creswell, 2013). Therefore, the researcher conducted the study in public schools in townships that are situated in the Metro East district of Western Cape Province, which are under-resourced disadvantaged schools. This site was chosen because it is easily accessible or reached by the researcher.

3.3.2. Participant selection

According to Creswell (2013), participant selection encompasses a total population collected from all units of analysis about which the researcher wishes to draw specific conclusions. In this study, the participant selection was drawn from the population interest of three different teachers who are teaching Natural Sciences subject in Grade 9. Purposive sampling is used in the study because it focuses on particular characteristics of a population, which is of interest, and best enables the researcher to answer the research question (Creswell, 2013). The sample criteria of inclusion refer to characteristics that the potential participant teachers must have to participate in the study. Therefore, the inclusion criteria of selection of the sample were: 1. Natural Science teachers and they are purposefully sampled on the basis that their schools are under-resourced, 2. Participants are full-time employed at selected schools in the Metro East district township of Western Cape, 3. Participants have at least two years of teaching experience. Furthermore, the advantage of using this criterion was to assist in choosing schools and participants having distinct knowledge and practices not shared by the rest, but target sources which are rich in information and relevant to the study and it also helps with ensuring that the individual teachers who participate can provide the researcher with the information necessary to address the research questions. These samples were decided by the researcher by selecting schools in proximity, using purposive sampling of three Grade 9 Natural Science teachers who taught science in the sampled schools that are under-resourced with low pass rates. The following Table 3.1 illustrates how the criterion of selection of the sample was employed in each school.

Table 3,1: Sample Table

Participants	Sample	Technique	Inclusion criteria
Schools	3	Purposive	Schools in proximity
Teachers	3	Purposive	Grade 9 Natural Science teachers Teach in the sampled schools

3.3.3 Data collection

The data collection instruments are defined as tools or devices chosen for data collection (Kothari, 2012). Therefore, the researcher used the following two instruments as methods for collecting data, namely: Interviews and document analysis of teachers' portfolios.

3.3.3.1 Individual Interviews

An interview is a data collection technique in which the researcher gathers evidence by recording answers given by the participants of the study (Creswell, 2013; Opie, 2014).). In an interview, the participants answer questions asked by the researcher from the interview guide (Creswell, 2013). The merits of an interview technique are the increased response rate of interviewees who consent to the interview in advance and become more involved, hence they are motivated to take part in the study (Creswell, 2013). The disadvantage of using an interview is subjectivity and bias by the interviewer. Opie (2014) divides the interviews into three major types namely: structured, semi-structured and unstructured interviews

According to Opie (2014), structured interviews resemble questionnaires because they are organised around the prearranged schedule of short, direct close-ended questions seeking simple answers. Structured interviews have the following characteristics: the researcher can regulate the flow of the discussion; the use of an interview guide makes the process a bit rigid, as there are objectives to follow and structured responses to questions asked, resulting in a simple data analysis. In a structured interview, respondents may not be able to elaborate on their responses. According to McMillan and Schumacher (2014), structured interviews are beneficial in a situation where the investigator is cognisant of anything unknown and can structure questions in a way to extract essential information from the participant.

An unstructured interview is neither standard nor formal, but rather open-ended and lengthy exchanges in which the researcher asks questions without preparation (Punch, 2015). Thus,

unstructured interviews may be distinguished by their flexibility, and the path of the research interview may be unpredictable, resulting in surprising discoveries the appropriate form of the interview was semi-structured because it allowed the interviewer to ask all interviewees the same questions with minor variations. According to Opie (2014), creating an interview schedule requires the researcher to include questions that will solicit adequate information concerning the phenomenon being investigated as much as possible, as well as addressing research goals and questions. Semi-structured interviews have the advantage because they provide the researcher with a chance to probe and add on to the participants' answers as long time permits for the participant to explain key points about given answers (Opie, 2014). This implies that semi-structured interviews permit the interviewer to get more detailed information that removes the doubts of the interviewer concerning the phenomenon being studied.

As a result, the researcher utilised a semi-structured interview schedule as one of the instruments for data collection when interviewing three Natural Science teachers f from different public township high schools in the Metro East district of Western Cape face to face, seeking to investigate their perceptions of the reputation of practical work in the delivery of the Grade 9 science curriculum. In addition, face-to-face interviews were necessary for the researcher to conduct to get detailed data from participants' views about the research question (s) and they were 30-45 minutes each. All interview conversations were audiotaped with consent by the participants, as required by research ethics.

3.3.3.2. Official documents

The official documents are the documentary data from which the researcher extracted information concerning the units of study; the data was collected as it occurred at the same time with other interview instruments including teachers' portfolios (Punch, 2015). According to Punch (2015), the primary purpose of papers is to verify information from other sources. Furthermore, official documents were a sample of qualitative data sources interpreted to provide needed evidence to support what could have emanated from the interviews and the meaning attached to specific topics. Documents analysis involved coding of content into "descriptive categories and themes". Document analysis was similar to the analysis of interview transcripts. Therefore, the researcher used documents in scrutinising the teachers' portfolio checklist in tabular format, which included: teaching plans from scheme

cum plans and records of assessed work as an indication of teaching practical work to the learners. The inspection of professional documents and portfolios as well as observing lessons was given by teachers involved in the study. All the important processes were done in the presence of the teachers involved and this was important for maintaining trustworthiness.

3.4. Data Analysis

According to Kombo and Tromp (2016), data analysis requires the researcher to select categorise, compare, synthesise, and interpret the information to get insights into the phenomenon of interest. Data gathered from each participant teacher were treated independently and then categorised into themes. The data was analysed using interviews and document analysis. The data collected through interviews was coded and analysed qualitatively. Qualitative data techniques were used in this study to categorize data and detect patterns based on several topics (McMillan & Schumacher, 2014). Thus, qualitative analysis was appropriate for this study since it entails reducing gathered data to a reasonable level, creating summaries, analysing and looking for patterns. Coding was used to break down data into manageable pieces. Audio-taped interviews played repeatedly. The audio-taped data were then transcribed into text.

