



**Implementation of Natural Sciences and Technology practical activities by novice and expert teachers**

**Patricia Makhubele**

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**Supervisor: Dr A.L Abrie**

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## DECLARATION

**Full name:** Patricia Makhubele

**Student number:** 29652953

I declare that:

**“Implementation of Natural Sciences and Technology practical activities by novice and expert teachers”** is my own work. The sources that I have use and quoted in this study have been acknowledged by means of a complete reference

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## ETHICS LETTER

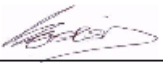


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Marielle Tappan  
Faerie Glen, Pretoria  
Tel 072 474 1158  
Email [mteditorialinfo@gmail.com](mailto:mteditorialinfo@gmail.com)



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## ABSTRACT

The importance of practical activities has been outlined in many articles and research studies. This study presents the way in which two novice and two expert teachers conduct practical activities in their intermediate phase in Natural Sciences and Technology (NST) classrooms and the challenges they face. This study was conducted in primary schools because researchers such as Mihret (2014, p.2) believe that “primary level science education is a cornerstone to lay a foundation to get young citizens interested in science”.

This study utilised a qualitative case study approach. The data was collected through classroom observations, open ended interviews and document analysis. The population of this study consisted of primary school teachers teaching Natural Sciences and Technology. The participants included two novice teachers and two expert teachers. The conceptual framework that guided this study emerged from the literature review. The conceptual framework of this study was based on concept of practical activity and the four pillared cognitive design framework.

The findings of this study indicated that the way that novice and expert teachers conduct practical activities differ and they face different challenges when conducting practical activities. Novice teachers conduct teacher centred activities, they do not allow their learners to conduct independent practical activities, they use practical activities as a way to remind learners of the work done in the classroom and they mostly use previously developed worksheets during practical lessons. Expert teachers on the other hand conduct learner centred practical activities, they allow their learners to work independently and they do not always use worksheets in their practical activities. The findings also indicated that novice teachers face more challenges in their practical lessons than expert teachers. Novice teachers find it difficult to manage their learners’ behaviour during practical lessons, they did not have confidence in their learners and they did not have effective disciplinary strategies. However, both novice and expert teachers had a challenge managing their time during their practical lessons.

**Key words:** Novice teachers, expert teachers, Natural Sciences and Technology, practical activities implementation, practical activity challenges, Intermediate Phase

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## ABBREVIATION AND ACRONYMS

Bed	Bachelor of Education
CAPS	Curriculum and Assessment Policy Statement
DoBE	Department of Basic Education
GDE	Gauteng Department of Education
NST	Natural Sciences and Technology
MST	Mathematics Science and Technology
HOD	Head of Department
USA	United State of America

## CHAPTER 1

### 1. Introduction

Several research findings have outlined challenges and shortcomings pertaining to teaching and learning science. Science education should develop scientific literate learners, hence promoting science education in primary level should not be underestimated. Studies have shown that most science teachers are dependent on textbooks when teaching science in both primary and secondary schools (Fitzgerald, 2012). This study examined the way in which novice and expert teachers conduct practical activities in their Natural Sciences and Technology classrooms.

In this introductory chapter, the background of this study will be explained as well as, the problem statement, research questions, rationale of this study, and benefits of this study, the objectives, the study's assumptions, lastly the concept clarification of key concepts that were used during this study will be provided.

#### 1.1 Background of this study

The interest in this study emerged from the fact that “primary level science education is a cornerstone to lay a foundation to get young citizens interested in science” (Mihret, 2014, p. 2). It is recognised that the teaching of science in schools is dominated by two types of teaching: “practical activities where learners follow the directions of the teacher to complete an experiment and the chalk and talk lesson in which learning is centred on teacher explanation and learners copying notes” (Hackling, Goodrun, & Rennie, 2001, p. 8). Refer to the way practical activities should be taught, this study was conducted in primary schools to view how novice and expert teachers are contributing towards learners learning science.

Novice teachers are teachers who have worked for 5 years or less as qualified teachers (Wonacott, 2002). Novice teachers experience an induction period during the first 5 years of their teaching. An induction period is a natural process that is not always formally planned. Novice teachers have to familiarise themselves with their new “job responsibilities, the work setting, and expectations of teaching” (McDonald & Healy, 1999, p. 14). During an induction period, novice teachers are confronted with numerous challenges. Novice teachers are

expected to fulfil the same roles as other experienced teachers who have been teaching for much longer. According to Jarvis and Algozzine (2006), novice teachers are required to possess the same skills as expert teachers. However they struggle to notice patterns in the classroom situation and most novice teachers struggle to perform given tasks outside the classroom as effectively as expert teachers (McDonald & Healy, 1999; Bransford, Brown, & Cocking, 2000).

Expert teachers on the other hand are teachers who have developed the ability to think more effectively than other teachers (Bransford, Brown, & Cocking, 2000). They are often characterised by their good discipline skills, they are very good at noticing patterns when solving challenges in a classroom situation and expert teachers have the ability to organise knowledge in a meaningful way (Gatbonton, 2008 ; Bransford, Brown, & Cocking, 2000).

The National Curriculum Statement (NCS) Grade R-12 that encompasses the Curriculum and Assessment Policy Statement (CAPS) requires Natural Science teachers, both novice teachers and expert teachers, to teach science in a way that focuses on solving problems, understanding the natural world, communicating and evaluating findings and complete investigations using practical skills (Department of Basic Education, 2012). According to Millar (2004), practical activities are seen as activities that engages several skills such as observing or controlling materials. Learners understand better when they see things practically and when they know how topics learned in science are relevant in their lives (Dillon, 2008).

This study was based on the 4 pillared cognitive design framework that was developed by Leonard, Dirfresne, Gerace and Mestre (1999). This design outlines the four knowledges teachers possess that influence their selection of a type of practical activity they conduct in their science classrooms namely; the operational and procedural knowledge, the conceptual knowledge and the problem state knowledge. The conceptual framework of this study was also based on the concept of practical activity.

The intention with the study was to find the way in which novice and expert teachers conduct practical activities in their Natural Sciences and Technology classrooms and the challenges they face.

## 1.2 Problem statement

Numerous studies show that science is not given enough time in primary classrooms (Key, 2006). Studies also show that “the way science is taught in primary schools is strongly influenced by teachers’ beliefs about teaching learning and science” (Keys, 2006). Practical activities play an important role in learners learning science. Practical activities provide learners with an opportunity to develop skills that they can use in real life situations (Millar, 2004).

Research has shown that expert teachers are better than novice teachers when organising knowledge, including knowledge related to practical activities (Bransford, Brown, & Cocking, 2000). Experts are knowledgeable in their discipline and they have the ability to conduct successful practical activities (Bransford, Brown, & Cocking, 2000). However, most of the existing research was conducted in the USA. A literature survey did not yield any similar studies that were conducted in South Africa. It is therefore not known to what extent South African novice and expert teachers conduct practical activities in their Natural Sciences and Technology classrooms and the challenge they face. This study sought to find out how South African novice and expert teachers conduct practical activities and the challenges they face.

According to research conducted in the USA, expert teachers have the ability to conduct experiments that “go beyond simple and mechanistic implementation in order for practical work to be rewarding for the learner” (Duarte, Sequeira, & Barbosa, 2002, p. 17). When practical activities are conducted successfully in science classrooms, learners are expected to become motivated to learn science, develop scientific skills, improve achievement of concepts and develop a solution driven mind (Duarte, Sequeira, & Barbosa, 2002, p. 17). If novice teachers cannot conduct successful practical activities, then practical lessons conducted by novice teachers might result in lessons that are not successful or rewarding for learners (Duarte, Sequeira, & Barbosa, 2002).

We do not know how practical activities in primary and secondary schools are conducted in South African Natural Sciences and Technology classrooms, this study was conducted in primary schools because, according to Hodson (1991, p. 176), in most science classrooms, particularly in

primary schools, practical activities are “mis-conducted, unproductive, and confusing”. As a result, practical activities contribute little to learners learning science. According to Hodson (1993), if teachers do not plan their practical activities before conducting them, their activities fail to have objectives. This study was conducted to contribute to our understanding of the way novice and expert teachers in South African classrooms conduct practical lessons in their Natural Sciences and Technology classrooms and the challenges they face.

### **1.3 Research questions**

The following research questions guided this study:

#### **1.3.1 The main research question**

How do novice and expert teachers in South Africa conduct practical activities in the Natural Sciences and Technology in the intermediate phase classrooms and what are the challenges they face?

#### **1.3.2 Sub-questions**

- Sub question 1: How do novice teachers conduct practical activities in Natural Sciences and Technology classrooms?
- Sub question 2: What are the challenges novice teachers face when conducting practical activities in Natural Sciences and Technology classrooms?
- Sub question 3: How do expert teachers conduct practical activities in Natural Sciences and Technology classrooms?
- Sub question 4: What are the challenges expert teachers face when conducting practical activities in Natural Sciences and Technology classrooms?

### **1.4 Rationale**

The researcher became interested in this study because according to an extensive literature survey done in this study, there is no literature in South Africa that compares the way novice and expert teachers conduct practical activities in science subjects in the intermediate phase of schooling. As a novice teacher teaching Natural Sciences, the researcher was also curious to



find out how novice and expert teachers conduct practical activities in the intermediate phase. This study was conducted in primary schools since according to Hodson (1991, p. 176), practical activities conducted in primary schools are mostly seen as “unproductive and of low quality’. Lastly, the researcher wanted to conduct this study because there is little literature on science in primary schools in South African Natural Sciences classrooms providing a gap of knowledge.

### **1.5 Benefits**

This study investigated how novice and expert teachers conduct practical activities in their Natural Sciences and Technology classrooms. This study has the potential to benefit various individuals, groups and institutions in the following ways:

- It could enable Natural Sciences and Technology teachers to learn from the success of other teachers who successfully conduct practical activities in their classrooms.
- Most Faculties of Education could use the findings of the study to narrow the gap that exists between novice and expert teachers. In other words, they could strive to expose teachers in training with skills that will enable them to be better prepared when they enter their induction period.
- It could help the MST (Mathematics, Science and Technology) teams in schools to encourage their teachers to focus more on practical activities which can be performed successfully and with locally available materials.

### **1.6 Objectives**

At the end of this study the researcher wanted to find out how novice and expert teachers in South Africa conduct practical activities in Natural Sciences and Technology classrooms in the intermediate phase. According to Fittell (2008), science is not receiving enough attention in primary classrooms and most primary school teachers lack the confidence to engage in practical activities. Therefore, the intention of this study was to conduct the research at primary school level to view how novice and expert teachers are conducting practical activities and what are the challenges they face.

## 1.7 Assumptions

The following assumptions were made in this study:

- There will be a difference between the way that novice and expert teachers conduct practical activities.
- Novice teachers will face more challenges when conducting practical activities than expert teachers.
- Expert teachers will use successful strategies when they conduct practical activities.

## 1.8 Concept clarification

The following concepts are defined according to the way they were used in this study:

- **CAPS (Curriculum and Assessment Policy Statement)** is the South African National policy pertaining to the promotion requirement of the National Curriculum Statement Grades R-12 (Department of Basic Education, 2012).
- **Direct instruction** is a teacher centred approach or teaching strategy, where a learner follows work provided by the teacher step by step (Bhukuvhani, Mupa, Mhishi, & Dziva, 2010).
- **Novice teachers** are teachers with 5 years or less of teaching experience (Wonacott, 2002).
- **Expert teachers** are teachers who have more than 5 years of teaching experience and have the ability to use different kinds of knowledge. The expert teachers have “acquired extensive knowledge that affects what they notice and how they organize, represent and interpret information” (Wonacott, 2002; Bransford, Brown, & Cocking, 2000, p. 43 ).
- **An induction period** is a natural process, not formally based, wherein novice teachers familiarise themselves with their new job responsibilities, the work setting, the teaching norms and expectations of teaching (McDonald & Healy, 1999).
- **The intermediate phase** is the phase of schooling that includes Grade 4-6 (Department of Basic Education, 2012).

- **Natural Sciences and Technology (NST)** is a subject that is taught in the Intermediate phase and that combines Natural Sciences and Technology (Department of Basic Education, 2012).
- **Practical activities** are tasks that engage learners in several activities such as observing or controlling objects and materials and also conducting experiments (Millar, 2004).

### 1.9 Chapter summary

This chapter presented an overview of this study, this study purpose and objectives. A background has been provided along with a brief background of the problem statement that is related to the study, the research questions, the rationale, the benefits of this study and assumptions that were made have also been provided.

The next chapter presents the literature relevant to this study and the conceptual framework that guided this study.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

In the first Chapter, it was established that there is no general literature that exists in South Africa that compares how novice and expert teachers conduct practical activities in Natural Sciences and Technology classrooms in primary schools. The literature shows that practical activities play an important role in helping learners understand science and in becoming scientific literate citizens (Millar, 2004).

This Chapter examines the literature addressing the characteristics of novice and expert teachers in the scholarly community. The Natural Sciences and Technology curriculum in South Africa is also examined, focusing on its aims. Lastly, the definition of practical activity, the challenges teachers come across when conducting practical activities in their classrooms, and the way teachers conduct practical activities in schools is reviewed.

#### 2.2 Description of novice teachers

When teachers are called novice teachers, it is because they have just started with their teaching career and have 5 years or less of teaching experience. Not all literature agrees with the following definition. Huberman (1993) defines novice teachers as teachers with less than 3 years of teaching experience. However, in this study novice teachers refer to teachers with 5 years or less of teaching experience as qualified teachers (Wonacott, 2002).

Novice teachers undergo a transition process called an induction period. The induction period is not formal. During the induction period novice teachers familiarise themselves with their “job responsibilities, the work setting, the teaching norms and the expectations of their career” (McDonald & Healy, 1999, p. 14). An induction period may be an exciting period for novice teachers, however, it tends to be a challenging period since according to Jarvis and Algozzine (2006) most programs in higher institutions do not provide adequate information to prepare novice teachers for this induction period. During the transition period, a novice teacher moves

from the idea of what teaching should be to the reality and complexity of classroom life, and 'most' of the time the reality of what happens in classrooms does not meet the expectations of most novice teachers (Achinstein & Barret, 2004).

When novice teachers embark on their teaching career they face multiple unfamiliar roles. One challenge of being a novice teacher is that the same roles that expert teachers' fulfill are also expected to be fulfilled by novice teachers. Regardless of the fact that novice teachers lack certain skills and specific knowledge when they start teaching, the teaching profession does not tolerate incompetence from both novice and expert teachers (Ozturk, 2008).

Novice teachers enter teaching with only the experience they have acquired as students from their teaching practice modules. When novice teachers enter the profession they "acquire knowledge of learners such as of the diversity in their readiness to learn, which they use to reconstruct their image of themselves as teachers" (Kagan, 1992, p. 155). If a novice teacher does not develop his/her own identity as a teacher, that might lead them to leaving teaching because it might be frustrating for them (Kagan, 1992).

Every novice teacher has to undergo development in their teaching career before he/she can become an expert teacher (Kagan, 1992). Novice teachers have to spend time to learn how to manage learners in their classroom, only once they have mastered that can they focus on learners learning. Every teacher goes through several stages before they become expert teachers, that is if they do develop into expert teachers. Not every experienced teacher becomes an expert (Berliner, 1994 in Schneider & Plasma, 2011). Levels of teacher development starts from novice, advanced beginner, competent, proficient and then expert (Schneider & Plasma, 2011). Hence a novice teacher cannot move directly from novice to expert. A novice teacher may be good at her/his job as a teacher, but he/she is not an expert teacher yet.

### **2.2.1 Challenges novice teachers face**

When novice teachers begin their teaching careers they bring in different backgrounds, life experiences and different motivations. Novice teachers often enter their classrooms with high hopes for their learners and themselves, yet it is known that the first 5 years of teaching are challenging years (McDonald & Healy, 1999). During the first 5 years of teaching, novice teachers often start to question their quality of teaching and the learning potential of their learners (McDonald & Healy, 1999). Novice teachers are often given the most challenging and troublesome learners that their colleagues who are more experienced in teaching do not want to teach. As a consequence, these novice teachers are often faced with trying to adapt to a new environment while at the same time, they are overwhelmed with the new responsibilities their job is expecting from them (McDonald & Healy, 1999). Novice teachers may face several challenges that originate from different places such as school environment, instruction challenges and planning challenges (Davis, Petish, & Smithey, 2006).

Teachers who just started teaching may experience a challenge in the school environment they are teaching at. When a teacher starts teaching he/she is expected to adjust to school facilities, school routines and the school policies and that might be a challenge for new teachers (Mutchler, Pan, Glover, & Shapley, 2000). When novice teachers go into teaching, they have reported that they are faced with the “unforeseen reality in their role” such as the demands of them being on a “school bell” schedule (Robert & McDougall, 2009, p. 16). Another school environment challenge novice teachers may face is to adapt to the culture of the school they are currently teaching at (Okumus & Biber, 2011).

Novice teachers face several challenges with relation to instructional strategies. Studies show that ‘most’ novice teachers depend on textbooks to develop a lesson (Hover & Yeager, 2004). During novice teachers’ lessons, they try to cover a lot of content from a textbook in a single lesson (Hover & Yeager, 2004). Novice teachers also reported that they often do not get support from their colleagues, and this might result in them finding teaching a complex activity with inadequate instructional resources (Okumus & Biber, 2011). With the instructional challenges faced by novice teachers, they might show few instructional strategies that are

associated with the potential to help learners to do well in their studies (Hogan & Rabinowitz, 2001).

Another challenge reviewed in this literature experienced by novice teachers is lesson planning. Research shows that novice teachers engage mostly in short term planning (Tsui, 1996). Novice teachers spend much time and energy preparing for daily lessons. According to Hogan and Rabinowitz (2001, p. 11) it is beneficial for a teacher to focus on both short term and long term goals, because a teacher that does that is expected to be “able to perceive and recall more subtle classroom events”. One novice teacher who was interviewed by Borko in Tsui (1996) clarified that the reason novice teachers focus on the short term planning is the result of their lack of experience and professional knowledge. Expert teachers on the other hand are said to be efficient at lesson planning. These teachers do not struggle with daily lesson planning. One of the reasons is that they do not have to start preparing lessons from the beginning, they just reflect on their previous lessons and develop it to suit their learners (Tsui, 1996).

### **2.3 Description of expert teachers**

Expert teachers differ from experienced teachers because all teachers will eventually become experienced but not necessarily ‘experts’. Expert teachers are usually defined as teachers who have more than 5 years of teaching experience and these teachers have the ability to use different kinds of knowledge (Wonacott, 2002). The difference between expert and novice teachers is not generally about experts’ intelligence or their good memory (Bransford, Brown, & Cocking, 2000). Expert teachers have “acquired extensive knowledge that affects what they notice and how they organise, represent and interpret information” (Bransford, Brown, & Cocking, 2000, p. 43).

An expert teacher is expected to possess the following characteristics (Richards & Farrell, 2005, p. 7):

- *“Ability to integrate and use different kinds of knowledge*
- *Ability to make intuitive judgments based on past experience*
- *Desire to investigate and solve a wide range of teaching problems*
- *Deeper understanding of students’ needs and student learning*

- *Awareness of instructional objectives to support teaching*
- *Greater efficiency and effectiveness in lesson planning*.

When a teacher possesses the characteristics mentioned above, he/she is said to be an expert in teaching practice.

Experts have the ability to do several things such as (Gatbonton, 2008, p. 2):

*“motivate students and hold their attention, know how to manage their attention, know how to manage their classroom effectively, and can change course in the middle of a lesson to take advantage of unforeseen opportunities to enhance student learning”.*

When teachers are considered to be experts they differ from novice teachers because they are expected to handle discipline in the classroom better than novice teachers (Gatbonton, 2008).