Meanwhile, the official documents were analysed in the same way as the data from interviews. The data from official documents is presented in a tabular format. To deal with trustworthiness (Kumar, 2012), the researcher described what is seen in the official documents. Furthermore, emerging themes from interviews and document analysis were used in answering the research question about Natural Science teachers' perceptions of the importance of practical work in teaching and learning in Grade 9, as well as the perceived challenges that they face when doing practical work.

3.5. Trustworthiness of the study

According to Kumar (2012), a research instrument's trustworthiness refers to the extent to which a research instrument measures what it has been designed to measure. Therefore, it was significant for the researcher to conduct the study properly by using semi-structured in-depth interviews and document analysis (teachers' portfolios) to ensure that data collected

from these instruments was trustworthy. When the researcher uses more than one instrument to collect data, it can triangulate, which is one of the qualitative strategies. Therefore, the following is a detailed look at the trustworthiness of the study. Lincoln and Guba (2013) argue that it is important to evaluate trustworthiness by proposing four aspects that are accurate to replicate the expectations of qualitative research. These aspects were described and made applicable in this study.

3.5.1 Credibility

According to Lincoln and Guba (2013), qualitative research credibility is used to describe how close the study findings are to the meaning research participants attach to the phenomenon being studied. To attain credibility, a qualitative researcher must be able to manage the risk of research responsiveness and bias (Lincoln & Guba, 2013). In the study, an affinity was developed with the subjects, allowing them to completely participate. For the semi-structured interview, gestures and facial expressions of participants when answering questions were analysed to ensure that the responses were not prejudiced. Therefore, the researcher transcribed the data. After the transcription, the transcripts were taken to the participants to confirm how genuine the responses were. The researcher intended to ensure that the transcripts reflect teachers' actual responses when asked questions during the interview.

3.5.2 Transferability

Lincoln and Guba (2013) define transferability as the extent to which findings are transferable or valuable to theory, practice, and future study. The findings of this study were specifically drawn from the population interest of three different teachers who are teaching the Natural Sciences subject in Grade 9 in the Metro East district of Western Cape. Meanwhile, it was difficult to make a broad view of the conclusions of other populations. Nonetheless, to address this, an account of the school and participants was given under pseudonyms, allowing for a comparison. The researcher went further to provide a research strategy and methodology so that the study could be reproduced.

3.5.3 Dependability

In qualitative research, dependability is how consistent and repeatable the research findings can be made (Lincoln & Guba, 2013). Dependability is concerned with consistency, which focuses on whether the study is repeatable and can produce similar results. Therefore, the researcher needed to conduct research properly by using semi-structured in-depth interviews

to ensure that data collected from documents (teachers' portfolios) is trustworthy. In addition, the research process and findings were put through external auditing by the supervisor to promote accuracy and assess the adequacy of the data obtained in the research study.

3.5.4 Confirmability

Confirmability is the ability of others to approve or substantiate the findings of a study (Lincoln & Guba, 2013). This aspect of confirmability in trustworthiness was dealt with by auditing the research progression, which was conducted by the supervisor of the study. Additionally, peers who are truly aware of the qualitative research, which considers the above-mentioned aspects of trustworthiness, checked the findings of this study.

3.6. Research Ethics

In safeguarding the rights of participant teachers of this study, the researcher followed the code of ethics, which is defined as moral behaviour, principle, and conscience and acting in good faith, while conducting the research guided the by values of participants. Thus, the needs and expectations of all targeted participants were chosen purposively, considered without being forced to participate and were able to withdraw from the study at their convenient time without asking for permission from the researcher (Kumar, 2012). Furthermore, Rule and John (2014) assert that conducting research following the code of ethics will prove the value of a study and boost its credibility. Therefore, the research community has the right to be appraised about the outcome, while the participants are entitled to privacy ensured by hiding their identity in the study. For research ethics to be trustworthy, below are four standard principles that were considered, as indicated by Rule and John (2014):

- **Autonomy:** This is the first ethical principle, according to Rule and John (2014), which respects the rights of the participants by being given full disclosure of the study undertaken. The researcher needs to ensure that the participants partake in the study voluntarily. Furthermore, Kumar (2012) indicates that participants should be given sufficient time to participate in the study, without any major inducement. This then, means that the researcher will give each participant the right to partake voluntarily in the

research and they are not forced to do so. When one agrees to participate, they are allowed to withdraw at any stage should they feel uncomfortable or unfairly pressured. Enough information should be supplied, and they should understand the research project before participating. The researcher first requested and obtained ethical clearance from the ethics committee of the Cape Peninsula University of Technology, where the researcher is registered for the study with this number EFEC 4-08/2022 (Appendix C).

- **Non-maleficence---** This is the second ethical guideline where the researcher guaranteed that throughout the entire research procedure, no participants or the institution were injured in any way. This principle guaranteed that the participant teachers were in safe hands and that no harm was done by the research.
- **Beneficence---** The third principle displays more magnanimity and fairness to the participants. The public has the right to know and the participants have the right to privacy in terms of protecting their identity. This belief further concerns the responsibility of the researcher to work for the good interests of the community. That involved giving feedback about the research outcomes and doing follow-up interventions about the studied phenomenon.

- **Justice---** This Is the final ethical guideline in which the researcher ensures that participants' anonymity is protected during the reporting process by employing proper confidentiality protocols. Data collected from the study excluded all identifying characteristics. Participants' information was confidentially provided, but not linked to their identity. Therefore, participants remained anonymous throughout the study. The researcher used code names for schools and pseudonyms for teachers.

3.7. Summary

Chapter 3 provided an outline of the research methodology and design adopted by this study. The sample, data gathering and analysis tools were accounted for. Further, the measures of trustworthiness of the study, which consist of credibility, transferability, dependability and confirmability, as well as the research ethics were provided.

CHAPTER 4: PRESENTATION OF RESULTS AND DISCUSSION OF FINDINGS

4.1 Introduction

The previous chapter provided a detailed discussion of the research methodology process and methods employed in the study, focusing mostly on how the research was conducted and organised. This chapter presents an analysis of the results collected using in-depth semi-structured interviews and document analysis. Qualitative data analysis was conducted to get detailed information from teachers' perspectives on the relevance of practical work. Therefore, data analysis started immediately after the transcription of all audio interviews and documents were analysed. Firstly, during the interviews, the data were recorded. Secondly, it was transcribed into the text from an audio tape played repeatedly to familiarise the researcher with the data collected and get emerging themes from interviews, in that way the transcripts were developed. Teachers' responses were coded manually and thoroughly interpreted. Then, the grouping of data followed themes identified from the data. Additionally, the findings and implications generated during data analysis were categorised and presented under each theme. Data from document analysis were analysed in the same way as the data from interviews. The results from official documents of teachers' portfolios were presented in the table.

4.2. Results from interviews

4.2.1 Theme 1: Teachers' perceptions of the importance of practical work in the natural sciences curriculum

First and foremost, with regards to teachers' perceptions of the importance of practical work in the teaching and learning of Natural Sciences in Grade 9 at three different township schools, which are the non-fee-paying public schools situated in the Metro East district of Western Cape. When questioned about the importance of practical work in Grade 9 teaching and learning, the three instructors gave typical comments, which are given below: :

T1: *OK emmm practical work is very important as it is a hands-on teaching and learning activity, learners put theory into practice… able to observe and manipulate apparatus.*

T2: *…as of importance it helps the learners to engage and understand science better as it involves learners with different needs…. meeting their needs, I have to come into contact with apparatus using our hands, so that they can learn through observation, experimentation making their conclusions in that way we are translating theory into practice.*

T3: *Right, practical work is very important because it helps the learners who are struggling with theory to cope as well…teaching is incomplete without practical work.*

All three sampled teachers perceive practical work as important in the teaching and learning of Natural Sciences in Grade 9. Furthermore, all participants indicated that they must conduct practical work because it helps the learners to understand science better through putting theory into practice, indicating that even those that are struggling with theory will cope.

4.2.2 Theme 2: Preferred methods of doing practical work in grade 9 natural sciences

Before teachers were asked about preferred methods of doing practical work, they were, firstly, asked about the types of practical jobs they knew. From the types of practical work mentioned above, they were asked about the one(s) they used when doing practical work and why they preferred this particular type. Teacher 1's response:

T1: *Errr, (long pause) I know demonstrations, experiments that's all…I used demonstrations because of lacked the necessary resources.*

The teacher's response after a long pause, is a sign of a lack of knowledge about various practical work and activities that can be used in the teaching of Natural Sciences.

Meanwhile, T2's response to the question was cited as saying, *Ummmh they are experiments, demonstrations, and investigations…I normally use demonstrations because of lack enough time plus they are time-consuming, and I'm allocated other classes to teach with a larger number of learners.*

On the other hand, T3's response, when asked about types of practical work, whether he or she knows which one he or she uses and why he or she prefers this type stated, *Mmmm I know investigations, demonstrations experiments and projects…I use demonstrations mostly because of a shortage of apparatus and lack of time.*

Apart from participants' views on their knowledge of the kind of practical work, demonstrations seemed to be the most preferred strategy for conducting practical work

activities required in the grade 9 curriculum. It became evident from participants' interviews as well as document analysis that they prefer to use demonstrations for other types of practical work; various reasons cited for this preference were a lack of necessary resources, time constraints and larger class sizes.

This theme will be discussed later in the findings as the preferred methods of doing practical work. Senior phase teachers were then asked to state how they employed preferred methods of conducting practical work in larger classes. Participants claimed that learners enjoyed conducting practical work, but they felt the opportunity they had to allow learners to work in groups as a way of enabling them to brainstorm and share ideas in that they also learn in the process was short. Participants' responses are listed below:

T1: we do it in groups….I demonstrate the type of practical work to my learners on how to do it using guided inquiry and facilitate it…

T2: …in groups using guided inquiry, so that they can engage, brainstorm and share ideas …I facilitate and guide them…by demonstrating how they must do it…in turn, they show me what they understand from it…

T3: …practical work we do in groups using guided inquiry and guide them on how to do by demonstrating…I don't just give them without explaining.

4.2.3 Theme 3: Perceptions of learners' interest and performance when engaging with natural science content through practical work

All Senior phase Grade 9 teachers claim that the learners as well as themselves learn from practical work. Their learners are more interested in the teaching and learning of practical work and even learners' performance indicates that. The following were their responses:

T1: …positive and they enjoy it…it does help with my teaching because the learners' performance improves, they pass well as they learn more science.

T2: …they are more excited, engaging and interested in hands-on activity…they perform well .. even those who are slow learners who are not active in the classroom environment, but when given practical work they perform well…

T3: …learners enjoy practical work, and they are always interested and engaged, so this does help with my teaching as it ensures that the work is drilled for permanent learning and

that learners can answer and ask questions…learners' marks as they perform better than normal theoretical assessments.

All three sampled teachers' responses indicate learners' positive disposition towards practical work, as they were observed by participants as being more interested, and this was articulated in participants' teaching, as the learners' performance improved and they learned science better, as compared to direct transmission pedagogical strategy in the natural sciences discipline.

4.2.4 Theme 4: Frequency of carrying out practical work in Grade 9 Natural Sciences Lessons

The participant teachers were asked how frequently they conduct practical work at three different township schools. The following were their typical responses:

T1: …to be honest with you, it depends on the topic we like doing… once a quarter only formal practical tasks because of limited resources.

T2: …I will be lying to say every day, but I think once in a term…only conduct for reporting purposes of assessment guideline (CASS). Apart from that, we don't have enough time…allocated other classes to teach and it is not stipulated in the school's timetable.

T3: …we conduct practical work I think about once in a term…if we conduct one task it will be for CASS because we have a shortage of apparatus and time.