Research shows that when experts are given a scenario to analyse, they think about many possibilities before drawing a conclusion. A study conducted in the USA elaborates on the fact that expert teachers are effective in noticing patterns (Bransford, Brown, & Cocking, 2000, p. 45):

*“Expert and novice teachers were shown a videotaped classroom lesson. The experimental set-up involved three screens that showed simultaneous events occurring throughout the classroom. During part of the session, the expert and novice teachers were asked to talk about what they were seeing. The expert teachers had a very different understanding of the events than novice teachers. Experts recognised features and patterns that were not noticed by novice teachers”.*

According to Bransford, Brown, and Cocking (2000), it is important for every teacher to have the ability to recognise patterns in a classroom situation since it improves instruction.

Other studies shows that expert teachers are teachers who enjoy challenges in the classroom and they mostly look for ways to grow their knowledge and abilities. Expert teachers are able to tolerate ambiguity in the classroom (Bransford, 2001, in Schneider & Plasma, 2011).

#### **2.4 Teaching and learning Natural Sciences and Technology in South Africa**

South Africa has amended the teaching and learning curriculum a number of times during the past 20 years. The ongoing revision of the curriculum has resulted in the National Curriculum



Statement (NCS) of Grades R-12 that encompasses the Curriculum and Assessment Policy Statements (CAPS) that are now used in schools. CAPS was introduced to amend the Revised National Curriculum Statement (RNCS) Grades R-9 and the National Curriculum Statement (NCS) Grades 10-12 (Department of Basic Education, 2012, p. 3).

The main aim of CAPS is to “give expression to the knowledge, skills and values worth learning in South African schools” (Department of Basic Education, 2012, p. 4). CAPS emphasises that the main aim of teaching is to help learners to acquire and apply knowledge and skills learned in their everyday lives. The purpose of CAPS is to educate learners to be able to do the following (Department of Basic Education, 2012, p. 5):

- *“Identify and solve problems and make decisions using critical and creative thinking;*
- *Work effectively as individuals and with others as members of a team;*
- *Organise and manage themselves and their activities responsibly and effectively;*
- *Collect, analyse, organise and critically evaluate information;*
- *Communicate effectively using visual, symbolic and/or language skills in various modes;*
- *Use science and technology effectively and critically show responsibility towards the environment and the health of others;*
- *Demonstrate an understanding of the world as a set of related systems by recognizing that problem solving contexts do not exist in isolation”.*

The focus of this study was to conduct research in the intermediate phase in the subject Natural Sciences and Technology (NST). This phase includes Grades 4-6. The Natural Sciences and Technology (NST) curriculum focus on achieving three specific aims. The first aim is about “doing science and technology”. In the first aim the main focus is on learners acquiring the skills to solve problems and complete investigations using practical processes. The second aim is about “understanding and connecting ideas”. In the second aim learners are expected to have the ability to recall scientific and technological knowledge in order to make connections. The last aim is “Science, Technology and Society”. In the last aim learners should be made aware about the applications of science and technology in society. In the “Science, Technology and Society” aim, teachers are expected to provide learning environments where learners see the

relevance of science in their everyday lives outside of school (Department of Basic Education, 2012, p. 10-11).

In this study the focus was on the first aim, “doing science and technology”. Since the aim focuses on learners acquiring skills using practical processes, it was suitable for this study.

## **2.5 Practical activities**

CAPS is expecting numerous activities from Natural Sciences and Technology teachers. One of the main requirements of CAPS is for teachers to help learners acquire and apply knowledge and skills learned in their everyday lives through practical activities (Department of Basic Education, 2012, p. 10).

In this study the term practical activity was used to refer to teaching and learning that engages learners to several activities such as observing or controlling materials (Millar, 2004). The term practical activity was not used as equivalent for laboratory work or experiments because some practical activities are not performed in the laboratory. If teachers include “discussions, demonstrations, observation or simulations in their lessons”, that was also referred as practical activity (Cossa, 2007, p. 22).

### **2.5.1 Importance of practical activities**

Practical activities are important in science classrooms because they provide the opportunity to educate learners to be scientifically literate citizens (Millar, 2004). Research shows that practical activities are important because they have the potential to help learners develop useful skills, help learners to develop scientific concepts and encourage learners to enjoy learning science.

Firstly, learners are expected to develop several skills when conducting practical activities. Learners learn how to handle and operate apparatus (Haigh, 2007). Practical activities allow learners to work hands on and they learn to make informed decisions (Millar, 2004). Learners develop good habits such as “initiative, resourcefulness, co-operation, and learn to work effectively with others” (Haigh, 2007, p. 7). Practical activities develop learners’ skills that allow them to know how to communicate using science concepts (Skoumios & Passalis, 2013). When

teachers conduct practical activities, learners are often expected to develop practical skills vital for university studies such as being critical thinkers(Reiss, 2012).

Secondly, practical activities are important because they have the ability to help learners develop scientific concepts. Research shows that learners learn scientific concepts with understanding during practical activities (Millar, 2004). When a practical activity is conducted teachers are able to reflect back on learners' work so that they may know where they need to improve their learners' scientific concepts (Millar, 2004).

Lastly, practical activities are important because they encourage learners to enjoy learning science. When learners enjoy and understand the practical activities conducted in class then they will enjoy learning science. Research shows that when learners enjoy learning science their attitudes and their interest towards science improves positively (Skoumios & Passalis, 2013). As the learners enjoy conducting practical activities, they get excited and inspired to learn more about science (Braud & Driver, 2002).

Most science teachers do take the initiative and implement practical activities in their classrooms. However, to achieve the above mentioned benefits, practical activities need to be conducted in an effective manner (Cossa, 2007).

### **2.5.2 Aims of practical activities**

According to Gott and Mashiter (1991), one of practical activities aims to allow learners to see science in the real world. Practical activities should intend to provide learners with the opportunity to learn scientific methods, scientific concepts and as a result to learn the nature of science. Practical activities should also intend to teach learners to view science as a practical endeavour(Arnold & Millar, 1996).

Lynch in Hodson (1992) states that practical activities aim to:

- Interest learners
- Improve learners scientific knowledge
- Improve learners understanding of how scientific method works

- Develop learners positive attitudes towards learning science
- Develop learners expertise in developing scientific investigations.

Research shows that the aims of practical activities will not be achieved if science teachers still follow a ‘recipe’ way of conducting practical activities. Science teachers should allow learners to have control over decision making during a practical lesson (Tiberghien, Veillard, Marechal, Buty & Millar, 2001).

### **2.5.3 Implementing practical activities in the science classroom**

A practical activity is an important part of science education, yet, the effectiveness of conducting practical activities has been questioned over the years (Skoumios & Passalis, 2013).

Most science teachers still perform a “direct instruction experiment” where learners follow the procedures given by a teacher step by step without acquiring their own knowledge and this method might result in lower cognitive activities (Haigh, 2007). According to Cossa (2007) teachers do conduct practical activities in their science lessons but, most of their practical activities are inefficient. If teachers continue to conduct practical activities in this manner, it will result in negative learning outcomes particularly in understanding science concepts and acquiring positive attitudes towards science (Cossa, 2007). The outcome of using a direct instruction approach is that it does not prepare learners for the skills needed in the 21<sup>st</sup> century (Bhukuvhani, Mupa, Mhishi, & Dziva, 2010).

According to Millar (2004, p. 2), it is not an easy task to state whether the teacher has conducted or implemented an effective practical activity as the word practical activity “is a very broad category”. The manner in which science teachers implement practical activities is influenced by different factors such as (Millar, 2004, p. 2):

- *Teachers’ objectives - teachers view of science, teachers view of learning and the practical context*
- *What the learners actually do- learners’ views of science*
- *What the learners actually learn- learners’ views of learning science*

When science teachers have implemented an effective practical activity they allow learners to have control of “decision-making process and not simply have to follow a recipe” (Millar, 2004, p. 7). It is important that science teachers conduct practical activities in an effective manner so that learners may benefit positively.

#### **2.5.4 Challenges in implementing practical activities**

There are several factors that influence the implementation of practical activities. Firstly if science teachers perceive that their learners have a low capacity to learn, they will conduct practical activities where the teacher does the demonstrations and learners participate in a very structured closed (direct instruction) practical activity.

Secondly, according to science teachers many learners in their classrooms have repeated at least one grade in their lives (Hattingh, Aldous, & Rogan, 2007). Learners who are repeaters are seen as “disruptive and possibly a nuisance in the class, and hence less practical activity is attempted”. It seems that teachers find it a challenge to conduct practical activities at any level since the majority of learners in classrooms are seen as disruptive, therefore learning does not become meaningful when learners perform a practical lesson (Hattingh, Aldous, & Rogan, 2007, p. 4).

Lastly, according to research that was conducted, science teachers state that their reasons for not conducting practical activities are because of the following (Kibirige, Osodo and Mgiba, 2014, p. 18):

- *“There is no space for conducting practical activity.*
- *There’s not enough equipment to conduct lab-work and no funds.*
- *Some claim that they do not have skills to use practical equipment.*
- *Some say the curriculum does not give them enough time to conduct practical activity”.*

Millar (2004) explains in his study that some teachers are concerned that practical activities do not promote effective learning. Teachers state that most learners do not learn what they want

them to learn during practical lessons. Hence this causes science teachers to question the effectiveness of practical activities (Millar, 2004).

## 2.6 The Conceptual framework

The conceptual framework of this study is based on the concept of “practical activities” and the 4 pillared cognitive design framework of knowledges. The way in which practical activities should be conducted in schools is discussed. The knowledge of novice and expert teachers which influences the type of practical activities they conduct is also discussed.

Practical activities refer to teaching that engages learners in several activities such as observing or controlling objects and materials (Millar, 2004). Practical tasks are rewarding to learners only when they are effective.

Hattingh, Aldous and Rogan (2007) divide the conducting of practical activities in four different levels. These levels represent a development from the lowest level (1) to the highest level (4) based on the way in which a science teacher conducts his/her practical activities. The four different levels are discussed below.

The **first level (1)** is teacher centred; a teacher does almost everything for the learners. This level is closed ended, meaning it does not allow learners to construct their own knowledge, therefore, it is not rewarding for the learners (Hattingh, Aldous, & Rogan, 2007). The **second level (2)** is also teacher centred, however, at this level a teacher conducts practical activities that promote learners’ inquiry. On this level some learners conduct practical activities themselves, however, the practical activities are “closed direct instruction”, they do not develop scientifically literate learners (Hattingh, Aldous, & Rogan, 2007).

The **third level (3)** is more effective than level 1 and 2. Learners are “encouraged to discover information” (Hattingh, Aldous, & Rogan, 2007). When teachers conduct level 3 practical activities learners have a good chance of acquiring skills that will make them scientifically literate citizens (Hattingh, Aldous, & Rogan, 2007).

The **last level(4)** is the most effective level. On this level learners develop their own practical activities. According to Millar (2004, p. 20) if the teacher is the one who developed learners’

practical activities, then that practical activity is “more open-ended, it develops learners’ tacit knowledge of scientific enquiry”.

Practical activities can be categorised on any of these four levels. Table 2.1 below was adapted from Hattingh, Aldous, and Rogan ( 2007, p. 3).

**Table 2.1 Different levels and types of practical activities**

Level	Types of science practical activities
1	<ul style="list-style-type: none"> <li>• “Learners are given detailed instructions on what to do.</li> <li>• Practical activities completely determined by the teacher.</li> <li>• Questions given, and detailed instructions on process.</li> <li>• The activity is proposed by the teacher, no clear links made to previous work.</li> <li>• After the practical activity there is no discussion.</li> <li>• Learners do not record the activity”.</li> </ul>
2	<ul style="list-style-type: none"> <li>• “Learners participate in closed (direct instruction) practical activities.</li> <li>• Some learners assist in planning and performing the demonstrations.</li> <li>• Learners communicate data using graphs and tables.</li> <li>• The Purpose of the activity is explained by the teacher, and is clearly linked to preceding work.</li> <li>• Discussion after the practical activity is centred on a demonstration in which the teacher repeats the practical activity.</li> <li>• Learners record the practical activity by completing a worksheet given by the teacher.”</li> </ul>
3	<ul style="list-style-type: none"> <li>• “Teacher designs practical activities in such a way as to encourage learner discovery of information.</li> <li>• Learners perform guided discovery type practical activities in small groups engaging in hands-on activity.</li> <li>• Questions are given, but learners choose how to proceed.</li> <li>• Purpose of the activity readily apparent to the learners, and clearly follows previous work.</li> <li>• After the practical activity, learners discuss and explain the observations and</li> </ul>

	<p>develop conceptual ideas that relate to the task.</p> <ul style="list-style-type: none"> <li>• Learners record the activity by writing a report with a given structure and format”.</li> </ul>
4	<ul style="list-style-type: none"> <li>• “Learners design and do their own 'open-ended' investigations</li> <li>• Learners decide the question and how to proceed.</li> <li>• The activity is proposed and specified by the learners, following discussion.</li> <li>• Learners reflect on the quality of the design and data collected and make improvements when and where necessary.</li> <li>• Learners can interpret data in support of competing theories or explanations.</li> <li>• Learners record the activity by writing a report in a format chosen by the learner”.</li> </ul>

The four “pillared cognitive design framework (**CDF**)” was developed by Leonard, Dirfresne, Gerace and Mestre (1999). This framework involves 4 different types of knowledgesnamely **operational and procedural knowledges, conceptual knowledge** and **problem state knowledge** (Leonard *et al.*,1999).

**Operational knowledge** can be defined as “a set of procedures or norms used by telecommunication operators to construct a genuine strategy tailored to the peculiarities of a given situation” (Valente & Rigallo, 2002, p. 124). Valente and Rigallo (2002, p. 127) further state thatoperational knowledge is mainly based on “individual competence and experience developed by skilled workers during their day-to-day activities. **Procedural knowledge** can be “procedures that are needed to bring knowledge into existence where every step have to be done. It is knowledge of formal language or symbolic representations. Knowledge of rules, algorithms and procedures”(Johari, Nor Hasniza & Mahani, 2012, p. 418).

**Operational and procedural knowledge** is the knowledge where teachers have the ability and the skills to take control of their learners’ behaviour without struggle. A teacher may use this knowledge to solve problems. Procedural knowledge is important in the science classroom because it allows learners to “deal effectively with a dynamically changing world”. **Conceptual knowledge** is a knowledge “that is rich in relationship and understanding. It is a connected web of knowledge, a network in which the linking relationship are as prominent as the discrete bits



of information”(Johari, Nor Hasniza & Mahani, 2012, p. 419). Conceptual knowledge is dominated by different elements such as “concepts, rules (procedures) and even problems (a solved problem may introduce a new concept or a new rule)” (Mettes, Pilot, & Roossink, 1981, Georgeff, 1987, p. 1384 and Haapasalo, 2003, p. 3). Lastly, **problem state knowledge** is the knowledge that deals with solving problems. Research shows that not every teacher will have a skill of helping learners solve problems effectively. Research shows that the four knowledges are linked together (Newell & Simon, 2005).

The conceptual framework below shows the four discussed knowledges with relation to novice and expert teachers. Since novice teachers have poor links between the four knowledges, they are expected to conduct lower level of practical activities (level 1 and 2) (Georgeff, 1987 and Hattingh *et al.*, 2007). Research shows that expert teachers have a strong link and connections between knowledges hence they are able to use these knowledges to achieve goals. Because of the expert teachers ability to link the knowledges, they are expected to conduct a higher level of practical activities (level 3 and 4).

When further elaborating on these four different types of knowledge, novice teachers’ understanding is shown as “more fragmented and less hierarchical than expert knowledge which has richer and more bidirectional connections within and between knowledge forms” (Leonard *et al.*, 1999, p.794).

This conceptual framework guided the development of the data collection instruments, and the data analysis. It framed the form in which the findings will be presented in Chapter 5.

Figure 2.1 on the following page shows the conceptual framework that guided this study:

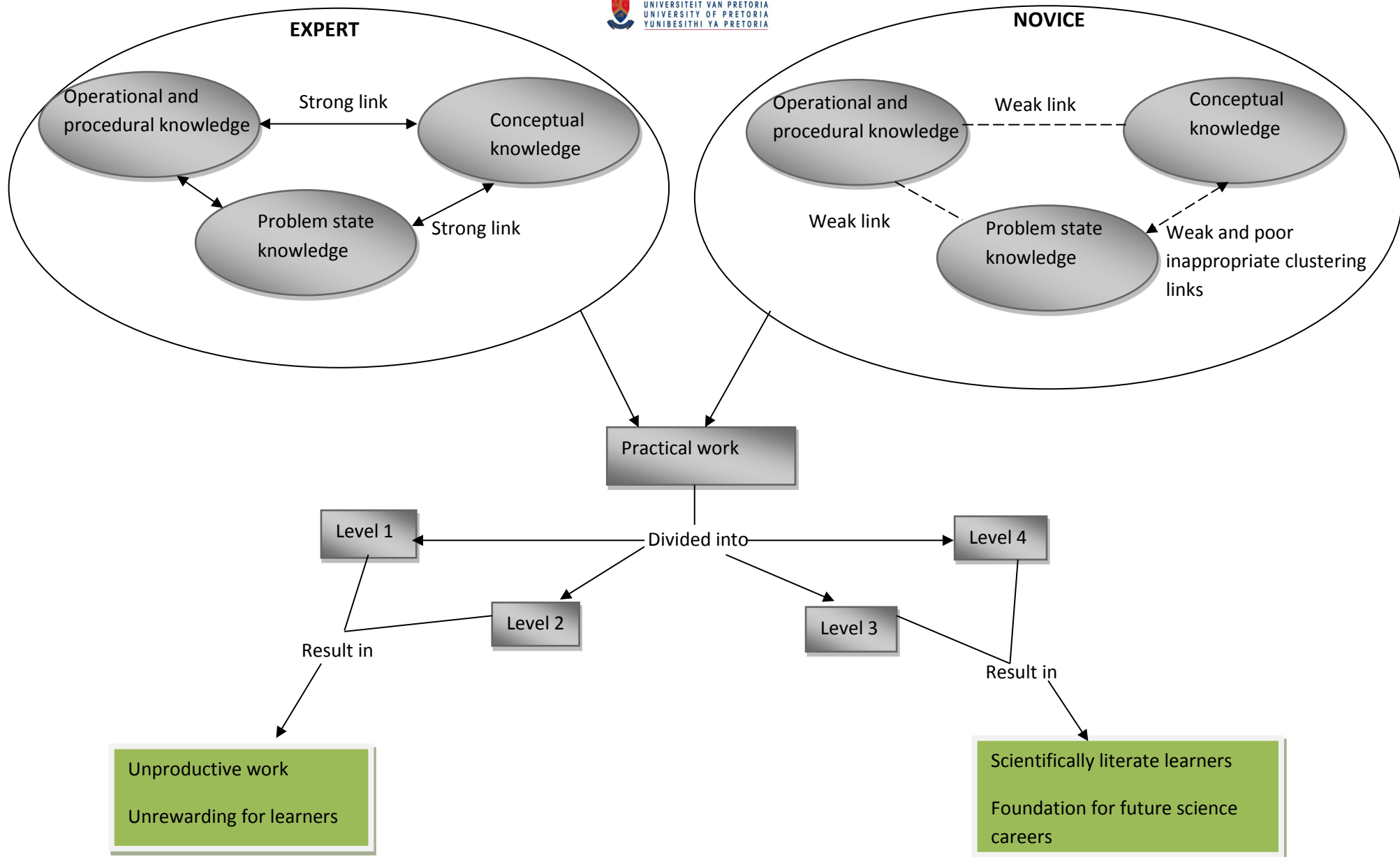


Figure 2.1. Knowledge model of novice and expert teachers, and practical activities with four different levels (adapted from Leonard *et al.*, 1999, p. 794-795; and Hattingh *et al.*, 2007, p. 3)

## **2.7 Chapter summary**

This Chapter attempted to examine the literature addressing the meaning of novice and expert teachers. The researcher has addressed the challenges novice teachers face in the school environment and also addressed the Natural Sciences and Technology curriculum. The researcher has explained what research says about the definition of practical activities, challenges teachers face when conducting practical activities, and the importance of practical activities in science classrooms. Lastly, the conceptual framework that guided this study has been discussed. The next Chapter explains how this study was carried out.