All three sampled teachers during the interviews were seen to be conducting prescribed practical work for reporting purposes and, hence, only formal practical tasks were conducted once in a term. Therefore, participants in this study equivocally reported only using practical work as a tool for assessing the learners each term, not daily, as required by the CAPS policy document. In addition, the comments above show inconsistencies within the participants' responses by use of ellipsis. They were not sure how frequently they conducted practical work. This might be because they do not have stipulated timetables or manuals for practical work or that they do not have a functional laboratory to effectively conduct their practical work daily.

Furthermore, all GET Senior phase teachers engage in practical work in traditional classrooms, and the statistics suggest that they felt the need for a laboratory so that they could

perform more practical work in Natural Sciences classes. The illustrative extracts from interviews are shown below:

T1: In our school, we conduct practical work in the normal classroom…it would be more fun every day if we could have a lab to do all experiments.

T2: …in the normal classroom I show my learners what do in turn they show me what they understand from practical work. If there was a lab, our learners would do more practical activities.

T3: …probably but in this school there no working science laboratory for us to carry out simple experiments or anything that can assist learners and teachers to conduct practical work is conducted in the classroom.

According to the findings of this study, all three sampled instructors agreed that a laboratory would allow them to conduct more practical work and become more active in science teaching. Furthermore, practical work should be assigned to the school timetable. Given that they do not have a functional laboratory, they conduct practical work in the normal classroom, for this reason, under no circumstances would they prefer practical lessons to theoretical ones. For instance, T3 stated that… *I prefer practical work to be more fun and it shows that learners can learn through observation, experiment, and translating theory into practice…than theoretical lessons, which are more boring because you are only teaching and telling the learners things…*

4.2.5 Theme 5: Lack or availability of resources for conducting grade 9 natural sciences practical work

Even though T1, T2 and T3 perceive practical work as an essential pedagogy in the learning and teaching of GET Senior phase in Grade 9 Natural Sciences, afterwards they were then asked questions such as do they have adequate resources to conduct practical work and, if not, what they do when they lack resources. Presented below were their typical responses extracted from interviews:

T1: Well no…our school lacks funds… it's a township school so I improvise ...we don't receive much support from our school management team keeps on promising to acquire a science kit yearly, Unfortunately, nothing materialises from such promises… Furthermore, we never see a subject advisor except for moderation.

T2:…no we don't …when we lack certain resources I go the extra mile by asking other schools to borrow that resource or use my own money to buy that certain resource…our school does not provide much support even workshops sessions we attended to once are short sessions no experiments are done.

T3: …no we do not have adequate resources…I tend to improvise and create my resources because our school does not provide enough support…. workshops we attend once every first term of the year even…

During the interviews, all three sampled teachers acknowledged that practical work was an important pedagogy in the teaching and learning of Natural Sciences. The most common issue that was found in their interview responses was that of inadequate resources to carry out practical work. T2 and T3 shared a similar view that their schools do not provide much support, even workshop sessions are short sessions, so no experiments are done. T1 also stated that the Natural Science subject advisor rarely visits them, except during moderation. Moreover, all three sampled teachers have agreed to improvise when they lack resources by going the extra mile and borrowing resources from other schools. Teachers also confessed to facing challenges when doing practical work, a case in point is this response from T1:

T1: … lack of resources (science kit, apparatus/equipment, consumable chemical mixtures and reagents), functional laboratory with various number of learners that I had to teach (class size) having 50 minutes period and practical skills. For instance, if maybe the testing didn't go as expected where more time is required then practical work will not be conducted effectively…

4.3 Discussion

4.3.1 Teachers' perceptions of the importance of practical work in the grade 9 natural sciences curriculum

The objective of the study was to explore teachers' perspectives on the value of practical work in the teaching and learning of Natural Sciences in Grade 9 at Metro East district township high schools in the Western Cape. During the interviews, all participants in this study perceived practical work as being essential in the teaching and learning of Natural Sciences in Grade 9. Furthermore, T1, T2 and T3 indicated that they must conduct practical work because it helps the learners to understand science better by putting theory into practice,

indicating that, even those who are struggling with theory will cope. T3 response is aligned with Faize and Dahar (2011) who sums it all up by saying that teaching is incomplete without practice. Thus, the importance of practical work has led to most science curricula globally encouraging science teachers to involve learners in practical activities (Hampden-Thompson & Bennet, 2013; Topics and Allen, 2012). The teachers' perceptions about the importance of practical work indicated that they truly agreed that it is essential. This is consistent with the literature of Miller (2004) and Mazwayi and Booi (2018), who identify practical work as any teaching and learning activity that allows students to manipulate objects and materials they are studying to better understand science. Additionally, T2 and T3's responses were similar in that they truly agree with the notions of the social constructivism theory, which views each learner as unique with unique needs and that they come from different backgrounds (Cross, 2014). They interact with each other influenced by observations made in experiments to understand the real world. Learning science involves practical work that enables the learners to have hands-on experience (Miller, 2004). Through practical investigation facilitated by the teacher, they construct their understanding of the learning process by translating theory into practice. T3s response further agrees with Shulman's (1987) framework of PCK of teachers' knowing the best teaching approach that mastered the subject matter knowledge of the learners to address the learners' difficulties (Magnusson *et al.,* 1999). During the interviews, participants were all aware of the importance of practical work as the best teaching technique. The perceptions of three sampled Grade 9 science teachers' justification for the importance of practical work were positive. The study findings corroborate the findings by Kibirige, Osodo and Mgiba (2014), which indicated that teachers had adequate perceptions regarding the importance of practical work. However, teachers rarely kept records of practical work. A gap still exists in the sense that teachers are not prepared to assess practical work daily, regardless of their satisfactory perceptions. This was evident during the analysis of documents (teachers' portfolios); the assessment of learners' performance using practical work was largely neglected. Furthermore, this finding was in line with Stoffels (2015) who indicates that teachers spent limited time supervising practical work in that the bulk of science assessment was more traditional in teachers' portfolios.