## CHAPTER 3

### RESEARCH METHODOLOGY

#### 3.1 Introduction

This Chapter outlines the research design used to study the way novice and expert teachers conduct practical activities in Natural Sciences and Technology classrooms. This Chapter elaborates on the research strategy that was used in selecting participants, explains how data was collected, and describes strategies for data analysis. This Chapter concludes with consideration of the validity of the study and the ethical considerations of this research.

#### 3.2 Research methodology

This study used a qualitative research approach. Qualitative approach is defined as an approach that does not accept that there is only one reality in the world we live in. Qualitative researchers assume that everyone views the world in their own way. Therefore, we cannot trust that “there is a single unitary reality apart from our perceptions” (Krauss, 2005, p. 761). The qualitative research approach emphasises that the world is not fixed, single or measurable. Being a qualitative researcher the interest lies in understanding the interpretation of the world and what those interpretations are at a particular point in time (Merriam, 1985).

A qualitative approach was chosen due to the following reasons:

- It showed a great potential value to this study for the researcher to get in-depth and rich data on how novice and expert teachers conduct practical activities.
- It could allow the researcher to be flexible with the questions as the researcher becomes immersed in the participants’ culture and understand how they carry out activities and why.

Since a qualitative approach assumes that the world cannot be viewed as a single reality, it was suitable to be used in this study because the way the participants of this study will view the world will not be similar.

### **3.3 Research design**

This study used a multiple case study design. This design was used since this study was analysing several factors such as learners' behaviour, novice and expert teachers' implementation of practical activities and challenges both novice and expert teachers face when conducting practical activities. A case study design is "an approach to research that facilitates exploration of a phenomenon within its context using a variety of data sources" (Baxter & Jack, 2008, p.17). A case study can also be defined as an "empirical inquiry that investigates a contemporary phenomenon within its real-life context" (Yin, 1984, p.23).

A case study was used in order to gain an in-depth understanding of each particular situation. In this case, both the novice and expert teachers were regarded as a unit of analysis. This study investigated four teachers, two novice and two expert in order to obtain an in-depth understanding of how they conduct practical activities in their classrooms. The way in which novice and expert teachers conduct practical activities might be influenced by many factors including the learners' background, teachers' teaching experience or the school context (Baxter & Jack, 2008).

### **3.4 Sampling**

The data in this study was gathered in schools around the Tshwane South District. There were 2 novice and 2 expert teachers. Convenience sampling was used to select the participants of this study. Convenience sampling is a type of sampling that "involves the selection of the most accessible subjects, it is the least costly to the researcher, in terms of time, effort and money" (Marshall, 1996, p. 523). Expert teachers were chosen in consultation with the supervisor and Natural Sciences GDE subject advisor in Tshwane South district. The researcher chose this sampling because participants were easily accessible to the researcher. The participants who were part of this study were teachers who are teaching in primary schools and they are teaching Natural Sciences and Technology in Intermediate phase.

### **3.5 Data collection**

In order to find out how novice and expert teachers conduct practical activities in the Natural Sciences and Technology classrooms, data was collected through tape-recorded interviews, classroom observations and document analysis.

#### **3.5.1 Interviews**

Only teachers were interviewed. Four interviews were conducted in this study. Each interview lasted 20-35 minutes. The interviews were face-to-face and they were semi-structured. A semi structured interview is an interview that consists of key questions that guide the researcher (Maree, 2012, p. 87). The purpose of the interviews was to ask the participants (both novice and expert teachers) how they conduct practical activities, how often they conduct them and what challenges they face when conducting practical activities. The interview schedule (Appendix F) and questions were developed from the literature review by the researcher and the supervisor.

Each teacher was interviewed once before they were observed. All the teachers chose to be interviewed at their schools. Before the researcher started with the interviews, the researcher explained to the participants the reasons for the interviews and asked for their permission to audio record the interviews.

#### **3.5.2 Observations**

The main purpose of using an observation technique in this study was to understand how novice and expert teachers conduct practical activities in their Natural Sciences and Technology classrooms, and the challenges they face when conducting practical activities. Four practical lessons were observed and each teacher was observed once. Since these were arranged observations, the practical activities might be considered as the teachers' best efforts rather than their 'typical' practical activities. The lessons were not video taped, the researcher used an observation schedule (Appendix E) during each observation. During the observations, the researcher was assessing the type of a practical activity a teacher gave the learners and on which level the practical activity falls as described by Hattingh *et al.* (2007) in Chapter 2. If the teacher used any level less than 3 it would mean his/her practical activity is ineffective

(Hattingh *et al.*, 2007). The observation schedule was developed from the research questions and literature review.

All four observations were conducted in a classroom. One classroom observation was done per school and per teacher. The study used four different schools (Tebogo’s, Kego’s, Tlou’s and Lerato’s schools (pseudonyms). The researcher visited the four schools on arranged dates to suit each teacher.

The teachers presented their different lessons on different topics. Tebogo (novice teacher) presented a practical lesson on “testing for starch”. Kego (novice teacher) presented a practical lesson on “metals and non-metals”. Lerato (expert teacher) presented a practical lesson on “building a skeleton” and Tlou (expert teacher) presented a practical lesson on “testing for starch”.

### 3.5.3 Document analysis

A sample of learners’ activity sheets (Appendix H) that were used during the observed lessons were analysed to validate data collected from interviews and observations. Each teacher provided learners with the worksheet during their practical activities.

The table below shows a summary of data sources and makes it clear on which research question each data collection strategy was used. Table 3.1 is based on Xipu(2011) and adapted for this study.

**Table 3.1: A summary of the strategy that was used in collecting and analysing of the data**

Method	The purpose	How was the data analysed?
Open-ended interviews Observations Document analysis (Worksheet)	To gather data on novice teachers’ implementation of practical activities.	The “interest was based” on how novice teachers conduct practical activities.

Open-ended interviews Observations	To identify challenges novice teachers face during practical activities.	The observation and interview technique helped the researcher to identify challenges novice teachers face.
Open-ended interviews Observations Document analysis (Worksheet)	To gather data on expert teachers' implementation of practical activities	The "interest was based" on how expert teachers conduct practical activities.
Open-ended interviews Observations	To identify challenges expert teachers face during practical activities.	The observation and interview technique helped the researcher to identify challenges expert teachers face.

### 3.6 Data analysis

This study used content analysis to analyse the findings from interviews, observations and the document review. Content analysis is referred to as "a systematic approach to qualitative data analysis that identifies and summarises message content" (Maree, 2012, p. 101).

The interviews were tape recorded and transcribed in the form of "verbatim-word for word". If the participants paused during the interviews, become silent or give responses such as "well....., I suppose", that was written as the element of "uncertainty" (Maree, 2012, p. 104; Kim & Roth, 2011). The transcribed interviews (Appendix G) were used to locate "keys" referred to as inductive codes. Inductive codes are codes that emerge from the transcribed data (Maree, 2012). This study also used *priori* codes that were established from the literature review and the conceptual framework of this study. *Priori* codes are written down before coding process begins (Maree, 2012). The researcher used *priori* codes such as:

- Open ended investigations



- Learner discovery of information
- Unrealistic expectations
- Direct instruction (teacher centred)

The observation notes were used to validate themes that were identified from interview transcripts. Practical sheets given to learners during practical activities were also coded to identify themes and confirm themes that emerged from the other data sources that were used.

Data in this study was organised by issues that arose from the study and research questions of this study. If there was new information that emerged from the collected data, the researcher would organise such information. Since this study had four sub-questions, these sub-questions were used as the main themes. The sub themes were created as the topics and issues emerged from the data (Cohen, Manion, & Morrison, 2007).

Data in this study was analysed using three techniques, the first one was linking data, the second one was pattern matching and the last one was explanation building (Yin (2003) from Baxter & Jack , 2008). The researcher would link data collected with data from the literature review to analyse it. And then she would match patterns that emerged from the collected data so as to build an explanation.

### **3.7 Validity and trustworthiness**

When the word validity is used in qualitative research it refers to “the extent to which the data is plausible, credible and trustworthy”. Validity in qualitative research can also refer to an “accurate presentation of a particular context or event as described by the researcher” (Muhammad, Muhammad, Muhammad, & Muhammad, 2008, p. 2 and Mayan (2001) in Maree, 2012, p. 305).

The term trustworthiness refers to the way in which researchers “persuade the audience that the findings in the study are worth paying attention to and that the research is of high quality” (Maree, 2012, p. 305). To ensure the trustworthiness of this study the researcher consulted the supervisor to verify and ensure that the research questions of this study were suited to be used for this case study design. The researcher also checked whether the research questions and the

interview questions were written clearly and that “the question is substantiated” (Baxter & Jack, 2008). The researcher applied participant checking when participants’ exact words were used to ensure what is written is what the participants said (Baxter & Jack, 2008).

This study followed the criteria established by Mays and Pope (2000, p. 51):

- “The use of triangulation- This research study used a variety of methodological tools as described in this Chapter in the data collection section.
- Participants’ validation- The researcher applied participants’ checking when participants’ exact words were used. When the researcher coded participants’ exact words, she called them to verify if what is coded is correct.
- Clear exposition of methods of data collection and analysis. The researcher provided detailed information that explained how interpretations were supported by the data.

### **3.8 Ethical considerations**

Ethical considerations are important in every research study. The ethical considerations “should be undertaken within an ethic of respect for people, respect for knowledge, respect for democratic values and respect for the quality of educational research (Bassey & Bera in Murray, 2006, p. 1).

#### **Research settings**

The researcher first sought permission to conduct this study from the proposal defense committee and the ethics committee of the Faculty of Education, University of Pretoria. The researcher gained access to the study settings by writing request letters to the Department of Education (Appendix A) and the schools principals (Appendix B) of selected schools. When access to the study participants was granted, the researcher held meetings with the teachers to outline the aim of this study and arranged dates for data collection.

#### **Informed consent**

Participants were informed (Appendix C) about their rights before the data collection research started. They were informed about their rights to withdraw from this study at any time. Parents

were informed by letters (Appendix D) that there will be a researcher present in their childrens 'classrooms. The learners were also informed (Appendix D) about the presence of the researcher however, they were not participating in this study.

### **Confidentiality, privacy and anonymity**

Confidentiality and anonymity are important in a research study. Researchers "need to assure participants that anything discussed between them will be in strict confidence" but with the understanding that data will be reported (Berg, 1998, p. 48). In this study, all the participants' responses were kept private and the results of the study were presented in an anonymous manner to protect participants' identities. The participants real names were not used, they were given pseudonyms. The names of the schools of the participants were also excluded from this dissertation.

### **3.9 Chapter summary**

In this Chapter I have outlined the research methods used to establish the way in which novice and expert teachers in NST classrooms in the Intermediate phase in South Africa conduct practical activities. The data collection methods of this study included open ended interviews, observations and document analysis.

This Chapter also outlined how data was validated to ensure trustworthiness. Finally ethical considerations were also considered in this study. The next Chapter deals with the results from the four participants used (2 novice and 2 expert teachers).

## CHAPTER 4

### THE RESULTS

#### 4.1 Introduction

This Chapter presents the results of this study. There were four participants in this study, two novice and two expert teachers. The results were generated through semi-structured interviews, classroom observations, and document analysis. The purpose of this study was to find out how novice and expert teachers in the Natural Sciences and Technology intermediate classroom conduct practical activities and this study was guided by the following question and sub-questions:

#### Main research question

How do novice and expert teachers in South Africa conduct practical activities in the Natural Sciences and Technology intermediate phase classrooms and what are the challenges they face?

#### Sub-questions

- How do novice teachers conduct practical activities in Natural Sciences and Technology classrooms?
- What are the challenges novice teachers face when conducting practical activities in the Natural Sciences and Technology classrooms?
- How do expert teachers conduct practical activities in Natural Sciences and Technology classrooms?
- What are the challenges expert teachers face when conducting practical activities in the Natural Sciences and Technology classrooms?

#### 4.2 Novice teachers: Implementation and challenges of practical activities

How novice teachers conduct practical activities in their Natural Sciences and Technology (NST) classrooms and what are the challenges they face.

#### 4.2.1 Tebogo's case

##### Background

Tebogo (pseudonym) is a young woman who started teaching in the middle of the year 2011. She teaches Natural Sciences and Technology (NST) and Mathematics. When she started teaching, Natural Sciences and Technology were separate subjects. She teaches Grade 4 and 6 learners. Ever since she started teaching she has been teaching Mathematics and Natural Sciences and Technology. Tebogo works for a normal government school. Her school is located in a township. The school has 7 buildings of 5 classrooms each and it has one office building. The school campus is beautiful and has black population only. Her learners mostly range from 40-45 per class. Her school does not have a laboratory and the classrooms only accommodate normal lessons not practical lessons. In other words, her classroom only has desks, chairs and a chalkboard but no laboratory facilities. She does, however, she conduct her practical activities in the same classroom. After each practical lesson she has to clean up for the next period. In her school the teachers are the ones moving from class to class. The duration of a single period in her school is 30 minutes and if it is a double period the duration is an hour. Her school is a primary school offering Grade R to Grade 7. She has been in her teaching career for 5 years at the time of data collection which still makes her a novice teacher, according to the definition adopted in this study.

##### *a. Interview results*

##### **Tebogo's definition of practical activities**

Tebogo understands practical activities as any activity that is "hands on". She believes that a practical activity is when you allow learners to discover things, and it can be guided or unguided. She elaborated that a practical activity can be as simple as a demonstration. She commented as follows:

*"A practical activity it can be when a teacher demonstrates a "hands on" activity and learners are watching. Or a teacher can bring few specimens or whatever materials the teacher will use and group the learners where they engage in "hands on" activity. A*

*practical activity can be anything from drawing to cutting open frogs if they have to or to building something. As long as it is “hands on” then it is a practical activity”.*

Tebogo approves of incorporating practical activities in primary level. She said that eventually Natural Sciences and Technology will lead learners into Life Sciences or Physical Sciences, hence it is better for learners to start developing the skills of practical activities from a lower level. She stated that science is a practical subject, so learners do, at some point in their lives need to develop practical skills.

This novice teacher believes that the NST curriculum as described in the CAPS documents does suggest practical activities to be conducted in NST classrooms and the practicals that are suggested are relevant to our learners. She stated that:

*“For example, term one Grade 6 for photosynthesis they do require you to do tests for starch where you bring food samples and iodine. The kids test for starch where it turns blue-black or remain the same. So our NST curriculum does encourage practical activities but my worry is that it is more on the Natural Sciences part than the Technology”.*

### **Are practical activities conducted frequently enough?**

Tebogo explained that she believes these activities are not conducted regularly enough. She elucidated that first problem is the issue of time. At their school they are given 30 minutes per period and within that time you have to do everything, for example, do corrections, introduce a new topic or give learners daily work. And if you decide to conduct a practical activity, it needs to be accompanied by a worksheet and the challenge is that primary learners work slowly. Most learners will not be able to complete the practical activity in the allotted time. Tebogo stated that even if you have a double period and decide to conduct a practical activity, the challenges are that:

*“Practical activities resources are available but they are limited. We as teachers we do not have teacher assistants especially during practical lessons. Practical’s are conducted in the classroom and when your period has passed the next teacher expect to find the class in good condition (clean)”.*

She said the government does sometimes provide science teachers with science kits. However the limitation of the resources limits the extent to which learners are able to access these, because:

*“A teacher cannot do a practical activity but demonstrate to learners because of limitations of resources. You cannot give each and every learner a science kit since they are limited, so that results in teachers just touching the practical skills not really enforcing the skills to the learners”.*

Tebogo was asked whether she ever allows her learners to set or create their own unguided inquiry questions during the practical activities. And her response was:

*“Yes I do. For most of my practicals when I work with NST I use a website called e-classroom. The practical activities from this website have everything and they are a good guide. I believe that every practical should be accompanied by a worksheet in order for a teacher to assess learners what was learned from the activity. You cannot give someone a skill and not assess if they learnt that skill”.*

Tebogo further explained that even though she uses e-classroom activities she does sometimes allow her learners to conduct their own unguided practical activities. She said learners sometimes need to be challenged. Instead of telling them what they should be observing, you should ask them what they think and what they see.

### **Challenges during practical activities**

Tebogo explained that she comes across challenges during practical activities. She said one of the challenges is the classroom in which she has to conduct practical activities and the safety of learners. She stated that:

*“For example, on my first year of teaching I was trying to do the states of matter, obviously you have to use hot water or something to boil the ice changing form from solid to liquid, from liquid to gas. So you will need maybe a source of heat, so that is not safe if you are in the classroom”.*

She said a second common challenge in most public schools is teacher to learners' ratio in the classroom. You find that you have many learners in the classroom but few materials and resources. Lack of resources limits the way practical activities can be conducted.

Third challenge Tebogo highlighted is lack of time. She said that:

*“Sometimes you do not finish your practical activities in one lesson, and these learners are not like in high school where if you did not finish you can continue tomorrow they will forget. Not everyone will remember what happened. I know they say when they see they will remember, but that is not everyone because 99 % of our kids have cognitive challenges”.*

The last challenge she stated is “lack of interest” from the learners and the science team. According to Tebogo, the lack of interest mostly comes from learners who are “cognitively challenged” (learners who do not do well at school, mostly those learners do who get an average of less than 30 %). Tebogo further stated that all those learners who do not see the reason or the purpose of carrying out practical activities, they distract the lesson. She stated that the sad part is that, you find you have 50 learners in the classroom, and 30 learners are “cognitively challenged” and only 20 are interested in school and learning.

### **Does the school and the Department of Basic Education support practical activities?**

Tebogo said the Department of Basic Education (DoBE) as well as the science department at her school support science teachers in conducting of practical activities. In Tebogo's opinion, the DoBE reinforces technology more because they realise that the NST teachers focus more on the Natural Sciences than on Technology. She stated that the DoBE does support the NST teachers but only to a limited extent. She said:

*“Only teachers who know or have a passion for science or technology will do what is right. Even when the facilitators come in schools, they will just ask if we did conduct a practical activity in for example photosynthesis, but they would not ask if did we go and touch a plant and the trees, show the learners that this is a leaf this is what, when we talk of a stem we talk of this part. They would not ask or say did you go test for starch,*



*what did you find, tell me about it. They just want what's on paper. So it shows that it promotes theory and more theory and less practice".*

### **Learners' behaviour during practical activities**

Tebogo's first words were that "it is upsetting". She said the challenge is that in the classroom there are learners who know the reasons of being at school and those who do not. Those learners who are interested in their school work find practical activities exciting and their behaviour is acceptable in class. Learners' behaviour during practical activities depends on the "learners' interest". Tebogo said:

*"Some learners just want to copy down the work they do not want to think. You know others just prefer writing down and not answering. Some prefer writing question and answer. So there is a difference in interest in the class. It is very rare to win them all. If you say okay today we are going to the garden or say today we are going to walk around the school to look for different kinds of frogs. Others will be excited that they are outside the class and others will have interest and curiosity on the activity".*

Tebogo believes that despite learners' behaviour during practical activities, practical activities are productive as long as learners learn what you want them to learn. Tebogo believes that practical activities are the "only activities" a teacher can use to teach learners to understand science.

### **How are learners organised during practical activities?**

Tebogo believes that the best way to organise learners in primary schools is by grouping them. It is more effective when you group them from strongest learner to weakest learner. It is advantageous when learners are grouped because:

*"In case of limited resources learners are able to share when they are in groups. Grouping is more efficient for primary learners. In groups they are able to get some work done".*

## **What can be done to improve practical activities in the Natural Sciences and Technology Classrooms?**

Tebogo said it would be great if science classrooms were built in a way that they are classrooms and a laboratory at the same time. Maybe each block in a school should have a laboratory or class like a laboratory that will encourage or support practical activities.

Tebogo said it would also be great if the curriculum changes, because she insists that currently it focuses more on theory than practical. She emphasised that the curriculum should be prescriptive, for example:

*“They must say week 1 photosynthesis and reproduction content, week 2 practical test for starch, week 3 plants and earth and week 4 practical and what’s not. It must be there so that we know we must do it”.*

She emphasised that the NST facilitators cannot assume that teachers are conducting these practical activities without proof and without giving us time for conducting them. Tebogo stated that she believes that the more learners get their ‘hands dirty’, the more they will remember the work.

### ***b. Observation results of the practical activity conducted***

#### **The practical activity (classroom activity)**

One of Tebogo’s practical activities was observed. The activity was conducted in a classroom that does not accommodate a practical lesson. They were 42 learners in her classroom. The activity was with the Grade 6 learners and it was about testing for starch. Tebogo downloaded the worksheet for the learners from e-classroom website (e-classroom, 2015). Tebogo grouped her learners. The practical activity aim was to “test which food items contain starch and which do not contain starch”. Tebogo brought the apparatus and ingredients for her learners. The apparatus she used were her school resources and the ingredients she bought out from her own pocket. Learners were given iodine solution, droppers, plates, and small amount of different foods (bread, apple, oil, cheese and maize meal). Learners were given a protocol to

follow during the activity. Learners were required to follow this protocol step by step. Tebogo gave each group of learners a small amount of food and they had to use a “dropper to drop a little bit of iodine onto each item of food”. After dropping the iodine they had to observe and record their results. For the conclusion of the activity, Tebogo’s learners had to answer questions such as, “name the food items that had starch and name the food items that did not have starch”.

Learners were supposed to reach the right answer because their worksheet had notes at the beginning and it stated that, if food has starch in it, the iodine will change from a yellow-brown colour to a blue-black colour. If the food does not have starch in it, then it stays as a yellow-brown colour.

The practical activity was simple enough for most learners to complete the activity. The activity focused on the process and the specific outcomes. Most learners showed interest during the activity, although there were some learners who were distractive during the activity. Learners willingly volunteered to come in front of the class and demonstrate the activity. Learners were recording what they were observing during the activity on a worksheet.

### **Classroom organisation**

Tebogo maintained classroom discipline through the activity, although some learners were excited hence they were distracting others most of the time during the activity. Learners were organised in groups during the activity.

### **Reflection on the observation**

Tebogo gave most learners a chance to participate during the lesson. Tebogo would teach her learners something at the beginning of each food test and she would later on ask them questions based on what she taught them. During the practical activity, Tebogo would go back and discuss previous results and ask learners to compare this with current results. Learners had to answer questions from the worksheet given by the teacher.

### ***c. Document analysis***

#### **Analysis of learners' practical activity sheets**

The practical activity sheets that were used during the lesson that was observed was about testing for starch. The worksheet was downloaded from the e-classroom website and used as it is (e-classroom, 2015). The worksheet outlined the learning outcomes of the practical activity. The worksheet had written notes at the beginning reminding learners of previous work done on the topic (food with starch). The notes highlighted facts learners will discover during the practical activity, such as; "If the food has starch in it, the iodine will change from yellow-brown colour to a blue-black colour. If the food item does not have starch in it then it stays as yellow-brown colour" (e-classroom, 2015).

The worksheet had a list of apparatus written for learners. They were protocols for learners to follow. Learners were required to record their observations and draw conclusions from the worksheet.

#### **4.2.2 Kego's case**

##### **Background**

Kego (pseudonym) is a young woman who is married with one child. She started teaching in the year 2013. At the time of data collection, Kego has been in the teaching career for 3 years. She works for a private school. Her school is located in the suburb. The school is a 3 storey building with one office building. Kego's school had a racially diverse learners' population. Her learners range from 25-30 per classroom. Her classroom accommodates a normal lesson as well as a practical lesson. Kego's classroom had resources that promote the conducting of practical activities (e.g. microscopes, a TV, and various science apparatus). Her school starts from Grade R-12. All the lessons in her school take an hour. Learners are the ones moving from class to class. Ever since she started teaching she has been teaching Natural Sciences and Technology (NST) and Mathematics. Kego teaches Grades 4-6.

## **a. Interview results**

### **Kego's definition of practical activities**

Before Kego described the definition of practical activities, she asked to be given time to think about an answer to that question.

Kego's understanding of practical activities is that, practical activities are any work that was done in the classroom by the teacher theoretically and then taking that work and putting it into practice. It is when a teacher, together with learners takes "theory and proves it practically".

Kego thinks that practical activities are a good idea to be conducted in primary level. She stated that:

*"Practical activities are good according to me, the reason is because when you conduct theory most of the time and no practical especially with primary school learners they tend to forget the work very fast. But when they conduct practical activities it helps them to remember the work better. And some learners learn better when they take the work that they have done theoretically in class and putting it into practice".*

Kego thinks that learners learn better when they see things practically, but it has to be work that they have already learned in theory.

Kego stated that the curriculum (CAPS) does suggest practical activities for teachers to conduct in the Natural Sciences and Technology lessons, and the practical activities suggested by the curriculum are relevant to learners in primary schools.

### **Are practical activities conducted frequently enough?**

Kego said that she believes that Natural Sciences and Technology teachers in primary schools are not conducting practical activities the way they should. She believes that there are many factors that prevent Natural Sciences teachers from conducting practical activities as often as they are required to by the curriculum. She stated that:

*“According to me, I do not think that practical activities are conducted frequently enough due to the fact of time. Time does not allow us; there is not enough time to conduct practical activities. There are lots of things in general that makes teachers to not conduct practical activities in the Natural Sciences classrooms”.*

Kego stated that in her school there are sufficient resources that Natural Sciences teachers can use to conduct practical activities. However, the biggest challenge is time. She stated that:

*“Resources are enough for us Natural Sciences teachers to conduct and support practical activities. Some of the resources we even make them ourselves. It is just time that make us teachers to not conduct enough practical activities but the resources are there in schools”.*

She said that she does not conduct practical activities in her Natural Sciences classrooms without providing learners with worksheets. Kego said she uses lots of things during practical activities, she sometimes uses posters. She stated that:

*“So I use the worksheets to guide the learners and then they will do the activities themselves to show that indeed they did understand the theory work that I have taught them. To see if they are doing it accordingly and in the right way”.*

Kego was asked whether she ever allows her learners to set or create their own questions during the unguided practical activities. Kego stated that in primary school is not greatest to allow learners to conduct unguided practical activities. She said that:

*“Learners from primary school is best if you guide them for the fact that if you just get in class and allow learners to conduct own unguided practical activities you will find that other learners will do certain things not the work given to them. Some learners will be busy with friends and not do what is wanted; they will be busy running around. So I think it is best to guide them so that you can check them that they really doing the right thing, and to check them that they are really doing what they supposed to be doing, not playing and walking around”.*

Kego said she believes that learners in primary schools are still too young to conduct unguided practical activities. She emphasised that especially learners who are in Grade 4 are worse than Grade 5 and 6 learners, they enjoy playing a lot. She said it is a challenge even during a normal lesson with no practical to get Grade 4 learners to sit down and concentrate in class. So an unguided practical activity will be a “disaster with primary learners especially Grade 4’s”. She said though it is not every learner that will cause trouble during a practical activity, there are some learners who will do what is right. Kego said it is best if Natural Sciences educators at primary level guide learners during a practical activity.

### **Challenges during practical activities**

Kego stated that the main challenge in primary schools during practical activities is learners’ behaviour. You find that you have a large class, although not all of the learners will be misbehaving, but those few learners who will misbehave will disturb the practical lesson.

Kego said one of the challenges during practical activities is that some learners find practical activities more fun than a learning experience. She affirmed that:

*“Learners will run around, some will not even focus. Some learners will not even put their minds in an activity they are busy with in class. You find that the ones who are clever will be working and the other learners see it as an opportunity to hang out with their friends and play around. Some learners become so excited to an extent that they do not even concentrate and just chat with their friends”.*

Kego said they are several challenges an educator may face when conducting practical activities. She said that she has faced challenges such as:

*“Some learners do not want to sit down they just want to be with their friends. Some learners will be standing and looking around what their friends are doing. When grouping learners they want to be grouped with their friends. And when learners are with their friends they just want to talk instead of doing given work. There will be some learners disturbing the lesson during the practical activity. Learners in primary school enjoy playing around so conducting a practical activity might be a challenge”.*

## **Does the school and the Department of Basic Education support the conducting of practical activities?**

Kego agreed that the school and the DoBE does support and encourage teachers to conduct practical activities in Natural Sciences classrooms. Kego said that the Head of Department (HOD) in her school fully supports teachers to conduct practical activities. She said that the Mathematics, Science and Technology (MST) team in her school supports each other when conducting experiments. Kego said:

*“The school does support Natural Sciences educators in the conducting of practical activities that is one of the reasons why we enforce that practical activities should be conducted, but the challenge is that time does not allow us to conduct them in every topic”.*

## **Learners’ behaviour during practical activities**

Kego said that primary school learners during practical activities they become too excited because they enjoy conducting practical activities. She said primary school learners enjoy practical activities more because they see things practically that they were taught theoretically.

Kego said it is easier for learners to remember especially when they write tests if they have conducted the practical activities in most topics because they have tested the theory and saw the results of it. She said:

*“I would actually advise all educators especially who teach science subjects to conduct practical activities as often as they can, but if time does not allow them then there is nothing they can do about it. But me, personally, I do try to conduct practical activities when I get time. I do fit in practical activities so that my learners can understand better”.*

Kego said most learners’ behaviour but not all of them during practical activities show interest in their work. She said that learners’ interest during the practical activities is not a challenge because primary school learners are very interested. Kego said you find that during Practical



activities learners are very excited. According to Kego, her learners remember the work easily and fast especially when they conduct something practically.

### **How are learners organised during practical activities?**

Kego stated that she prefers that learners are divided in groups during practical activities. She said she thinks it is best when learners are in groups because:

*“It improves their communication skills, learners learn to socialise with each other. You find that learners get to know one another and it also helps learners who take time to understand concepts”.*

She said when she groups learners she ensures that each group has a hard working learner. She believes that the hard working learner will assist the slow learners and show them how things should be done. Kego said sometimes learners conduct practical activities as individuals but most of the time it is in groups. She said when they are in groups the hard working learners motivate the slow learners in having ideas and be part of the practical activity.

### **What can be done to improve practical activities in the Natural Sciences and Technology Classrooms?**

Kego said she believes the following should be done to improve how practical activities are conducted in Natural Sciences and Technology classrooms:

*“Educators should bring all the required resources to class during practical activities. Every topic should be accompanied by a practical activity”.*

#### ***b. Observation results of the practical activity conducted***

##### **The practical activity protocol (classroom activity)**

Kego was observed in one of her practical activities. The activity was conducted in a classroom that accommodates a practical lesson. They were 26 learners in her classroom. Kego conducted her practical activity with the Grade 5 learners. The activity was about comparing metals with non-metals. The teacher started the practical activity by explaining the activity to learners. The

learners were then provided with a worksheet. Kego brought materials for her learners, the materials included, a hammer, coins, a box, wood, metal spoons, screws, plastics, paper clips and papers. Learners were given a protocol to follow during the investigation. Learners in their groups had to write down from the materials given which ones are shiny and which ones are dull. Then learners had to use a hammer to hit different materials and record what happens and lastly learners had to write down which materials are metals and which ones are non-metals. To conclude the investigation, learners had to answer the questions on the worksheet designed by the teacher. Learners had to answer, “List materials that are metals, list the materials that are non-metal materials, write down the properties of metal and write down the properties that are non-metal”.

Learners were expected to reach specific answers because the teacher explained to them at the beginning of the activity the properties of metals and non-metals so they knew what to look for in the activity. Learners were following the protocol given by the teacher step by step.

Most learners were doing the same thing since the instructions were outlined to them. The learners understood the activity since most of them did not go to the teacher with questions to ask. The activity focused on the procedure since all learners in class were expected to “take different objects and state whether it is a metal or non-metal, and whether it is dull or shiny”.

Learners understood the learning outcomes of the activity (therefore the learning outcomes were clear to learners), only a few learners were approaching the teacher to ask questions.

### **Classroom organisation**

Kego maintained classroom discipline throughout the activity although they were some learners who were busy chatting during the lesson. Learners were organised in groups during the practical activity. Learners were in groups of five, only one group had six learners. Learners formed their own groups during the practical activity that was observed.

## **Reflection on the observation**

Learners were very excited during the practical activity and they were actively involved. The teacher grouped the learners based on best performing learner in class to poor performing learner. Most groups knew what was expected of them. The strongest learners were the ones who were more active in their groups. The strongest learners in the groups were the ones going to the teacher to ask if they were still in the right track. After the activity learners had to record their findings and report it back to the class.

### ***c. Document analysis***

#### **Analysis of learners' practical activity sheets**

The practical activity was about properties of non-metals and metals. Kego created and organised her own practical activity. The worksheets had notes at the beginning highlighting properties of metals and non-metals that was taught in previous lessons.

The worksheet outlined the aim of the activity. Learners were also given explicit instructions to follow during the activity. The worksheet outlined the apparatus to be used by learners during the activity. It was stated in the worksheet that for the practical activity, learners are going to need “small hammer, four objects made of different metals and four objects made of non-metals”.

## **4.3 Expert teachers: Implementation and challenges of practical activities**

How expert teachers conduct practical activities in their Natural Sciences and Technology (NST) classrooms and what are the challenges they face.

### **4.3.1 Lerato's case**

#### **Background**

Lerato (pseudonym) is a married woman who started teaching in 2001. Her first 6 years of teaching was in a government school. When she was teaching in a government school, her

learners ranged from 40-45 learners per class. In her previous school she was teaching Mathematics and Natural Sciences and Technology. She stated that she enjoyed Natural Sciences and Technology more than Mathematics. Lerato is currently teaching in a private school. She teaches Natural Sciences and Technology (NST) in Grade 5 only and she stated that she enjoys it a lot. Her learners range from 30-35 per class. Lerato stated that she finds science very interesting because their reactions to doing things are different compared to mathematics.

The school she is currently teaching at is located in the suburbs. Lerato's school campus is attractive with inviting gardens. The school has equipped laboratories and a library. Lerato's school campus is neat and offers classes from Grade R-12. The duration of a single period is 30 minutes and 1 hour duration if it is a double period.

#### **a. Interview results**

##### **Lerato's definition of practical activities**

According to Lerato, practical activities has to do with something that learners are able to do themselves or it can be something that is done in class that they can see. She said when something is practical it means it needs supervision from the teacher, while other activities do not. She further stated that practical activities are more "hands on", unlike when learners are sitting and listening to the teacher talking. Lerato said personally she prefers to do practical activities in class, rather than learners just doing based activities.

She said it is good for primary school learners to conduct practical activities because they get to experience something themselves. She explained that:

*"Most of the time when learners have to build something, they think they might be able to do it one way and then it does not work, so it teaches them how to solve problems. I think it develops another set of skills that other activities will not necessarily do".*

So according to Lerato, it is absolutely good for primary school learners to conduct practical activities. Lerato said the Natural Sciences curriculum does suggest practical activities to be conducted. However, she said that some topics are not suited for practical activities. She thinks

that the practical activities suggested by the policy are relevant to the learners. She said sometimes some learners will be a bit more advanced hence the activities might not be challenging enough for them. She said:

*“What I sometimes find with the Grade 5’s topics it does not always lend itself to practical activity. The content that we have to teach is not necessarily something that will always be a practical activity”.*

### **Are practical activities conducted frequently enough?**

According to Lerato, in her experience science teachers in schools do generally conduct practical activities. She said practical activities may include several activities; she said it is also practical when teachers bring in gadgets such as iPads or tablets.

Lerato said sometimes science teachers avoid practical activities because it is “lots of work” unlike a “normal” theoretical lesson. She said science teachers avoid practical activities because:

*“Practical activities are a lot of preparations and learners tend to get very excited during the activity. It is a challenge for most teachers to keep learners under control especially if you do not have structures in place (materials). Practical activities is exhausting since it is hands on and learners’ noise level is high it fails to maintain classroom discipline”.*

Lerato further stated that:

*“Practical activities can be exhausting, you get five million questions because other learners did not listen when you explained the first time around and then now they will come to you with million questions. I think practical activities are not the easiest activities to conduct because they require lots of prep and they are very hands on while it is easy to give learners something to write”.*

Lerato said because she taught in government schools, she knows that you will not find sufficient resources for practical activities most of the time. She said at the school she is currently working at, she is lucky because there are enough resources. She said limited

resources should not prevent teachers from using practical activities as a teaching strategy. She said she once worked in a school with limited resources and that never stopped her from using practical activities. She said:

*“If you are creative as a science teacher you can make a plan. You can also adjust the activity for something that is available to you. We did an activity about the effect of removing calcium from bones, and it needed chicken bones, vinegar and water, I mean that is available to almost all teachers. You can be creative, it is easier if you do have the resources, but it is not impossible, it is definitely not impossible”.*

Lerato said she uses worksheets during practical activities. But she said her worksheets are dependent on the type of practical activity given to learners. In some practical activities she does not give learners the worksheets, learners conduct activities entirely on their own, she shows learners an observation and learners do the activity on their own.

Lerato was asked if she ever allows learners to set their own unguided questions during the practical activity. Her response was that she does, but not often. She said the learners do set their own questions but with her it will be the questions that they discuss in class when she is busy explaining the practical activities. She said:

*“The questions that they will set will be the questions that they ask in class but not as part of the activity that will be part of the explanation of the work. Learners will ask questions but not setting of questions. And learners come up with some very interesting questions when you explain the work. And with the amount of work that we need to cover in science, you have to have a structured plan for practical activities or else you not going to cover everything”.*

### **Challenges during practical activities**

Lerato said the challenges she has come across when conducting practical activities in the science classroom are the following:

*“I find it a challenge of being fully prepared for the activity. As a teacher having everything set up (materials). It is also a challenge to ensure that learners are doing the work. And as a teacher selecting a practical activity that is interesting for the learners it is never an easy task”.*

### **Does the school and the Department of Basic Education support the conducting of practical activities?**

Lerato said it depends on the type of school one is in. The school may either encourage teachers or discourage them from conducting practical activities. She said that she is lucky because her school supports and encourages teachers to conduct practical activities. Her school holds subject meetings every week where Grade 4, 5 and 6 science teachers get together. She further explained that the school supports teachers by providing them with necessary resources that are needed for practical activities.

Lerato stated that the DoBE also supports the use of practical activities since the DoBE knows its benefits. She is just not sure if teachers in other schools use the support they get from the DoBE to conduct practical activities.