4.3.2 Preferred methods of doing practical work in grade 9 natural sciences

During the teacher interviews and document analysis (teachers' portfolios), it was determined that the three sampled teachers performed demonstrations as part of their practical experience. This finding is aligned with Ramnarain's (2016) literature which reported that,

even though teachers' theoretical perceptions were satisfactory about practical work, the challenges of large, overcrowded classes made it difficult for them to include practical work daily. This may be alluding to his finding that about 64% of the teachers sampled were using demonstrations, despite the benefits of practical work. This study revealed that demonstrations of types of practicals were key for teachers to use. This agrees with Pekmez *et al*. (2015) who found that teachers preferred to use demonstration due to inadequate knowledge of other types of practical work to be done. Stoffels (2015) found that, in developing countries, teachers complained about not having enough time to supervise practical work, hence resorting to using demonstrations. This is more so in that the bulk of assessments found in teachers' portfolios were of content-based lessons. However, Kapenda *et al.* (2016) literature cited the challenge of insufficient resource materials and, in some instances, a limited number of practical work that can be performed in schools. During interviews, it was established that only T3 understood the listed samples of practical work as demonstrations, investigations, experiments, and projects (Hattingth, *et al*., 2014:75).

Furthermore, Senior phase Grade 9 teachers' responses have shown that they prefer doing practical work in groups by demonstrating the type of practical work; this statement links very well with literature reported in the studies of Dillon (2011). This does not consider practical work, if it does not involve a group of learners engaging in doing practical work on their own and with guidance from their teacher, as this improves the ability of the learners to work in groups while practising cooperative learning strategies and attaining practical skills when working together. This is like Toplis and Allen (2012:32), who argue that practical work allows learners to acquire more science skills and knowledge than in a theory lesson. According to Toplis and Allen (2012:32), "practical work that is done in a group influences positive fondness and better understanding." Furthermore, participants indicated that they use only one type of inquiry (guided) and demonstrations which align with the theoretical framework of Vygotsky (1976) that emphasizes learners as being actively involved through working hand in hand with each other in the learning process to construct their knowledge (Windschitl, 2014). With the assistance of the teacher as an instructor and facilitator of knowledge acquisition experience, learners become equally involved in the learning and they learn from one another (Dillon, 2011; Mazwayi & Booi, 2018).

4.3.3 Perceptions of learners' interest and performance when engaging with natural science content through practical work

The sampled teachers' views regarding overall attitudes of learners towards practical work have shown that the latter were interested, and they do feel positive. As reported in Braund and Driver (2012), this demonstrates that "practical work enables learners to learn more about science." Therefore, these findings reaffirm the notion that teaching using practical work permits learners to develop better insights into science, due to their ability to see how the whole works, rather than being "spoon-fed" by teachers. Working hands-on in the activity of practical work ensures that the work is drilled for permanent learning and their performance improves. Furthermore, participants indicated that learners perform better, as they can interact with each other.

4.3.4 Frequency for conducting practical work in grade 9 natural sciences.

The frequency of teachers teaching using practical work in their schools was investigated. The three participant teachers regarded practical work as important, but they did not conduct practical work daily due to the challenges that they encounter when doing practical work, which include inadequate resources, non-functional laboratory, lack of time (Onwu and Stoffels, 2015) and larger class size (Ramnarain, 2016). This finding seems to concur with Treagust's (2015) literature which claims that utilising practical work in Natural Sciences is underrated, particularly by teachers from previously disadvantaged schools. Similarly, Hartly (2016) noted that the importance of practical work tends to be overlooked, since it continues not to be performed daily in our South African schools. This was evident from the findings of this study; findings from interviews reveal that teachers' carried out prescribed practical work for reporting purposes of CASS and it was only formal practical tasks once in a term. Therefore, teachers only use practical work as a tool for assessing the learners each term, not daily, as required by the CAPS policy document. The study further found that teachers tended to conduct formal practical work only, and no casual practical work was conducted. This finding was not surprising as, even in document analysis of teachers' portfolios, the only evidence of formal practical work and assessments given to learners were mostly content-based lessons, resulting in their poor performance, as they do not grasp subject content thoroughly, as compared to doing practical work on daily basis. Even the teachers' responses on how frequently they conduct practical work show inconsistencies, as they were not sure how frequently they conduct practical work if they only do it for CASS purposes. This could

be due to that they do not have specified timelines or manuals for practical work, or they do not have functional laboratories to successfully conduct practical work.

4.3.5 Lack or availability of resources for conducting grade 9 natural sciences practical work

The responses of all three sampled participants about resources equally voiced out that the lack of adequate resources for conducting practical work was one of the justifications for avoiding practical work when teaching natural sciences at under-resourced schools. Teachers pointed out that schools lacked funds and they did not receive much support in performing practical work. Even though the participants acknowledged the essence of practical work, workshops are conducted by the curriculum advisors annually, in most cases, at the beginning of the year, preferably in the first term. From this finding, it can be deduced that conducting experiments is not a priority for teachers. They, therefore, mentioned that they require more training so that practical work can be effectively done at schools. T1 said that they have never seen their Natural Sciences subject advisor, except for moderation. Nevertheless, all participants did not have adequate resources but were prepared to go the extra mile and borrow resources from neighbouring schools or use their own money to resort to improvisation and create their resources, suitable for practical work. With teachers' different explanations for carrying out practical work the way they did because of lacking the necessary resources, they end up sticking to only one preferred method of demonstration with guided inquiry. This finding corroborates with the DBE (2011) document calling upon science teachers to find ways to address a shortage of resources by being able to improvise and go the extra mile to borrow the resources that they do not have from other neighbouring schools so that practical work can be conducted. Additionally, all the teachers confessed that they have experienced the following challenges when doing practical work: lack of resources, inadequate time as a result of poor timetabling of classes, as well as large class sizes and practical skills (manuals) etc.

4.4 Results from document analysis

The documents analysed in this study were teaching plans extracted from schemes of work, lesson plans and assessment records teaching of practical work.. Practical work instruction sheets prepared by teachers were inspected for their design, plan, and organisation of the practical activity. Most documents were poorly designed and improperly organised, a sign that teachers put little effort in preparing for practical work. Furthermore, teachers’ portfolios

contained theory lesson plans, an indication that practical work received peripheral attention. In some case, teachers never kept important documents used for planning for a practical task such as programmes of assessments timetables, or manuals for teaching practical activities to be taught daily. The only records that all teachers had were mark lists for prescribed practical tasks used for reporting purposes in Continuous Assessment Strategies (CASS). Table 4.1 presents findings for portfolios.

Table: 4.1: Results from teachers' portfolio

Participant teacher	**Types of documents**	**Evidence of practical work**
1	Teaching plan from schemes of work	➢ No teaching plan for practical work ➢ Missing practical work annual work scheduled
	Lesson plan	➢ Content-based lesson plans ➢ No lesson plan for practical work
	Design of the lesson	➢ Teacher demonstrations ➢ Grouped learners on how to complete practical work using guided inquiry and it is facilitated by the teacher.
	Assessment records of work	➢ No assessment plan for practical work, except for reporting purposes of CASS.
2	Teaching plan from schemes of work	➢ Available, but does not cater for practical work daily
	Lesson plan	➢ Content lesson plans are available and no lessons for practical work.
	Design of the lesson	➢ Demonstrations and guided inquiry by the teacher. ➢ Learners are divided into groups and are allowed to show what they understand from practical work.
	Assessment records of work	➢ Not available ➢ Available marks recorded termly of practical work are for CASS
3	Teaching plan from schemes of work	➢ Not available in the portfolio
	Lesson plan	➢ Lesson plan for teaching content available ➢ No lesson plan for practical work

Participant teacher	Types of documents	Evidence of practical work
	Design of the lesson plan	➢ Demonstrations and guided inquiry by the teacher. ➢ Learners are grouped and they do practical work with help from the teacher.
	Assessment record of work	➢ Assessment records for practical work are for CASS.

4.5 Implications of the study

The implications to Natural Science teachers, principals, curriculum consultants, and the education department are to emphasise the importance of practical work that learners accomplish effectively to boost their learning ability. Knowledge can hardly be transmitted directly from teachers to learners. In science, learners should be engaged in their learning so that they can actively create meaning for new material. This is effectively achieved through observing and seeing science concepts; thus, this involves the availability of resources and learners being completely hands-on to practical work.

After the researcher visited three township schools, the researcher found that there was no functional laboratory, however, teachers had positive perceptions about the importance of practical work in the teaching and learning of Natural Sciences in Senior phase Grade 9. Besides their positive perceptions about practical work, it was not performed daily, with teachers indicating various challenges that they encountered when doing it. Thus, the DBE should encourage schools to allocate more money to science resources that are needed to conduct practical work. The needed resources are kits, equipment, consumables such as chemical mixtures and reagents and functional laboratories. There is a need to train teachers to be acquainted with practical work. The three sampled teachers were prepared to go the extra mile and borrow resources from other schools, no matter what the conditions were. Hereafter, teachers need to be encouraged to perform practical work daily, instead of just improvising only for reporting purposes of assessment guidelines for CASS. Thus, they need to thoroughly plan practical lessons more frequently to enhance the teaching and learning of practical work to be effective.

4.6 Summary

This chapter presents and analyses data obtained through interviews and document analysis of teachers' portfolios, which are summarized in a tabular fashion, Lastly, this chapter provides empirical findings and a discussion of the data collected. The implications of the study were also discussed clearly.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The previous chapter presented the analysis and discussion of the results collected utilizing in-depth semi-structured interviews and document analysis of teachers' portfolios. This chapter presents conclusions and recommendations derived from the findings of the study concerning the perception of teachers on the importance of teaching Natural Science to Grade 9 using practical work. .

5.2 Conclusions

The study's findings revealed that teachers in township schools appreciated the importance of using practical activity in Natural Sciences at Grade 9. Although teachers had perceive practical work as being important, rarely did they use it as pedagogy for daily teaching, as recommended in the CAPS curriculum. Furthermore, the results collected from teachers' responses to research questions and document analysis have proven that they did not have stipulated timetables and teaching plans for practical work. Meanwhile, teachers were prepared to go the extra mile and improvise no matter what the conditions were by using only one preferred method of demonstration and guided inquiry. Furthermore, teaching science with an important emphasis on inquiry practical work, as the pedagogy prescribed by CAPS, needs to be implemented to enhance teaching and learning to be effective. There is a dire need to provide adequate resources for conducting practical work in schools. Time and larger class sizes, as the challenges that teachers encounter in these township schools, must be addressed. Teachers' pedagogical knowledge needs to be developed by being properly trained to enable them to carry out meaningful science practical work more often. Practical work as a teaching technique has been found to provide good possibilities for learners to comprehend science curriculum content through interaction and engagement in hands-on practical exercises.

5.3 Recommendations for further research

This study investigated teachers' perceptions of the importance of practical work in the teaching and learning of Natural Sciences in Grade 9 at three township schools. Time constraints prevented the study from involving more than three schools and teachers. The study recommended a repetition of a similar research with a larger sample size of science

teachers to acquire a better understanding of teachers' viewpoints on the value of practical work.

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Appendix A: Interview schedule for Grade 9 Natural Science teachers.

Semi-structured interview questions

1. How do you perceive the importance of practical work in the teaching and learning of Natural Sciences in Grade 9?
2. What types of practical work do you know?
   2.1 From the types of practical work that you have mentioned above, which one(s) do you use when doing practical work?
   2.2 Why do you prefer that particular type of practical work?
3. What is your preferred method of doing practical work in larger classes?
   3.1 How do you employ your preferred method when doing practical work in larger classes?
4. What is your view on learners' attitudes towards practical work in Natural Science?
   4.1 Does this help with your teaching?
   4.2 Is learners' performance influenced by this?
5. How frequently do you conduct practical work?
6. Is there any specific functional laboratory for conducting practical work in your school?
   6.1 If no, where do you conduct practical work?
7. Which type of lesson do you prefer, more theoretical or practical lesson?
   7.1 Why do you prefer this type of lesson more?
8. Do you have adequate resources to carry out practical work in your school?
   8.1 If not, explain why?
   8.2 What do you do when you lack resources?
9. Do you face challenges when doing practical work?
   9.1 If yes to the above question, mention what challenges you face when doing practical work in Natural Science.