### **Learners’ behaviour during practical activities**

Lerato stated that learners behave differently during practical activities, but most of them become excited because it is a ‘hands on’ activity. She said:

*“During practical activities you get different groups. There is going to be the one that takes over everything and does not want anyone to do anything. And there’s going to be the one that sits at the back and tries to hide and not do anything. Then that is why as a teacher you have to look around and ensure that everyone participates”.*

Lerato emphasised that it is very important how learners are organised during practical activities so that you can ensure that every learner can partake in the activity. Lerato said with her it depends on the type of practical activities to be done, she said she normally says:

*“This time you can choose your own groups, and next time I will say okay you are number one, two, three and four so then I choose the groups. So it is all going to depend but overall learners are actually very good during practical activities, they enjoy it, they behave themselves, and they get excited”.*

### **How are learners organised during practical activities?**

Lerato said the way learners are organised during practical activities always depends on the type of activity a teacher has given them. She said:

*“Some activities like building of the skeleton you would not do with a group that is too big that is why it works better in pairs. Some activities it is almost better for them to do on their own. So it is going to depend on the activity, so it all depend what type of an activity and what you want to achieve through that activity”.*

### **What can be done to improve practical activities in the Natural Sciences and Technology classrooms?**

Lerato said science teachers should conduct different types of practical activities. She said:

*“It does not help that you get one type of an activity and try to force everything into that. Some activities might work better when you do them in groups and some activities might work better when you do them as a class demonstration and they do certain part. So it is all going to depend on the type of an activity and how you planned it”.*

#### ***b. Observation results of the practical activity conducted***

##### **The practical activity protocol (classroom activity)**

One of Lerato’s practical activities was observed. The activity was conducted in a laboratory. They were 30 learners in her classroom. Lerato conducted the practical activity with the Grade 5s. The activity was about building a skeleton. Lerato started the activity by explaining it to the learners and allowing her learners to ask questions about the activity. Learners were given a worksheet that explained that they have to build their own skeleton. It could be a human or an



animal skeleton. Learners were asked the previous day to bring materials they will use to build their skeleton. Lerato's learners brought materials such as coloured papers, paper clips, boxes, matchsticks, straws, bottles, wool, glue and Sellotape. The worksheet highlighted that learners have to write their own aim for the activity, the procedures they will follow when building their skeleton and lastly their reflection on the activity.

Learners were not given protocols to follow; they had to develop their own protocols to show how they went about their activity. Learners had to write down their own purpose of the activity. The teacher gave learners suggestions to help them with their activity, however it was up to them whether they wanted to use the suggestions or not. There was no right answer for learners to reach since every pair of learners was doing their own activity. The learners were using their understanding of a skeleton to build one.

Learners brought their own materials from home. In the beginning of the activity the teacher reminded the learners about the work they have done in previous lessons. The teacher allowed the learners to do their own unguided activities, she just maintained the discipline. Learners participated very actively during the practical lesson.

Learners were conducting their own practical activities so they were doing it at their own pace. The focus of the activity was not on the process. Learners were not required to do the activity based on specific procedures given by the teacher.

The activity did not focus on one defined outcome since learners were coming up with different conclusions. Learners knew what was expected from them during the activity and they also knew that they had to be as creative as possible.

Learners made plans before they started with their activity, however when carrying out the activity their plans changed, the teacher allowed the learners to change anything they did not understand or agree with. For example, some learners said they were going to use straws for their activity but ended up using boxes.

## **Classroom organisation**

Lerato maintained classroom discipline throughout the activity. The learners were organised in pairs (according to the teacher the activity was suitable for learners to be in pairs). Learners chose their own partners for the activity and the teacher encouraged them to work together and share ideas.

## **Reflection on the observation**

Lerato started the activity by asking the learners questions about the work from previous lessons. The teacher allowed the learners to pair themselves. The learners came with their own materials from home. Learners were participating actively, they were self-motivated. The teacher allowed the learners to do their own practical activities (their own understanding of the activity). At the end of the activity, learners explained their work and reasoned why they did what they did.

### ***c. Document analysis***

#### **Analysis of learners' practical activity sheets**

Lerato conducted a practical activity about skeletons. The worksheet was created by the teacher herself. Lerato said she creates a new worksheet each year depending on the reflection of previous year worksheet. Lerato said it always depends on her group each year that determines the type of a worksheet she will create.

The worksheet highlighted suggestions learners could use to assist them during the activity. Learners were also advised to use the MES principle to label their skeletons but, it was up to them to use it or not. MES stands for, M –Material, in this part of the label you indicate which material you will use. E- Explain, in this part of the label is to give more information on the function of the part. S- Size, in this part of the label gives the actual measurements for each of the different parts of your product. Learners had a choice to use MES as a guide in their activity.

### **4.3.2 Tlou's case**

#### **Background**

Tlou (pseudonym) started studying for his Bachelor of Education in New Zealand in 1999. He completed his education degree after 3 years. He started teaching in 2002 in a small, poorly resourced rural town in New Zealand. When he started teaching he was teaching several subjects, including English, Natural Sciences, History, Geography and Mathematics. The teachers in that school were dependent on the surroundings for resources. Tlou taught in that school for 10 years.

Tlou came to South Africa in 2012. He is currently teaching in a private school, located in the suburbs. Tlou's school campus is eye-catching with expansive fields. He teaches Natural Sciences and Technology and Mathematics in Grade 6. The school is well resourced and well structured. The school he is teaching at is a primary school. The school caters for Grades R-7. The classrooms at Tlou's school accommodate a practical lesson as well as a normal lesson. The teachers in his school move around to different classes not the learners. All the lessons take an hour.

#### **a. Interview results**

##### **Tlou definition of practical activities**

Tlou stated that when something is practical it must be as 'hands on' as possible. A practical activity must be "enjoyable, fun, engaging and energising" to all learners. He said safety should be the first priority during practical activities. He said during a practical activity a teacher should make everything clear to the learners, learners must know what is expected of them. Tlou further elaborated that:

*"Maybe start a lesson about what you doing, what you learning and go through it, your aims, your hypothesis, observations, deductions and conclusions. And then I would have a reflection at the end where we basically talk about what you have learnt and have a collaborative learning as much as much as possible".*

He said practical activities are very important at primary level. With practical activities you are teaching learners to bring things into details; however that is not possible if learners have to follow steps given by the teacher. He said it is important for learners to have an aim and a hypothesis so that they can know what to do; primarily it is important for learners to know what is expected from them. However the hardest part during a practical activity is to make sure that learners are doing what you expect them to do and the testing is accurate, precise and fair.

According to Tlou, the CAPS document does suggest practical activities for teachers and the lists that it suggests are good. He said primarily the main thing we should be focusing on with CAPS are the four main areas, the life and living, matter and material, energy and change and earth and beyond. He further said:

*“Practical activities from CAPS are suggested activities, now that is the key word ‘suggested activity’ to get that content out. Some of those activities are brilliant and wonderful, and some I would suggest that they need modification and you can work on and elaborate on. If you want to do the activities from CAPS there are brilliant ones, otherwise come with your own be innovative and think outside the box”.*

Tlou said the relevance of the activities suggested by CAPS depends on the school one is teaching in. He said some of the activities suggested by CAPS are not relevant to learners in public schools, so as a teacher you have to prioritise what activities you can discuss and practice with your learners that are relevant to them.

### **Are practical activities conducted frequently enough?**

Tlou said that the time spent on practical activities is inadequate and “worrying”. He feels that teachers should spend more time on practical activities especially in the current “global economy and environment”. Tlou said that he feels that teachers should spend more time on promoting the sciences and that conducting practical activities promotes that. He explained that:

*“There is a drop away in what is called STEAM teaching, which is Science, Technology, Engineering and Mathematics, those types of learning have never more being needed. In the past it was because people wanted to create, now that still exist, but there is a need for problem solving, facts, and inspiration”.*

Tlou stated that resources are not available at all schools; some schools have limited resources. He said it is unfortunate that most Natural Sciences and Technology teachers really have to think out of the box and come up with alternative plans on how they will get the message across. He said at the end of the day it does not matter whether resources are there or not. It is easy for a teacher when the resources are there, but as a Science teacher you have to be creative. He explained that:

*“Even though they are no resources it can come to a stage where you have to use secondary resources. I mean we are doing a science expo with my learners at the moment, and I told them that you do not need to go and buy new things just use what is laying around the house”.*

Tlou said he tries not to use worksheets most of the time, although he sometimes will use them. He said he prefers to just allow learners to discuss, work collaboratively to try and solve problems or have them take part in a ‘hands on’ activity. He believes Natural Sciences teachers should be careful about the type of worksheets they use. He said a worksheet should:

*“Not be a multiple choice worksheet, it should challenge learners. It must promote creative thinking. A worksheet must promote analysis and synthesis. And it must be on high level from Bloom’s taxonomy”.*

Tlou further elaborated that he prefers seeing teachers asking higher order questions on a worksheet such as:

*“Why do you think we have a problem at the moment nationwide on pollution? How do we battle the problem of fossil fuel? I should rather see a worksheet that is not busy work, not regurgitation and not throwing back what you have learnt”.*

Tlou was asked if he ever allows learners to set their own unguided questions during the practical activity. His response was that, he absolutely does allow his learners to set own questions because the aim of practical activity is for learners to learn how to solve problems. He said the more discussion questions the better.

### **Challenges during practical activities**

Tlou said the challenges he came across when conducting practical activities are that:

*“Learners have limited background knowledge. Since the knowledge of learners is limited, you have to spoon fed them with information before getting anything back. Time is against every teacher”.*

Tlou said that he also thinks that:

*“Lots of NST teachers might prefer to tick boxes rather than inspiring. Lots of teachers are trying to get CAPS out there or get knowledge or get the idea out there instead of focusing on inspiring children and fostering their interest and their enthusiasm”.*

### **Does the school and the Department of Basic Education support practical activities?**

Tlou said that in his school they do support each other in terms of doing practical activities. Most science teachers believe that the more practical activities the better. He stated that:

*“We are trying basically to support each other in my school. We work together as a very close team. We encourage each other and make sure that things are as practical as possible”.*

The DoBE does support teachers in conducting of practical activities. He said he thinks CAPS is a good support for teachers although the support teachers get from the government it is sometimes not enough.

### **Learners' behaviour during practical activities**

Tlou believes that the manner in which learners behave during practical activities is acceptable ever since he started conducting practical activities. He said you will find some learners who are difficult to control during a practical lesson, but he said he personally does not have a problem with learners' behaviour during practical activities.

### **How are learners organised during practical activities?**

Tlou said he organises learners in pairs, individually or in groups. He said the practical activity that you want to conduct will either lend itself to learners conducting it in groups, individually or in pairs. Tlou explained that:

*“Rather have small collaborative groups or big groups working together or learners sharing ideas with each other whatever that lends itself to positive learning. Organisation of learners during a practical activity depends on a situation. A good teacher will make sure that the pairs or group situation is appropriate or not.”*

### **What can be done to improve practical activities in the Natural Sciences and Technology classrooms?**

Tlou stated that there's a lot that can be done in order to enable teachers to conduct effective practical activities within the South African schools system. This could include:

*“Providing teachers with everything that they can possibly need in order to conduct practical activities. Improve resources in all schools. Train teachers on how to conduct or incorporate effective practical activities, on how to use resources, and how to communicate with learners”.*

Tlou emphasised that training of teachers on how to use resources is vital. If teachers are not trained on how to use resources then they will not be effective when conducting practical activities.

## ***b. Observation results of the practical activity conducted***

### **The practical activity protocol (classroom activity)**

One of Tlou's practical activities was observed. The activity was conducted in a classroom that accommodates a practical lesson. There were 26 learners in his classroom. Tlou conducted his practical activity with Grade 6 learners. The activity was about testing for starch. Learners were not given guidelines or hints to conduct their practical activity. Learners were not given procedures to follow; instead they had to write down the methods they used to get to the outcomes that they designed themselves.

Tlou started the activity by reminding his learners of the work done on the topic of starch. Learners were given a worksheet for the completion of the activity. The teacher encouraged his learners to bring samples of food from their homes. Learners brought samples of food such as apples, bananas, bread, cheese, fruit juice, tomatoes, coffee, jam and milk. The worksheet had words with definitions where learners had to write down their protocol of the activity. For example:

- *"Aim -What do you want to learn or find out in your activity*
- *Method -How do you plan to achieve your aim and what steps are you going to do to achieve this aim".*

Learners had to write down the apparatus they used and the food samples. Tlou provided his learners with iodine solution. As a conclusion of the activity, learners had to write down their findings and then present them.

Learners were not required to reach a specific answer during the activity. Any learner could conclude what made sense to them during the practical. Learners were provided with a worksheet during the activity and they had to engage in observations of fellow classmates' practicals and discussions. The teacher assessed learners' prior knowledge at the beginning of the activity. Learners were very disciplined and focused during the practical activity.



Tlou allowed the learners to conduct the activity at their own pace. The activity was not designed to let all learners perform the same steps, all learners were performing their own activity. The activity was about testing for starch but every learner went about it their own way. The activity did not focus on one prescribed outcome, its focus was on learners' own results which varied.

Learners discussed the results after conducting their activities. Learners used their own examples and thinking, the teacher only guided them during the activity. Most learners were actively engaging during the activity. The teacher advised the learners to always relate their work to real life situations. Learners will move around and share ideas with other pairs.

### **Classroom organisation**

The teacher maintained discipline during the activity, however as learners were conducting their activities there was not much to discipline. Learners worked in pairs (teacher highlighted that it was suitable for the activity for them to work in pairs).

### **Reflection on the observation**

The teacher began the lesson by checking learners' prior knowledge. Learners were disciplined during the activity and they were actively involved. The teacher encouraged the learners to ask for help from other partners if they did not understand what to do. During the activity Tlou would stop the learners and motivate them. The learners were encouraged to be creative with their work. At the end of the activity, the learners presented their findings to the class.

### ***c. Document analysis***

#### **Analysis of learners' practical activity sheets**

The worksheet that was used during the starch test activity was created by the teacher himself. (Tlou was conducting a practical activity on starch testing. He gave his learners a worksheet during the activity. Tlou is the one who created the worksheet). In the worksheet Tlou outlined the definitions of different words and then learners had to write down what those words mean in their activity. For example he wrote that:

*“The word aim is similar to purpose: What do you want to learn or find out”.*

Learners had to write down their own aim of the practical activity, what they wanted to find out it could be anything related to the topic. There were also words such as:

*“Method: How do you plan to achieve this? What steps (in order) are you going to take to achieve your aim”?*

There were no direct protocols given to the learners to follow in the worksheet. Learners had to develop their own protocols and write down how they went about their activity. At the end of the activity learners had to make deductions (explain what their activity meant to them) and write conclusions.

#### **4.4 Chapter summary**

This chapter presented the results of this study established on how novice and expert teachers conduct practical activities in their Natural Sciences and Technology classrooms in intermediate phase. The results were collected through face-to-face interviews, observations and document analysis (worksheet).

In summary, the teachers who were part of this study were 2 novice and 2 expert teachers. Each teacher was interviewed and observed once. The teachers who participated were holders of degree qualification. One teacher teaches in a township school while the other 3 teach in developed places.

The Natural Sciences and Technology teachers both expert and novice knew the benefits of conducting practical activities in the science classroom. Teachers face different challenges when conducting practical activities such as; limited resources, learners’ behaviour, learners’ safety, learners’ ratio, learners’ lack of interest and the preparations of practical activities can be exhausting. The next chapter deals with the analysis and findings of this study.

## CHAPTER 5

### FINDINGS AND DISCUSSIONS

#### 5.1 Introduction

This Chapter presents the findings and discussions of results in Chapter 4. This Chapter also links the findings with the literature reviewed in Chapter 2. The findings of this study cannot be generalised to a broader population in South African Natural Sciences and Technology intermediate phase classrooms, but may still add to the knowledge about novice and expert teachers when implementing practical activities. The findings are discussed with a view of answering the following research questions:

#### Main research question

How do novice and expert teachers in South Africa conduct practical activities in Natural Sciences and Technology intermediate phase classrooms and what are the challenges they face?

#### Sub-questions

- How do novice teachers conduct practical activities in Natural Sciences and Technology classrooms?
- What are the challenges novice teachers face when conducting practical activities in Natural Sciences and Technology classrooms?
- How do expert teachers conduct practical activities in Natural Sciences and Technology classrooms?
- What are the challenges expert teachers face when conducting practical activities in Natural Sciences and Technology classrooms?

#### 5.2 Novice teachers' findings: Implementation of practical activities

In this study several findings were identified regarding the implementation of practical activities and challenges faced by novice teachers during practical activities. As mentioned in the

problem statement of this study, a literature survey conducted in this study could not find any similar studies that were conducted in South Africa showing how novice teachers conduct practical activities in the Natural Sciences and Technology classroom. The findings below were made through a thorough study of data that was collected through open-ended interviews, classroom observations and document analysis.

### **5.2.1 Novice teachers' implementation of practical activities in the Natural Sciences and Technology classroom in the intermediate phase**

The following findings were made, based on the question, 'How do novice teachers conduct practical activities in the Natural Sciences and Technology classroom?'

**Finding:** Practical activities conducted by novice teachers in their NST classrooms in the intermediate phase were mostly teacher centred.

#### **Analysis and discussion**

The main role of learners in a teacher centred activity is for them to carry out the activity prescribed by the teacher. Learners have little control over the problem and solution of the given task. The role of the teacher is to guide learners by prescribing them with an activity to do. The teacher shows learners how to handle the experiment and how to reach the conclusion (Van De Valk & De Jong, 2009). Both Kego's and Tebogo's practical activities were teacher centred, however, other factors such as overcrowding of classrooms and school context could have influenced a type of practical activity a teacher conducts.

According to Haigh (2007) most science teachers in schools still carry out a "direct instruction experiment" where learners follow the protocols given by the teacher step by step without acquiring their own knowledge and that might lead to the use of only lower cognitive activities. Kego and Tebogo conducted the practical activities at a lower level (teacher centred). According to Cossa (2007), science teachers do implement practical activities in their classrooms however, most of their activities are inefficient.

Teacher centred practical activities are clearly a problem in South African classrooms. The following example illustrates the teacher centred approach by the novice teachers. Tebogo's learners were told which apparatus they should use and they were following the protocols given by the teacher step by step. At the end of the practical activity, Tebogo's learners had to answer questions given to them from the worksheet. Therefore, learners were not constructing their own knowledge learned from the practical activity. During the activity, learners knew exactly what was expected of them since the practical activity was outlined for them. The worksheet that was given to the learners summarised all the steps they should follow during the activity.

According to research conducted by Bhukuvhani, Mupa, Mhishi and Dziva (2010), if science teachers perform a direct instruction approach it mostly results in learners lacking interest in their work and not being prepared for the skills needed in the 21<sup>st</sup> century. Tebogo mentioned during the interview that:

*“The lack of interest mostly comes from learners who are cognitively challenged. Those learners who lack interest do not see the purpose of coming to school or doing their work. You find you have 50 learners in one class and from that 50, 30 learners are cognitively challenged and only 20 learners are interested in their work”.*

As mentioned in Chapter 2, novice teachers undergo an induction period during the first 5 years of their teaching careers (McDonald & Healy, 1999). During this period they have to move from the ideal of what teaching is to the reality of classroom life and the reality of what happens in the classroom. Tebogo is one of the novice teachers who is still in her induction period. She is frustrated by the fact that “most” of her learners in her classroom are cognitively challenged, hence it results in her conducting a direct instruction activity. Tebogo further stated in her interview that:

*“Sometimes when learners are given a practical activity they fail to finish during a single period. And these learners are not like high school learners where they can continue with the work the following day. They will forget. Not everyone will remember what*

*happened. I know they say when they see they will remember, but that is not everyone because 99 % of our kids have cognitive challenges”.*

Tebogo said that “99 % of her learners are cognitively challenged” yet she does not teach in a special needs school. It shows that Tebogo is overwhelmed by her work and this result in her blaming her learners and conducting a teacher centred activity because of her frustration. Hattingh, Aldous and Rogan (2007) stated in their study that the manner in which the teachers perceive their learners has the greatest influence on the level of practical activities performed in their science classrooms. If a science teacher views her/his learners with lesser or no capacity to learn, then they will conduct a practical activity that is closed (direct instruction) with no learners’ input. Tebogo is one of the science teachers who has no faith in her learners hence it results in her performing lower level practical activities. She stated in her interview that:

*“Some learners just want to copy down they do not want to think. You know others just prefer writing down and not answering. Some prefer writing question and answer. So there is a different in interest in the class. It is very rare to win them all. If you say okay today we are going to the garden or say today we are going to walk around the school to look for different kinds of frogs. Others will be excited that they are outside the class and others will have interest and curiosity on the activity”.*

From the observation, it showed that Kego, similar to Tebogo, conducted a teacher centred practical activity. The practical activity that learners were conducting was prepared for them by the teacher. The teacher provided learners with a worksheet that outlined the steps to follow when conducting the activity. Learners were told what to do and how to do it.

As mentioned by Hattingh *et al.* (2007), teachers’ views of learners influence the manner in which they implement activities in their science classrooms. Kego is also a teacher who does not have faith in her learners. Kego stated in her interview that:

*“Some learners do not want to sit down, they just want to be with their friends. Some learners will be standing and looking around what their friends are doing. The will be*

*some learners disturbing the lesson during the practical activity. Learners in primary school enjoy playing around so conducting a practical activity might be a challenge”.*

Kego displayed little faith in her learners’ capacity to behave well during practical activities. She views primary school learners as learners who enjoy moving around in class and talking with friends which makes it a challenge for her to conduct a practical activity. McDonald and Healy (1999) stated in their study that, during the first 5 years of teaching, novice teachers often start to question their quality of teaching and the learning potential of their learners. Since Kego perceives her learners troublesome, it results in her giving learners’ lower level (teacher centred) practical activities.

Millar (2004, p. 2) mentions in his study that the manner in which science teachers conduct practical activities in their classrooms is influenced by several aspects such as:

- *“Teachers’ objectives– teachers’ views of science, teachers’ views of learning and the practical context.*
- *What the learners actually do- learners’ view of science.*
- *What the learners actually learn- learners’ view of learning science”.*

Millar (2004) is stating that the way in which science teachers view science influences how they conduct practical activities. During the interview, Kego was asked about her understanding of what practical activities are, but before Kego responded to that question, she asked to be given time to think about the answer. Kego was uncertain what practical activities were, hence that influences the manner in which she conducts practical activities in her classroom. The uncertainty of the definition for practical activity may result in the teacher conducting a lower level of practical activities (Millar, 2004).

**Finding:** Novice teachers do not often conduct independent practical activities in their NST classrooms in the intermediate phase.

## Analysis and discussion

When a science teacher has conducted an effective practical activity, the learners are allowed to have control over “decision-making processes and not simply have to follow a recipe” (Millar, 2004, p. 7). A practical activity should allow learners to learn to be independent (Osborne, 2002). Millar (2004) stated that a practical activity should allow learners to do “hands on” activities and learn to make informed decisions. Tebogo felt that independent practical activity would be good for learners, however, the data showed that she does not conduct it. Kego on the other hand felt that an independent practical activity is not suitable for primary learners.

Tebogo was asked if she ever allows her learners to conduct unguided practical activities. Her response was that:

*“Yes I do. For most of my practicals when I work with NST I use a website called e-classroom. The practical activities from this website have everything and they are a good guide”.*

The activity Tebogo downloaded outlined the protocols for the learners and they followed them step by step. Tebogo’s learners were dependent on her to write down the list of apparatus to use in the activity, to write down the aim of the activity they were conducting and to provide the materials they will be using during the activity.

Kego said it is not a good idea to conduct an unguided activity with primary school learners. She said:

*“Learners from primary school is best if you guide them for the fact that if you just get in class and allow learners to conduct unguided practical activities, you will find that learners are not doing what you expect from them. Some learners will be busy with friends and not do what is wanted; they will be busy running around. So I think it is best to guide them”.*



Both these novice teachers, Kego and Tebogo, guide their learners during a practical activity. They highlight protocols their learners have to follow, apparatus to use during the activity and at the end of the activity they write down questions they want their learners to answer.

**Finding:** Novice teachers do not use practical activities as a way of solving problems in their NST classrooms in the intermediate phase.

### **Analysis and discussion**

According to Meyer (2004), novice teachers lack the experience to organise their thinking, hence, they end up conducting practical activities just to help learners to remember the work, not to teach learners problem solving skills.

Kego's and Tebogo's practical activities were focusing on specific outcomes, learners were expected to reach specific answers. Their activities were not based on solving a specific problem or situation. Both of these teachers conducted practical activities to help their learners remember the work they have been taught. Tebogo stated during an interview that, "the more learners do hands on activities, is the more they will remember the work".

Kego on the other hand stated that, practical activities are good in primary schools because learners forget work done in class if the teacher focuses more on theory and no practical. Kego also stated that practical activities help learners to remember the work better. She further stated that learners learn better when they take the work done theoretically and put it into practice. Kego furthermore mentioned that primary schools' learners learn better when they see things practically but it has to be work they have already learned in theory.

Meyer (2004, p. 972) stated that:

*"Novice teachers' activities end up unproductive because, "the process of learning to teach is complex and novice teachers are limited by their lack of background experience as educators and therefore have limited framework for making sense of what is happening in their classroom".*

Meyer (2004) is stating that the reasons novice teachers are conducting practical activities that are not promoting problem solving skills is because they lack the experience and they have a limited background of teaching.

**Finding:** Novice teachers mostly use worksheets during practical activities in their NST classrooms in the intermediate phase.

### **Analysis and discussions**

Both novice teachers, Kego and Tebogo, stated that they do not conduct practical activities that are not accompanied by a worksheet. Tebogo said:

*“I believe that every practical activity should be accompanied by a worksheet in order for a teacher to assess learners. You cannot teach someone a skill and not assess it”.*

Kego also said that:

*“I use a worksheet to guide the learners. The learners do the activities themselves to show that they did understand the theory work that they were taught in class. A worksheet is there to see if learners are conducting a practical activity according and in the right way”.*

According to Kisiel (2003), an effective worksheet can be divided into three categories namely, level of choice, cognitive level and response format. Firstly a worksheet should indicate a level of choice where it allows learners to control and make decisions about given task. A level of choice can range from no choice (the task given have only one correct response) over some choice (where the task given has several possible responses) and to subject choice (where the task is applicable to multiple settings, the learner decides where and how to do what).

Both Kego’s and Tebogo’s worksheets had protocols for learners to follow. At the end of the activities learners had to answer questions about the practical activities they were conducting. Kego’s and Tebogo’s worksheets showed that learners did not have control over the activities and decision making. Kego stated that she believes there is a “right way” of conducting a practical activity, hence she was expecting learners to reach specific objectives, and learners did

not have control over the activity the teacher did. Research shows that if a teacher is expecting learners to reach specific “correct responses” during a practical activity, that will result in a lower level task (Kisiel, 2003).

Secondly, according to Bloom, Engelhart, Furst, Hill and Krathwohl (1956), an effective worksheet should include few if not all of the six cognitive levels namely; knowledge, comprehension, application, analysis, synthesis and evaluation. Kego’s and Tebogo’s worksheets focused on cognitive knowledge only. Both Kego’s and Tebogo’s practical activity sheets had notes at the beginning. The notes were highlighting the facts learners should know about the topic they were busy with. The notes gave learners a picture of what they should be looking for in the activity. The teachers were seeking to understand if learners knew the work done in previous lessons. So the focus of both novice teachers’ activities was on testing learners’ knowledge and not giving them a chance to investigate on their own.

Lastly, a response format is very important in a worksheet. It is important how learners are asked to respond to a given task on the worksheet. A worksheet should accommodate several responses (Kisiel, 2003). A worksheet should accommodate different learners’ learning styles; it could be through verbal/non-verbal or written/non-written. Kego and Tebogo tried to accommodate learners since both of them allowed learners to write answers asked about the activity (written work) and learners had to present their findings at the end (verbal style).

Researchers however criticise worksheets that place the stress on filling out of the worksheet such as Tebogo and Kego’s worksheets. Learners should explore their surroundings without the assistance from their teachers (Lucas, 2000). Researchers such as Griffin and Symington(1997), further stated that when incorporating prior knowledge and interest into the worksheet, a learner-centred approach is recommended in which learners are finding answers to their own questions. Both Kego’s and Tebogo’s worksheets had questions for learners to answer at the end of the practical activity. Learners were not taking control of their own learning; they were not given a chance to decide where or how to apply the given task (McManus, 1985).

**Finding:** Novice teachers mostly organise their learners in groups during practical activities in NST classrooms in the intermediate phase.

### **Analysis and discussion**

Kego and Tebogo associate practical activities with group work. Their understanding is that when learners are conducting a practical activity learners must be in groups without taking into consideration what the activity is about. Tebogo stated that:

*“The best way to organise learners in primary school during a practical activity is by grouping them. It is even more effective when you group them from strongest learner (understand better than others) in class to weakest learner (take time to understand given work)”.*

Kego on the other hand said:

*“I prefer when learners are divided in groups during a practical activity. When learners are in groups it is important to ensure that in each group there is a hard working learner since he/she will assist the learners who take time to understand”.*

According to Lucas (2000), conducting a group work activity is good because it increases the enjoyment of the activity; it facilitates question asking and promotes the active participation of learners. Researchers such as Borun and Dritsas (1997), on the other hand, stated that group work activity should be accompanied by a worksheet that “is group-work friendly”. That means not all practical activities can have a group work worksheet. Therefore, the manner in which learners are organised during a practical activity should depend on a type of activity learners are conducting.

### **5.3 Novice teachers’ findings: Challenges they face during practical activities**

The following findings made are based on the question, ‘What are the challenges novice teachers face when conducting practical activities in the Natural Sciences and Technology classroom?’

**Finding:** Novice teachers do not have confidence in their learners when conducting practical activities in their NST classrooms in the intermediate phase.

### **Analysis and discussion**

The findings of this study show that both Tebogo and Kego do not have faith in their learners. McDonald and Healy (1999) stated that, mostly during the first 5 years of teaching novice teachers often start to question their quality of teaching and the learning potential of their learners. Tebogo stated that conducting a practical activity with primary school learners can be a serious challenge because learners do not finish the activity. If you think as a teacher you will continue with the learners the following day they will not remember the work. She said that it is a challenge in a science classroom to “win all” learners. Tebogo does not believe that all of her learners have the capability to do what she wants them to do.

Tebogo regards her learners as pupils with poor competence. She stated that, “99 % of our learners have cognitive challenges”. Tebogo does not teach in a special needs school but still feels that her learners are not capable of mastering the work. With 99 % it means almost all of the learners in her class are not capable. This just shows that she does not have confidence in her learners at all since she further stated that, “there is lack of interest from learners especially those who are cognitively challenged”.

Kego is no different from Tebogo. She also has no confidence in her learners. Kego stated that, “learners in primary school are still too young to conduct unguided practical activities”. This shows that Kego has no faith in primary school learners. She does not see potential in her learners if she thinks her learners are still young to think “out of the box”. Kego further stated that, “it is a challenge to get learners focused in a normal lesson; unguided practical activities will be a disaster”. This does not only show that Kego does not see potential in her learners, but it also shows a sign that Kego is overwhelmed by her work.

**Finding:** Novice teachers teaching NST in the intermediate classrooms are overwhelmed by teaching.

### **Analysis and discussion**

Kego is not the only novice teacher who is overwhelmed by her work, Tebogo is also overwhelmed. At the beginning of an interview with Kego, she was asked what her understanding was about the definition of practical activities. Before Kego could respond, she asked to be given time to think about it. She looked so confused that she had to think deeply so as to give the “right answer”. Kego is so overwhelmed by her work that she said, “learners make lots of noise during practical activities, and it is frustrating”.

According to Veenman(1984, p.143), novice teachers go through a “transition from teacher training to the first teaching job which could be a traumatic one”. Novice teachers experience the pressure of a new job which could result in stress, workload, physical complaints and psychological complaints hence they tend to be frustrated by their work and take out their frustration to learners.

Tebogo stated that in a class of 50 learners, you find that 20 learners are capable and the other 30 are not capable. It sounds as though Tebogo is so stressed by her learners that she does not see potential in them. Veenman (1984, p.147) said novice teachers have frustrations because they are not trained for “the demands of their work”. With an overwhelmed teacher like this, it results in her conducting poor practical activities because she believes that her learners are not capable. Tebogo does not know what to expect her expectations are too high.

The data shows that Tebogo is shifting the blame of her struggles in the classroom to her learners. She feels overloaded by her work if she feels that conducting a practical activity is not enough in one lesson and primary school learners never complete their work. Tebogo even has negative attitudes towards other teachers. She stated that, “only teachers who know or have passion in science or technology will do what is right”.

Tebogo defined practical activities as, “an activity that is hands on”, and where learners are allowed to “discover things”. However, she does not conduct a practical activity that allows her

learners to discover things themselves since she does not believe in her learners. She sees “hands on” as needing no cognitive contribution.

Fantilli and McDougall (2009) stated that, novice teachers are overwhelmed by their work because they are not given time to adapt to the school facility, school routines and establishing for the first time their own classroom management procedures.

**Finding:** Novice teachers have a challenge managing learners’ behaviour during practical activities in the NST classrooms in the intermediate phase.

### **Analysis and discussion**

Kego and Tebogo had a lot to say about their learners’ behaviour during practical activities. Tebogo’s first word was that it is “upsetting”, one of the signs of work stress. Veenman (1984, p. 147) said, sometimes learners of novice teachers misbehave because “novice teachers are given the more difficult classes or less able classes”. McDonald and Healy (1999) also said, novice teachers are often given the most challenging and troublesome learners that their colleagues who are more experienced in teaching do not want.

Tebogo said in her classroom there are learners who know the reasons of being at school and those who do not. Those who know the reasons of being at school behave well and those who do not make unnecessary noise during the lessons.

During Kego’s observation, most of her learners were running around during the activity. Most of them were not completely focused on the given work because they were busy talking with friends. It is proof of what Kego said during the interview that, during practical activities:

*“Learners will run around, some will not even focus. Some learners will not even put their minds in an activity they are busy with in class. You find that the ones who are clever will be working and the other learners see it as an opportunity to hang out with friends and play around”.*

Kego stated during the interview that she normally group her learners. However, during the observation she allowed her learners to group themselves and that increased the misbehaviour of learners in class since they grouped themselves with their friends.

**Finding:** Novice teachers have a challenge disciplining their learners effectively during practical activities in NST classrooms in the intermediate phase.

### **Analysis and discussion**

Classroom discipline “is a real problem for beginning teachers” (Veenman, 1984, p.145). Novice teachers tend to get very sensitive when their misbehaving learners disrupt their planned presentation. Novice teachers fail to effectively discipline learners since disciplinary skills are learned through the experience of teaching (Veenman, 1984). The discipline problems is not unexpected, but still a bigger problem for novice than expert teachers.

Both Kego and Tebogo have a challenge when it comes to disciplining their learners. Their learners were making lots of noise during the activity and they both took time to discipline them. Even though they did maintain an acceptable noise level of learners during the practical activities, they still took time to make learners keep quiet.

The methods Kego and Tebogo used to discipline their learners were not effective enough since learners will be quiet for few minutes and then make noise again. On the previous finding, Tebogo said learners’ behaviour is “upsetting” because managing the learners during a practical activity is a challenge to her. Kego had a serious challenge disciplining her learners. Most of her learners did not want to sit down when she needed them to. Some of her learners were moving around to see their friends.

**Finding:** Novice teachers mostly fail to manage their time during practical activities in the NST classrooms in the intermediate phase.



## **Analysis and discussion**

One of the other challenges novice teachers face is to manage their time in order to accommodate the conducting of practical activities. Novice teachers tend to spend more time and energy preparing for daily lessons (Tsui, 1996). When novice teachers prepare a topic, they prepare it as a separate unit from the rest of the other topics in the textbook, so that results in them spending too much time when they prepare lessons (Tsui, 1996).

Kego stated that; she does not conduct practical activities as frequently as she should because of the limited time. She said that there is enough support from the Department of Basic Education and educators at work, the only challenge preventing the conducting of practical activities is time. Because of time, Kego said she is unable to conduct practical activities in most topics in NST. Tebogo emphasises that the time is not enough for teachers to conduct adequate practical activities. Even if as a teacher you have a double period (in her school being an hour), it is still not enough. This shows that Tebogo has a challenge managing her teaching time.

## **5.4 Expert teachers' findings: Implementation of practical activities**

### **5.4.1 Expert teachers' implementation of practical activities in the Natural Sciences and Technology classroom in the intermediate phase**

The findings below show how expert teachers in the South African classroom conduct practical activities. The findings were collected through open-ended interviews, classroom observations and document analysis. The following findings are made based on the question, 'How do expert teachers conduct practical activities in the Natural Sciences and Technology classroom?'

**Finding:** Expert teachers mostly conduct learner centred practical activities in the NST classrooms in the intermediate phase.

## **Analysis and discussion**

According to the findings of this study, both Lerato and Tlou conducted learner centred practical activities. Both teachers did not give their learners direct instructions to follow. It was pointed out that learners enjoy practical activities more when they are conducting the open-

ended activities where they ask their own questions and find ways to answer those questions (Gibson & Chase, 2002). Researchers such as Crawford, Krajcik, and Marx(1999) stated that the more learners are engaged in open-ended tasks the more they will improve their ability of asking good research questions and their way of answering or solving problems to their questions.

In a teacher centred approach the main role of a learner is to carry out procedures prescribed by the teacher, learners have little or no control over the design of questions and solutions (Van de Valk & De Jong, 2009). The role of the teacher is to formulate questions for learners, show them how to handle apparatus, how to find data and interpret it and how to reach conclusions (Van de Valk & De Jong, 2009).Tlou and Lerato’s practical activities were not conducted in that manner.

In Lerato’s classroom, learners had to write down their own purpose of the activity. They were given a chance to write down what they want to achieve during the activity. Lerato provided her learners with a few suggestions on how they can go about their activity but learners were not forced to comply within those suggestions. Learners were using their own understanding during the activity. As Anderson (2002) stated, when an activity is learner centred, learners direct their own learning, they design and direct their own task just like Lerato’s learners. Anderson (2002) further stated that, when an activity is learner centred it emphasises reasoning from the learners, and problem solving.

As Van de Valk and De Jong (2009) stated that, when a teacher is conducting a teacher centred activity she/he prepares apparatus for the learners and shows them how to use them. Lerato did not prepare materials for her learners, learners were the ones that prepared everything they thought was needed to conduct their own activity. According to findings gathered from the observations and document analysis, learners were not given protocols to follow. They had to write down their own protocols they were going to follow for their activity. Anderson (2002) said that when an activity is teacher centred a teacher will expect specific answers from the learners. With Lerato’s learners, there were no “right answers” for learners to reach because

every pair of learners in the classroom was conducting their own understanding of the practical activity given.

Just like Lerato, Tlou also conducted a learner centred practical activity. From the observation analysis, learners were not given guidelines to follow during their practical activity. Just like Lerato's learners, Tlou's learners had to formulate their own procedures that they were going to follow during their activity. Learners had to write down the methods they were going to use for their activity.

Anderson (2002) furthermore stated that, a learner centred activity does not involve a teacher giving learners a worksheet to complete and learners completing the same task, tasks should vary among learners if it is learner centred. Tlou's learners were given a worksheet, however, their worksheet needed them to write down their own aim of the activity highlighting what they wanted to learn from the activity. There were no direct instructions for the learners to follow during the activity.

Research shows that when expert teachers plan, "they integrate their knowledge of the curriculum, the learners, teaching methods and strategies" (Tsui, 1996, p. 30). Hence they are able to plan and implement a practical activity that is learner centred. Tsui (1996) stated that expert teachers are able to integrate their knowledge of the curriculum into their teaching strategy. Both Lerato and Tlou were able to notice when, where and how to integrate CAPS in their classroom.