Appendix B: Document Analysis (teachers' portfolio)

Participant teacher	**Types of documents**	**Evidence of practical work**
1	Teaching plan from schemes of work	
	Lesson plan	
	Design of the lesson	
	Assessment records of work	
2	Teaching plan from schemes of work	
	Lesson plan	
	Design of the lesson	
	Assessment records of work	
3	Teaching plan from schemes of work	
	Lesson plan	
	Design of the lesson plan	
	Assessment records of work	

Appendix C: Ethical clearance letter

Cape Peninsula
University of Technology

Faculty of Education
Highbury Road
Mowbray
7700
Tel: +27 21 959 6583

FACULTY OF EDUCATION

On the **30 August 2022** the Chairperson of the Faculty Research Ethics Committee of the Cape Peninsula University of Technology granted ethics approval **(EFEC 4-08/2022)** to **N. Boyi** for an **MEd degree**.

Title:	**Teachers' perceptions of the importance of practical work in the teaching and learning of Natural Sciences in Grade 9 at township schools.**

Comments:

The Faculty Research Ethics Committee unconditionally grants ethical clearance for this study. This clearance is valid until **31st December 2025**. Permission is granted to conduct research within the **Faculty of Education only**. Research activities are restricted to those details in the research project as outlined by the Ethics application. Any changes wrought to the described study must be reported to the Ethics committee immediately.

Date: 5 September 2022

Prof. Zayd Waghid

Chair of the Faculty Research Ethics committee

Faculty of Education

efec@cput.ac.za

Appendix D: Research approval letter from the Department of Education

Western Cape Government
Education

Directorate: Research

meshack.kanzi@westerncape.gov.za
Tel: +27 021 467 2350
Fax: 086 590 2282
Private Bag x9114, Cape Town, 8000
wced.wcape.gov.za

REFERENCE: 1645DCF1800004A-20230613
ENQUIRIES: Mr M Kanzi

Mrs Nitia Boyi
4511 Tsietsi Mashinini Road
Samora Machel, Phillipi
Cape Town
7785

Dear Nitia Boyi,

RESEARCH PROPOSAL: TEACHERS' PERCEPTIONS OF THE IMPORTANCE OF PRACTICAL WORK IN THE TEACHING AND LEARNING OF NATURAL SCIENCES IN GRADE 9 AT TOWNSHIP SCHOOLS.

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **4 September 2023 till 30 September 2024.**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Mr M Kanzi at the contact numbers above quoting the reference number.
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

The Director: Research Services
Western Cape Education Department
Private Bag X9114
CAPE TOWN
8000

We wish you success in your research.

Kind regards,
Meshack Kanzi
Directorate: Research
DATE: 4 September 2023

Appendix E: Letter To The School Requesting Permission to Conduct Study.

Letter To The Principal Requesting Permission To Conduct Research At The School For Masters' Degree (Science Education).

Dear: Principal A

My name is Nitia Phiwekazi Boyi. I am presently registered at Cape Peninsula University of Technology for Masters in the field of Science Education. I formally request permission to conduct research at the school that will be part of the basis of my research under the supervision of Dr Booi. The research will investigate teachers' perceptions on the importance of practical work in the teaching and learning of Natural Sciences in Grade 9 at township schools. I can assure you that in no way will my research interfere with the normal running of the school timetable. My intended research work at the school will entail collection of data through official documents like teachers' portfolios and interviews, whereby I will be interviewing three teachers who are teaching Natural Sciences in Grade 9 as the subject, focusing on their perceptions about the importance of practical work, conducting follow-up interviews and making audio recordings of all interviews. All participants will be informed in advance, and everything will be explained to all participants beforehand, their rights and responsibilities. The data collected will remain confidential and anonymous. The names of the teacher and your school will not be used in the analysis of the data.

This study will contribute by benefiting and awakening Natural Sciences teachers about the importance of practical work in the teaching and learning at township schools. The finding from this study will be used as a tool to inform all the educational stakeholders about the challenges township schools face when exercising the CAPS curriculum syllabus in terms of practical work.

Upon the completion of the study, I undertake to provide the school with a bound copy of the full research report. If you require any additional information regarding my research, please do not hesitate to contact me on 063 072 7995 or email: nitiaphiwekazib@gmail.com.

Yours faithfully

Nitia Phiwekazi Boyi

Consent form (Principal)

As the principal of the school A, I hereby give consent to Nitia Phiwekazi Boyi to involve the Natural Sciences Grade 9 teacher in the investigation study.

Principal's signature: ..... **Date:** 04/09/2023

Researcher's signature: NP Boyi **Date:** 4 September 2023

Appendix F: Letter of consent for teachers' (participants)

4511 Tsietsi Mashinini Road

Samora Machel

Phillip

7785

LETTER REQUESTING CONSENT FROM TEACHER TO PARTICIPATE IN THE STUDY.

Dear: Teacher 1

My name is Nitia Phiwekazi Boyi and I am writing to request permission to conduct a research study at your school. I am currently enrolled, doing my Masters in the field of Science Education at Cape Peninsula University of Technology. I am investigating teachers' perceptions of the importance of practical work in the teaching and learning of Natural Sciences in Grade 9. I would like you to be part of my research. I will collect data from your official documents (teachers' portfolios) and interview you.

The interviews will be voice-recorded (audio). All recordings will remain confidential and anonymous; the name of the teacher and the school will not be mentioned. Participation is voluntary and you as a teacher can withdraw at any stage should you feel uncomfortable without giving reasons for doing so.