Tlou stated in his interview that he does conduct practical activities suggested by CAPS. He said:

*"Practical activities from CAPS are suggested activities, now that is the key word 'suggested activity' to get that content out. Some of those activities are brilliant and wonderful, and some I would suggest that they need modification and you can work on and elaborate on. If you want to do the activities from CAPS there are brilliant ones, otherwise come with your own be innovative and think outside the box".*

Tlou showed that he knows how to integrate his knowledge of CAPS, he said the relevant of the activities suggested by CAPS depends on the school environment. Some of the activities

suggested by CAPS are not relevant to learners in public school, so as a teacher you have to prioritise what activities you can discuss and practice with your learners that are relevant to them.

Lerato on the other hand said that practical activities suggested by CAPS are good activities depending on your learners and the environment of the school. She said some of the topics in Natural Sciences and Technology especially in Grade 5 cannot be conducted practically. She said the activities suggested by the curriculum are good but sometimes learners are smarter than those activities. It appears that the activities are not challenging enough for most learners in the classroom. She said:

*“What I sometimes find with the grade 5’s topics it does not always lend itself to practical activity. The content that we have to teach is not necessarily something that will always be a practical activity”.*

Meyer (2004) stated that, the practice of expert teachers is very creative that it can be seen as a balance between teaching as art and teaching as science. He further stated that expert teachers’ actions and communications in the classroom seem to be exceptional, they just seem to know what to do or what to say. Tlou and Lerato were confident with their activities during classroom observation.

**Finding:** Expert teachers mostly conduct independent practical activities in their NST classrooms in the intermediate phase.

### **Analysis and discussion**

When learners engage in unguided activities is when they draw on their own image, their previous experiences and their style of learning and create the knowledge that is new and beneficial to them (Kirschner, Sweller, & Clark, 2004).

Lerato stated that she does allow her learners to conduct an unguided practical activity but not often. She stated that she sometimes allows learners to set their own questions unguided

during a practical activity. As it is stated earlier, a learner centred activity allows learners to take control of their own work, direct their learning and design their own tasks (Anderson, 2002).

When Lerato is explaining the practical activity to learners, she allows her learners to set their own unguided questions but the questions learners will set will be those that they ask in class but not as part of the activity. Lerato mentioned that learners mostly come up with some very interesting questions when you are busy explaining work to them. This shows that not only does Lerato allow her learners to conduct unguided practical activities; but it shows that Lerato has faith in the abilities of her learners.

Tlou stated that unguided practical activities are good for learners especially in teaching them how to solve problems. Tlou said:

*“I absolutely do allow my learners to set own questions because the aim of practical activity is for learners to learn how to solve problems. I believe that the more discussion questions the better”.*

Tlou emphasises that he does not conduct a practical activity were learners have to follow steps given. He believes that it is important for learners to have an aim and a hypothesis so that they can know what to do.

Expert teachers do not only conduct an unguided practical activity because they strongly believe in learners, but because they are able to “improvise” (Tsui, 1996, p. 38). If expert teachers have to change their plans to involve all learners in the classroom they have an ability to do that. Expert teachers have a better way to respond to learners’ needs and classroom events that “require decisions and actions because they have well established routines”, which they can call upon to respond to a variety of unanticipated events (Tsui, 1996, p. 38).

**Finding:** Expert teachers mostly use practical activities to solve problems in their NST classrooms in the intermediate phase.

## **Analysis and discussion**

Some researchers trust that when learners are challenged to solve problems or to “learn complex knowledge in an information rich setting”, they construct their own solutions and that results in the “most effective learning experience” (Kirschner, Sweller, & Clark, 2004, p. 3).

Lerato stated that she conducts a variety of practical activities in her classroom. She said that, “it does not help that you get one type of an activity and try to force everything into it. Some activities might work better when you do it in groups and some might work better when you do it as a class demonstration. Lerato stated that she conducts different activities in her class from most challenging activities to the not so challenging.

Tlou stated that a practical activity must be as hands on as possible. A practical activity must be “enjoyable, fun, engaging and energising to all learners”. So Tlou was conducting an activity that needed his learners to think “out of the box and out of their comfort zone”. Tlou’s learners were not expected to reach a specific answer. Learners were given an opportunity to conclude what made sense to them during the activity. The activity that Tlou gave his learners did not focus on the outcomes but focused on learners own results which varied. Learners had an opportunity to solve the problem on their own understanding and pace.

Expert teachers have well developed knowledge bases and organisation that is responsive to multiple external and internal reminders and highly linked, allowing for flexible patterns of organisation and problem solving (Bereiter & Scardamalia, 1993). Hence Tlou and Lerato were able to conduct problem solving activities that were high in Bloom’s taxonomy due to their knowledge of the curriculum (Bloom *et al.*, 1956).

**Findings:** Expert teachers do not mostly use worksheets during practical activities in their NST classrooms in the intermediate phase.

## **Analysis and discussion**

According to Griffin and Symington (1997), when a teacher uses a learner-centred approach it is when her/his worksheet requires learners to find answers to their own questions. Tlou and Lerato do not relate a practical activity with a worksheet. They do not believe that every

practical activity should be accompanied by a worksheet, they stated that your practical activity might require you to use a worksheet or not to use it. When Tlou and Lerato were observed they both used worksheets in their activity. They believe that the use of a worksheet depends on the activity presented to learners.

Researchers such as Kisiel (2003) and McManus (1985) stated that a worksheet should allow learners or give learners time to pursue their own interests. Worksheets designed by Tlou and Lerato gave learners a chance and an opportunity to explore their own interest. Learners should be given a freedom of choice for exploration to take place. An effective worksheet has the ability to provide learners with a motivating experience (Kisiel, 2003; McManus,1985).

Prior knowledge in a worksheet is very important because it is the “raw material that conditions all learning” (Roschelle, 1995, p. 18).However according to some researchers, studies have showed that learners who have the lowest level of prior knowledge about the topic being studied gain the most knowledge during an activity (Falk & Adelman, 2003; Falk & Storksdieck, 2005).

Lerato said she uses worksheets during a practical activity however, she said her use of worksheets depends on the type of practical activities given to learners. During Lerato’s interview, she said in some practical activities she does not give learners worksheets, the learners conduct the practical task entirely on their own. As Kisiel (2003) stated, an effective worksheet should allow learners to have control over their work and make their own decisions.

During the observation, Lerato created the worksheet for a practical lesson for learners. The worksheet activity was open-ended because the document analysis showed that the worksheet was more of a guide to learners than direct instructions to follow. The activity tested learners’ knowledge, understanding and their thinking. The activity forced them to think creatively since learners were supposed to create/design their own procedures to follow.

Tlou stated that he does not use worksheets often. He said he tries by all means not to use them. Tlou prefers to let learners discuss and work collaboratively to try and solve a problem. He stated that Natural Sciences teachers should be careful about the type of worksheets they

use. He further stated that, a worksheet should “challenge learners and promote creative thinking”. Tlou’s statement is supported by Kisiel (2003) and; McManus (1985) as they said that a worksheet should provide learners with the ability to be motivated and have a creative imagination.

Tlou’s and Lerato’s worksheets did not provide learners with notes that they could use to help them with the practical activity they were conducting. The manner in which they have prepared their worksheets is mentioned by Falk and Adelman (2003); Falk and Storksdieck (2005) in their studies that when learners do not have prior knowledge during the activity they tend to gain the most knowledge.

Tlou also stated that he believes that a worksheet must promote analysis and synthesis; it must be on higher levels of Bloom taxonomy, he said he always tries to ensure that his activities are challenging for his learners.

**Findings:** The way expert teachers organise their learners during practical activities always depends on the type of practical activity they are conducting in their NST in the intermediate phase.

### **Analysis and discussion**

Borun and Dritsas (1997), stated that group work activity should be accompanied by a worksheet that “is group-work friendly”. That means if a teacher decides to conduct a practical activity that accommodates learners being in groups, then the worksheet should also accommodate group work. Therefore, these researchers are stating that the way in which learners are organised during a practical activity depends on the type of activity learners are conducting.

During his interview, Tlou stated that the way he normally organises his learners during a practical activity always depends on the activity he is conducting with learners. He said practical activities can lend themselves to individual work, pair work or even group work. He further stated that:



*“I rather have small collaborative groups or big groups working together or learners sharing ideas with each other whatever that lends itself to positive learning. Organisation of learners during a practical activity depends on a situation. A good teacher will make sure that the pairs or group situation is appropriate or not.”*

Lerato also stated that it is important to know how to organise learners during practical activities, so that it is ensured that every learner participates during the activity. Lerato said it is important to ensure that the manner in which learners are organised is suitable for the practical activity conducted. During an interview Lerato stated that:

*“Some activities like building of the skeleton you would not do with a group that is too big that is why it works better in pairs. Some activities it is almost better for them to do on their own. So it is going to depend on the activity, so it all depend what type of an activity and what you want to achieve through that activity”.*

### **5.5 Expert teachers’ findings: Challenges they face during practical activities**

The following findings made are based on the question, ‘What are the challenges expert teachers’ face when conducting practical activities in Natural Sciences and Technology classroom?’

**Finding:** Expert teachers’ face only a few challenges when conducting practical activities in their NST classrooms in the intermediate phase.

#### **Analysis and discussion**

Unlike novice teachers, expert teachers did not have so many challenges they were facing in their classrooms, instead they were able to point out challenges other teachers’ face during practical activities that to them is not a challenge anymore.

Tlou and Lerato pointed out that the challenges that they face when conducting practical activities in their classroom was that learners have limited background knowledge. And since learners’ knowledge is limited you have to spoon feed them with information before getting anything back.

Both Tlou and Lerato complained about never having enough time for teachers to conduct practical activities frequently. However, Tlou stated that he believes time is against any teacher so he believes that, as a teacher you must learn how to budget your time effectively. Tlou and Lerato did not face any challenges relating to learners' behaviour, managing their classroom discipline or facing teaching frustrations.

According to Tsui (1996), expert teachers attend to learners' discipline immediately when they misbehave. Expert teachers are able to manage classroom discipline because they are able to "analyse and interpret classroom events and problems in a principled way, they are able to provide justification for their suggestion" (Tsui, 1996, p. 37).

Expert teachers, due to their experience in teaching and in their classrooms, can easily recognise patterns in the classroom events and hence make sense of them immediately (Tsui, 1996). Tsui (1996) stated that expert teachers are not easily frustrated by their work because of their experience in the classroom.

## **5.6 Summary of an implementation of practical activities: Novice and expert teachers**

The following findings are discussed with a view of answering the following sub-questions:

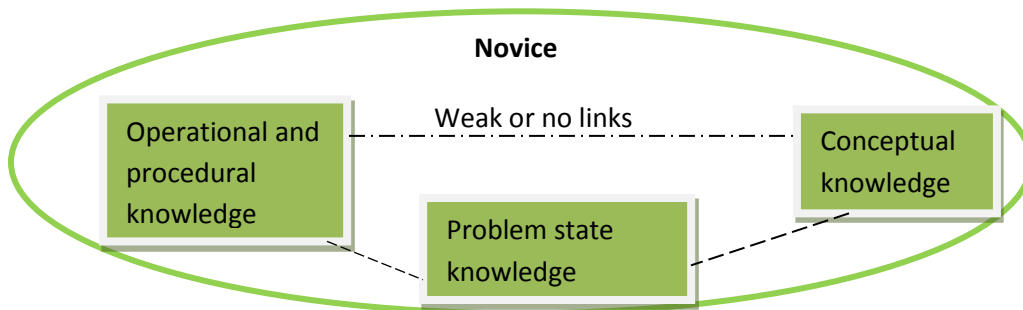
- How do novice teachers conduct practical activities in Natural Sciences and Technology classrooms?
- How do expert teachers conduct practical activities in Natural Sciences and Technology classrooms?

**Finding:** There were distinct differences in the way in which novice teachers conduct practical activities compared to expert teachers in their NST classrooms in the intermediate phase.

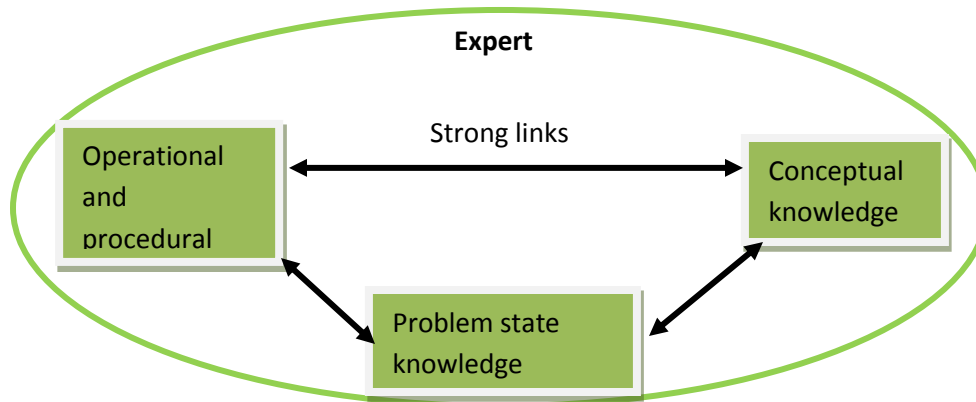
### **Analysis and discussion**

The findings of this study shows that the way in which novice teachers conduct practical activities differs from expert teachers in the South African intermediate phase in the Natural Sciences and Technology classrooms.

The framework of this study involved 4 forms of knowledge, namely the operational and procedural knowledge, conceptual knowledge and problem state knowledge (Leonard *et al.*, 1999). From the findings of this study, it showed that the novice teachers' understanding is described as more incomplete and less hierarchical than expert teachers. Novice teachers have poor and weak links among their knowledge as shown below (Leonard *et al.*, 1999):



The poor links of knowledge of novice teachers resulted in them conducting practical activities that are of a lower level. Knowledge of expert teachers is richer and more “bidirectional” connections occur within and between knowledge forms. Expert teachers conducted practical activities of a high cognitive level since they have rich link of knowledge. Expert teachers linked knowledge is shown below (Leonard *et al.*, 1999):



The way novice teachers conduct practical activities in their NST classrooms differ from expert teachers. Table 5.1 below shows how novice teachers in this study differed from expert teachers when conducting practical activities in their NST classrooms in the intermediate phase.

**Table 5.1: The way novice and expert teachers conduct practical activities in their NST classrooms in the intermediate phase in South African schools**

<b>Novice teachers</b>	<b>Expert teachers</b>
Teacher centred activities	Learner centred activities
Learners complete a worksheet	Learners direct their own learning
All learners complete the same activity designed by the teacher	Tasks are different among learners and learners design their own protocols
Teachers control the practical activities	Learners control their own activities
Learners search for 'right answer'	Learners solve problems
Learners are guided throughout the activities	Learners conduct their own unguided activities

This study is also based on the concept of “practical activity” as part of the study conceptual framework. According to Hattingh *et al.*(2007, p. 3), practical activities can be divided into 4 different levels as discussed in Chapter 2. These levels represents a development from the lowest levels (1 and 2) to the highest levels (3 and 4). Table 5.2 below shows which levels novice and expert teachers used when conducting practical activities in their NST classrooms in the intermediate phase in South Africa.

**Table 5.2: The levels of practical activities used by the novice and expert teachers during practical activities in NST classrooms in the intermediate phase in South Africa (Hattingh, Aldous, & Rogan, 2007, p. 3)**

<b>Practical activities levels</b>	<b>Novice teachers</b>	<b>Expert teachers</b>
Level 1 <ul style="list-style-type: none"> <li>• “Learners given detailed instructions on what to do.</li> <li>• Practical activity completely determined by the</li> </ul>	√	

<p>teacher.</p> <ul style="list-style-type: none"> <li>• Questions given, and detailed instructions on process.</li> <li>• Activity is proposed by the teacher”.</li> </ul>		
<p>Level 2</p> <ul style="list-style-type: none"> <li>• “Learners participate in closed (direct instruction) practical work.</li> <li>• Some learners assist in planning and performing the demonstrations.</li> <li>• Questions given, and outlines guidance on process, some choices left to learners.</li> <li>• Purpose of the activity explained by the teacher, and clearly linked to preceding work.</li> <li>• Discussion after the practical activity is centred on a demonstration in which the teacher repeats the practical activity.</li> <li>•</li> </ul>	√	
<p>Level 3</p> <ul style="list-style-type: none"> <li>• “Teacher designs practical work in such a way as to encourage learner discovery of information.</li> <li>• Learners perform guided discovery type practical work.</li> <li>• Questions given, but learners choose how to proceed.</li> <li>• After the practical activity, learners discuss and explain the observations and develop conceptual ideas that relate to the task”.</li> </ul>		√
<p>Level 4</p> <ul style="list-style-type: none"> <li>• “Learners design and do their own 'open-ended' investigations.</li> <li>• Learners decide the question and how to proceed.</li> <li>• The activity is proposed and specified by the learners,</li> </ul>		√

<p>following discussion.</p> <ul style="list-style-type: none"> <li>• Learners reflect on the quality of the design and data collected and make improvements when and where necessary.</li> <li>• Learners can interpret data in support of competing theories or explanations.</li> <li>• Learners record the activity by writing a report in a format chosen by the learner”.</li> </ul>		
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**The following findings are discussed with a view of answering the following sub-questions:**

- What are the challenges novice teachers face when conducting practical activities in Natural Sciences and Technology classrooms?
- What are the challenges expert teachers face when conducting practical activities in Natural Sciences and Technology classrooms?

**Finding:** Novice teachers face more challenges than expert teachers when conducting practical activities in their NST classrooms in the intermediate phase in South Africa.

### **Analysis and discussion**

Data collected from this study showed that novice teachers face more challenges in the NST classrooms when conducting practical activities than expert teachers. Research showed that when novice teachers begin their careers they bring in different backgrounds, life experiences and motivations and that might influence the teaching strategies they use in their classrooms (McDonald & Healy, 1999). Expert teachers on the other hand are viewed as those teachers with the ability to integrate the use of different kinds of knowledge (Wonacott, 2002). Table 5.3 below shows the challenges novice and expert teachers faced when conducting practical activities in this study.

**Table 5.3: Challenges the novice and expert teachers face when conducting practical activities in NST classrooms in the intermediate phase in South Africa**

<b>Novice teachers</b>	<b>Expert teachers</b>
Have no confidence in learners	Not a challenge
Overwhelmed by their teaching career	Not a challenge
Struggle to manage learners' behaviour especially during practical activities	Not a challenge
Struggle to maintain effective classroom discipline (especially during practical activities)	Not a challenge
Managing time (it is a challenge to complete an activity in one lesson)	Managing time (it takes time to prepare for practical activities)

### **5.7 Conclusion**

The intention of this study was to conduct research at primary school level to view how novice and expert teachers conduct practical activities in their Natural Sciences and Technology classrooms in the intermediate phase. Findings showed that novice and expert teachers differ in the way they conduct their practical activities. Researchers such as Bereiter and Scardamalia (1993) stated that it is because expert teachers have a well developed knowledge gained through experience and dedication to their work. The novice teachers in this study were overwhelmed by their work and that made them lose confidence and faith in their learners. Due to the lack of confidence of novice teachers in their learners, they conducted practical activities of a lower level (level 1 and 2) (Hattingh *et al.*, 2007). The novice teachers practical activities were teacher centred, their learners were conducting the activities to prove the work done theoretically in classroom and not to develop problem solving skills. The expert teachers on the other hand had lots of faith in their learners. They allowed their learners to conduct unguided practical activities. The learners of expert teachers were given the opportunities to direct their own learning and design their practical activities. Both novice and expert teachers in

the NST classrooms in the intermediate phase stated that there is no adequate time to conduct practical activities.

### **5.8 Limitations of the study**

One of the limitations of this study is that the findings of this study cannot be generalised to a broader population in South African NST classrooms in the intermediate phase. As this was a dissertation for M.Ed, the focus was on execution of a research project not on the development of new knowledge. The purpose of this study was not to generalise but to get a deeper understanding in a specific topic.