I am looking forward to your response as soon as possible. If you require any additional information regarding my research, please do not hesitate to contact me on 063 072 7995 or email: nitiaphiwekazib@gmail.com

Yours faithfully

NP Boyi

Nitia Phiwekazi Boyi

TEACHERS' CONSENT FORM TO PARTICIPATE IN THIS STUDY

1. I have understood the purpose and the nature of the study explained to me by the researcher. ✓
2. I have had enough information and I am prepared to fully participate in the study. ✓
3. I understand that participation of the research study involves answering questions asked. ✓
4. I agree to my interview being audio voice recorded. ✓
5. I understand that my participation to partake in this study is voluntarily and that I can withdraw at any stage should I feel uncomfortable without giving any reasons or being penalised for doing so. ✓
6. I am quite aware that the data collected and findings will be processed into research report, journal publications or be presented in conferences, but my participation will be kept anonymous and confidential. ✓
7. I fully agree to participate in the research study. I have received a copy and signed consent agreement form. ✓

I T1, confirm that the researcher asking my consent to take part in the research study has truly informed me about the nature, procedure and potential benefits of participation.

Participant Signature: ..... **Date:** 04-09-23

Appendix F: Interview transcripts

Interview transcript TEACHER 1 (School A)

Interviewer: Nitia Phiwekazi Boyi **Date:** 4 September 2023

Title: Teacher's perceptions on the importance of practical work in the teaching and learning of Natural Sciences at township schools.

Research question: What are teachers' perceptions on the importance of practical work in the teaching and learning of Natural Sciences in Grade 9 at township schools?

Researcher: My research question is about teachers' perceptions on the importance of practical work in the teaching and learning of Natural Sciences focusing on grade 9, mainly because I'm trying to find out your perceptions about this particular phenomenon from your point of view. I would like to thank you so much for allowing me to interview you. During the interview, I'm going to ask you some few questions. If you do not understand any question, you are allowed to ask me to elaborate further. And one more thing, I want you to be free as much as you can, as this in not a test, you are not going to fail or pass for answering. In this interview, there is no correct or wrong answer. All I want from you is to be honest in answering the questions. By the way, this is between me and you; nobody will know how you answered here. As a matter of fact, I will not say your name, or indicate that you answered this way, Okay? Just be free and you can express yourself in the language that you are comfortable on, let alone that I'm speaking in English, you can also say some terms you do not understand in the language that you are comfortable with. Now, let's move on to the first question: How do you perceive the importance of practical work in the teaching and learning of Natural Sciences in Grade 9?

T1: Ok emmm practical work is very important as it is a hands-on teaching and learning activity, learners they put theory into practice… able to observe and manipulate apparatus.

Researcher: thank you, now if I may ask this question! What types of practical work do you know?

T1: Errr, (long pause) I know demonstrations, experiments…that's all.

Researcher: From the types of practical work that you have mentioned above, which one(s) do you use when doing practical work? Why do you prefer that particular type of practical work?

T1:

Errr type of practical work I used demonstrations because of lacking the necessary resources.

Researcher: So what is your preferred method of doing practical work in larger classes? How do you employ your preferred method when doing practical work in larger classes?

T1: we do it in groups….I demonstrate the type of practical work to my learners on how to do it with using guided inquiry and facilitates it…

Researcher: Ok then, what is your view on learners' attitudes towards practical work in Natural Science? Does this help with your teaching? Is learners' performance influenced by this?

T1: Uhmm learners attitude towards practical work are positive and they actual enjoy it…it does really help with my teaching because the learners performance improve they pass well as they learn more science.

Researcher: How frequently do you conduct practical work?

T1: …to be honest with you, it depends on the topic we like doing… once a quarter only formal practical tasks because of limited resources.

Researcher: Is there any specific functional laboratory for conducting practical work in your school? If no, where do you conduct practical work?

T1: …no functional laboratory in my school, we conduct practical's in the normal classroom.

Researcher: Which type of lesson do you prefer more theoretical or practical lesson? Why do you prefer more this type of lesson?

T1: Uhmmm…you know I prefer more practical work because learners are more hands on in the teaching and learning with putting theory into practice of what they have learned…

Researcher: Ok then, do you have adequate resources to carry out practical work in your school? If not explain why? What do you do when you lack resources?

T1: Well no…our school lack funds…basically its township school so I improvise ...we don't receive much support from our School Management Team in short SMT promise to purchase the science kit when they make yearly budget. But that does not happen… Besides that we never saw our Natural Science subject advisor except for moderations.

Researcher: Do you face challenges when doing practical work? If yes to the above question, mention what challenges do you face when doing practical work in Natural Science?

T1: Yeahh, of course there are many challenges that I face when doing practical work just to name a few (uhmmm) lack of resources (science kit, apparatus/equipment, consumable chemical mixtures and reagents), functional laboratory with various number of learners that I had to teach (class size) having 50 minutes period and practical skills. For instance, if maybe the testing didn't go as expected where more time is required then practical work will not be conducted effectively…

Appendix G: Document Analysis tabular format (teachers' portfolio)

Participant teacher	**Types of document**	**Evidence of practical work**
1	Teaching plan from schemes of work	➢ No teaching plan for practical work ➢ It does not include annual work scheduled for practical work.
	Lesson plan	➢ Content based lesson plans ➢ No lesson plan for practical work
	Design of the lesson	➢ Demonstration by the teacher ➢ Learners are grouped on how to do practical work using guided inquiry and it is facilitated by the teacher.
	Assessment records of work	➢ No assessment plan for practical work, except for reporting purposes of CASS.
2	Teaching plan from schemes of work	➢ Available but does not cater for practical work daily
	Lesson plan	➢ Content lesson plans available and no lessons for practical work.
	Design of the lesson	➢ Demonstrations and guided inquiry by teacher. ➢ Leaners are divided into groups and are allowed to show what they understand from practical work.
	Assessment records of work	➢ Not available ➢ Available mark recorded termly of practical work are for CASS
3	Teaching plan from schemes of work	➢ Not available in the portfolio
	Lesson plan	➢ Lesson plan for teaching content available ➢ No lesson plan for practical work

	Design of the lesson plan	➢ Demonstrations and guided inquiry by the teacher. ➢ Learners are grouped and they do practical work with help from the teacher.
	Assessment record of work	➢ Assessment records for practical work are for CASS.