### **5.9 Recommendations**

Firstly, participants had a concern about not having enough time to conduct practical activities in their NST classrooms in the intermediate phase. Therefore, I suggest that practical activities should have a scheduled time separate from theoretical lessons in the NST classrooms. The practical activities are important in the science classrooms because there are expected to develop learners' scientific concepts (Haigh, 2007).

Secondly, this study shows that novice teachers face more challenges in their classrooms. Novice teachers seem to be overwhelmed by their work, they have a lack of confidence in their learners, they have a challenge managing their time during practical activities and novice teachers struggle to maintain classroom discipline especially during practical activities. This finding leads the researcher to suggest that the Department of Basic Education should develop a policy in schools where expert or experienced teachers are expected to mentor novice teachers in their first years of teaching (mentorship program should last at least 3-4 years).

Lastly, results showed that the NST teachers especially the novice teachers have a challenge implementing effective practical activities in their NST classrooms in the intermediate phase. The DoBE should develop workshops where the NST teachers are trained on how to implement effective practical activities and also how to use practical activity resources.



### **5.10 Concluding remarks**

A qualitative approach using a case study method was conducted. The conceptual framework of this study was developed from the literature. This study was guided by the concept of “practical activity” and a 4 pillared cognitive design.

The data of this study was collected through open-ended interviews, classroom observations and document analysis. There were 4 participants of this study, 2 novice and 2 expert teachers who teach NST in the intermediate phase.

This study investigated the way in which novice and expert teachers conduct practical activities in the NST classrooms in the intermediate phase. Novice teachers in this study were defined as teachers with less than 5 or 5 years in the teaching practice. Expert teachers on the other hand were defined as teachers who have the ability to integrate the use of different kinds of knowledge (Wonacott, 2002).

The findings of this study indicated that novice teachers differ from expert teachers when they conduct practical activities in their NST classrooms. Novice teachers do not conduct independent activities and they mostly design worksheets for their learners where learners follow protocols step by step and they associate practical activities with group work. The novice teachers only conduct practical activities to enforce knowledge to learners not to develop their critical thinking and problem solving skills. Expert teachers on the other hand conduct independent activities, they do not mostly use worksheets but when they do, learners design their own protocol to follow during the activity. The way expert teachers organise their learners during practical activities mostly depends on the type of the activity they are conducting. As discussed in this Chapter, novice teachers faced more challenges when conducting practical activities than expert teachers in the NST classrooms in the intermediate phase.

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## **Lists of appendices**

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Appendix B: Informed consent letter to the principal

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## APPENDICES

### APPENDIX A



For administrative use only:  
**Reference no: D2016 / 293**  
 Enquiries: Diane Buntling 011 843 6503

## GAUTENG PROVINCE

EDUCATION  
 REPUBLIC OF SOUTH AFRICA

### GDE RESEARCH APPROVAL LETTER

<b>Date:</b>	<b>23 September 2015</b>
<b>Validity of Research Approval:</b>	<b>8 February 2016 to 30 September 2016</b>
<b>Name of Researcher:</b>	<b>Makhubele P.</b>
<b>Address of Researcher:</b>	<b>P.O. Box 1188; Kwaggafontein; 0458</b>
<b>Telephone / Fax Number/s:</b>	<b>079 025 0594</b>
<b>Email address:</b>	<b>patlerato@gmail.com</b>
<b>Research Topic:</b>	<b>Implementation of practical work in South African Natural Science classrooms by expert and novice teachers</b>
<b>Number and type of schools:</b>	<b>FOUR Primary Schools</b>
<b>District/s/HO</b>	<b>Tshwane North and Tshwane South</b>

***Re: Approval in Respect of Request to Conduct Research***

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved. A separate copy of this letter must be presented to the Principal, SGB and the relevant District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted. However participation is VOLUNTARY.

The following conditions apply to GDE research. The researcher has agreed to and may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

***CONDITIONS FOR CONDUCTING RESEARCH IN GDE***

1. *The District/Head Office Senior Manager/s concerned, the Principal/s and the chairperson/s of the School Governing Body (SGB,) must be presented with a copy of this letter.*



1

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**Office of the Director: Knowledge Management and Research**

9<sup>th</sup> Floor, 111 Commissioner Street, Johannesburg, 2001  
 P.O. Box 7710, Johannesburg, 2000 Tel: (011) 355 0506  
 Email: David.Makhado@gauteng.gov.za  
 Website: www.education.gpg.gov.za



## APPENDIX B



Department of Science, Mathematics and Technology

Faculty of Education, University of Pretoria

0002 Pretoria

To the Principal,

My name is Patricia Makhubele. I am a MEd student at University of Pretoria. I am conducting a research on the implementation of practical work in South African Natural Sciences and Technology classrooms by teachers. My project is supervised by Dr Mia Abrie, senior lecturer at the University of Pretoria. The Department of Education has approved my research and a copy of the approval letter is attached to this document. I request that you give me a permission to invite teachers in your school to participate in this study.

The study has been approved by Ethics Committee of the Faculty of Education of the University of Pretoria and has been given the reference number of SM 15/07/02.

The purpose of this study is to find out how teachers in South Africa conduct practical activities in the Natural Sciences and Technology classrooms and the manner in which learners behave during the practical lesson. Although much research has been conducted on practical work in Secondary schools, very little is known about the way practical work is done in primary schools.

The data will be collected through tape-recorded interviews, classroom observations and document analysis. The interview will take 20-35 minutes, and the duration of the observation

will depend on the length of the lesson. Only teachers who have given their consent will participate in this study.

Data collected from this study will be handled in strict confidentiality, and neither the school nor the participant will be identifiable in any report. The teachers who are participating may withdraw anytime during the research process without any penalty.

After I have received approval to approach teachers in your school to participate in this study, I will:

- Obtain informed consent from teachers
- Obtain informed assent from learners
- Obtain informed consent from parents
- Arrange time for data collection in your school.

It is hoped that this research will enable Natural Sciences and Technology teachers to benefit from the success of other teachers to successfully conduct practical work in their classrooms. The findings might be useful to Faculties of Education to fill the gaps that exist between teachers. It has the ability to also help the SMT (Science, Mathematics and Technology) teams in schools to encourage their teachers to focus more on practical activities which can be performed easier and with locally available materials.

If you have any questions regarding this study, please contact me or my supervisor (Cell number 0790250594 [patlerato@gmail.com](mailto:patlerato@gmail.com); Dr Mia Abrie [Mia.Abrie@up.ac.za](mailto:Mia.Abrie@up.ac.za)).

Thank you for taking time to read this information.

Makhubele Patricia  
Researcher

Dr Mia Abrie  
Supervisor

## APPENDIX C



Department of Science, Mathematics and Technology

Faculty of Education, University of Pretoria

0002 Pretoria

Dear teacher,

### **IMPLEMENTATION OF PRACTICAL ACTIVITIES IN SOUTH AFRICAN NATURAL SCIENCES AND TECHNOLOGY CLASSROOMS BY TEACHERS**

My name is Patricia Makhubele. I am a MEd student at the University of Pretoria. I am conducting research based on the implementation of practical activities in South African Natural Sciences and Technology classrooms by teachers. My project is supervised by Dr Mia Abrie, senior lecturer at the University of Pretoria. The Department of Education has approved my research and a copy of the approval letter is attached to this document. I am inviting you to participate in this study, before you agree or not agree to participate in this study please read the information of this research below.

The purpose of this study is to find out how teachers in South Africa conduct practical activities in the Natural Sciences and Technology classrooms. Although much research has been conducted on practical work in secondary schools, very little is known about the way that practical work is done in primary schools.

It is hoped that this research will enable Natural Sciences and Technology teachers to benefit from the success of other teachers to successfully construct practical work in their classrooms. The findings might be useful to Faculties of Education to fill the gaps that exist between teachers.

If you agree to partake in this study I will collect data through tape-recorded interviews, classroom observations and document analysis. I will interview you and it will take 20-35 minutes. I will come in your classroom and observe your practical lesson, the duration of the observation will depend on the length of the lesson.

Data collected from this study will be handled in strict confidentiality, and neither the school nor you will be identifiable in any report. However, taking part in this research means that the headmaster and your colleagues will know that you are part of the research since your practical lessons will be observed. But even that being the case, you will not be identifiable. If you decides to participate in this study you have the right to withdraw anytime during the research process without any penalty.

If you have any questions regarding this study, please contact me or my supervisor (Cell number 0790250594 [patlerato@gmail.com](mailto:patlerato@gmail.com); Dr Mia Abrie [Mia.Abrie@up.ac.za](mailto:Mia.Abrie@up.ac.za)).

Thank you for taking time to read this information.

Makhubele Patricia

Dr Mia Abrie

Researcher

Supervisor

Department of Science, Mathematics and Technology

Faculty of Education, University of Pretoria

0002 Pretoria

## **IMPLEMENTATION OF PRACTICAL ACTIVITIES IN SOUTH AFRICAN NATURAL SCIENCES CLASSROOMS BY TEACHERS**

I agree that I have been informed about the nature of the research and that my rights have been explained to me. I have discussed the project with the researcher, Patricia Makhubele, who is conducting the project for her MEd degree, supervised by Dr Mia Abrie in the Department of Science, Mathematics and Technology Education at the University of Pretoria.

I understand that if I consent to participate in this project I will be:

- Interviewed
- Asked to provide copies of practical work sheets
- Observed during my practical lesson

I understand that if I participate in this study my contribution will be kept confidential and I will not be identifiable in any research report. I understand that by being observed my colleagues and headmaster will know that I am part of a research study, however it is up to me to reveal my role in this research. I also understand that there are minimal risks associated with this study. I understand that I will remain anonymous, my participation is voluntary and I have the right to withdraw anytime during the research process. My withdrawal will not affect me in anyway.

For more information and questions I may contact:

The researcher Patricia Makhubele at 0790250594 or email her at [patlerato@gmail.com](mailto:patlerato@gmail.com)

The supervisor Mia Abrie at [Mia.Abrie@up.ac.za](mailto:Mia.Abrie@up.ac.za)

I understand that by signing the consent letter I am agreeing to participate in this study. I understand that my contribution will be used primarily for a MEd dissertation.

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Signature: \_\_\_\_\_

## APPENDIX D



UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA  
Faculty of Education

Department of Science, Mathematics and Technology

Faculty of Education, University of Pretoria

0002 Pretoria

28 May 2015

Dear Parent,

### **PARENT INFORMED LETTER**

My name is Patricia Makhubele. I am a student at the University of Pretoria studying Masters in Life Sciences. I am conducting a research study and I am supervised by Dr Mia Abrie, a senior lecturer at the University of Pretoria. I am informing you that I will be in your child classroom where the main focus will not be at your child but his/her teacher.

Below I have discussed the detailed information of my study:

#### **Purpose**

The purpose of this study is to find out how teachers in South Africa conduct practical activities in their Natural Sciences and Technology classrooms. Although much research has been conducted on practical work in Secondary schools, very little is known about the way that practical work is done in primary schools.

#### **Procedures**

- A Natural Science and Technology teacher will be observed during one or two practical lessons (effective teaching and learning will not be disturbed).

- The researcher will observe how learners behave during the activity.

### **Benefits**

It is hoped that this research will enable Natural Sciences and Technology teachers to benefit from the success of other teachers to successfully conduct practical work in their classrooms. It will also help the SMT (Science, Mathematics and Technology) teams in schools to encourage their teachers to focus more on practical activities which can be performed easier and with locally available materials.

### **Confidentiality, Anonymity and Rights**

Data collected from this study will be handled in strict confidentiality, and neither the school or your child will be identifiable in any report.

If you or your child has any questions regarding this study, please feel free to contact me or my supervisor (cell number: 0790250594 email: [patlerato@gmail.com](mailto:patlerato@gmail.com); Dr Mia Abrie [Mia.Abrie@up.ac.za](mailto:Mia.Abrie@up.ac.za)).

---

Patricia Makhubele

---

Dr Mia Abrie





Department of Science, Mathematics and Technology

Faculty of Education, University of Pretoria

0002 Pretoria

28 May 2015

Dear learner,

**IMPLEMENTATION OF PRACTICAL ACTIVITIES BY NATURAL SCIENCES AND TECHNOLOGY TEACHERS IN SOUTH AFRICAN CLASSROOMS**

My name is Patricia Makhubele. I am a Natural Sciences teacher and I am currently studying master's degree at the University of Pretoria. As part of my study I am conducting a research in schools and your principal has given me permission to conduct it at your school. I am doing this study so that I can find the way Natural Sciences and Technology teachers conduct practical activities in their classrooms.

This letter will explain to you what I will be doing in your classroom. If there are some words that you may not understand, ask me or an adult to explain them to you. You may take this letter home for your parent to read it for you.

**What the study is about:**

This study is about the way teachers who are teaching Natural Sciences and Technology teach practical activities in their classrooms. I am conducting this research at your school, because we do not know how practical activities are taught in primary schools.

## Your role

You will be in the class when I observe how your Natural Sciences and Technology teacher teaches one or two practical lessons. You should work and behave just as you always do in class. I will be writing down what your teacher does or says. I will not bother you or the teacher while you are working.

I will write a report based on what I have observed in your classroom, but I will not use your name in the report or say something that will let others know who you are.

If you want to ask me any questions about the study, feel free to contact me at:

0790250594 or email me at [patlerato@gmail.com](mailto:patlerato@gmail.com) or contact my supervisor at: [Mia.Abrie@up.ac.za](mailto:Mia.Abrie@up.ac.za) (Dr Mia Abrie).

---

Patricia Makhubele

---

Dr Mia Abrie

## APPENDIX E

### OBSERVATION TEMPLATE

Observation date and time.....

Participants .....

School name.....

#### 1. Observation of the way that the teacher conducts practical work

##### *(a) Practical activity protocol*

- i. Is the activity teacher centred (the teacher prepares everything for the learners) or not?
- ii. Do learners follow the procedures given by the teacher step by step (closed ended)?
- iii. Does the teacher provide worksheets that outline the aim of the activity?
- iv. Does the teacher expect the learners to reach the “right answer”?
- v. If there are calculations involved, does the teacher show the learners how to do them?
- vi. Does the teacher require learners to engage in:
  - a. discussion,
  - b. demonstration,
  - c. observation,
  - d. simulation, or
  - e. other activities? Specify \_\_\_\_\_
- vii. Are learners given a chance to conduct their own practical activities?

**Notes:**

***(b) Classroom demonstration***

- i. Is the demonstration slow enough for learners to understand what is happening?
- ii. Does it focus on the process?
- iii. Does it focus on the outcomes?
- iv. Are the learning outcomes clear?
- v. Are the learning outcomes limited, not confusing for the learners?

**Notes:**

**2. Classroom organisation by the teacher**

- a. Does the teacher maintain classroom discipline?
- b. Are learners organised in
  - a. groups,
  - b. individual
- c. Are the lab rules outlined?
- d. Are learners encouraged to wear protective clothing? (If relevant)

**Notes:**

**3. Other relevant observations not covered by 1 and 2**

**Notes:**

**4. Reflection on the observation**

**Notes:**

## APPENDIX F

### INTERVIEW TEMPLATE

#### Theme: Conducting practical activities in the Natural Sciences and Technology classrooms

Interviewee: -----

Interviewer: ----- Date: -----

We are conducting this research to find out how Natural Sciences and Technology teachers conduct experiments/practical activities in their classrooms. Do you mind to be asked few questions on your experience in conducting experiments/practical activities?

Your participation in this study is entirely voluntary. Any information you provide will be treated with confidentiality. All responses and your school will remain anonymous. You can withdraw from the interview at any time and you will not be penalised. You can refuse to answer any question that makes you feel uncomfortable. The information you provided will only be used for research purposes.

#### Section A (introduction)

1. Any questions/comments before we start?

#### Section B (Background)

This sections deals with background information of the participant

2. When did you start teaching?

3. Tell me about your teaching career.

3(a). Subjects you teaching?

3(b). How long have you been teaching those subjects in 3a?

### **Section C (Practical activities)**

4. This section pertain the participants' views on practical activities.

- (a) How would you describe experiments/practical activities in the Natural Sciences?
- (b) What do you think of experiments/practical activities in primary level in NST classrooms?
- (c) What do you think of experiments/practical activities suggested in the NS/Tech curriculum?
- (d) Are they relevant to the learners?
- (e) Are they conducted frequently enough?
- (f) Do you have sufficient resources for experiments/practical activities?
- (g) Do you use worksheets for the experiments/practical activities?
- (h) Do you ever allow learners to set their own questions unguided?
- (i) What are your challenges regarding experiments/practical activities?
- (j) Does the school/department support/encourage experiments/practical activities?

### **Section D (Practical activities with learners)**

This section deals with the participants' experience with learners during practical activities.

- 8. How do learners behave during experiments/practical work?
- 9. Do you organise learners in groups/individuals during experiments/practical work?
- 10. Do learners work effectively when they are in groups or individual?

### **Section E (Conclusion)**

This section is a chance for the participant to make recommendations in order to improve the effective conduction of practical activities in Science classrooms.

- 10.
  - (a) What can be done to improve practical activities in Science classrooms?
  - (b) If I want to clarify any of your answers may I contact you again?
  - (c) How would it be best to contact you later on?

## APPENDIX G

### INTERVIEW TRANSCRIPTIONS

#### TEBOGO

**Researcher:** Thank you very much for allowing me to interview. Before we start do you have any question you want to ask?

**Teacher A:** No

**Researcher:** Okay no question you are good, okay first question that I would like to ask is, when did you start teaching?

**Researcher A:** 2011

**Researcher:** Okay 2011, and then mmm tell me about the subjects you have been teaching and when did you start teaching them.

**Teacher A:** I have started 2011 and I have been teaching Maths and Natural Science and technology. But then before Natural science and Technology they were separated. So therefore now is Natural Science and Technology is one subject. And I also teach Maths grade 4, normally I do grade 4-6.

**Researcher:** Ohkay, mm and then how long have you been teaching those subjects, like you said it is Natural Science and Maths, how long have you have been teaching them?

**Teacher A:** I'll say if I do not count this year, it is five years full. At the end of this year it will be 6 years

**Researcher:** Okay according to you aah... what are practical activities or experiments if I should say?

**Teacher A:** Okay according to me practical is based on, its hands on. It is like the guided or unguided discovery were you let the learners aah... or you yourself like it can be two way. Firstly it can be a demonstration where you show the learners your hands on activity they just watch



you. Or you can bring just few specimens or whatever materials you will use and group the learners where they engage that hands on activity. So it can be anything from drawing to cutting open frogs if they have to or to maybe building something as long as it is more hands on unlike writing you know.

**Researcher:** Mmmohk. What do you think of practical activities in primary level?

**Teacher A:** Is it good. I mean if you check science, because Natural Science is gonna vent into Life sciences or physical sciences at some point in life, so they need that skill to be practical because in science it is more practicality. If you cannot prove it then unfortunately you are not, it is not correct if I can put it that way.

**Researcher:** Okay does our curriculum like CAPS suggest to us what kind of practical's we should be doing?

**Teacher A:** Oh when I look at our CAPS eeh... the practicality it is there it does, for example the term one grade 6 for photosynthesis they do require you to do tests for starch where you bring food samples, bring iodine and then you know the kids test for starch when it turns blue-black. So they do encourage it, but however eeh... my worry is it is more on the Natural Science part than the technology. Because the technology as well has practical's

**Researcher:** Oh because it is mixed

**Teacher A:** Yes, they do ill say they do.

**Researcher:** Oh, so these practical activities that they suggest are they relevant to learners?

**Teacher A:** I think they are. They are, but some topics they do not encourage practical work. Because I was taught aah... when I was still in high school, maybe you do a dissection of a kidney and you cannot just write we did a dissection they will want proof. Our teacher would ask us to take half that we disserted, put it on white water and then we would have blood smashes and then you draw to show that we did a dissection and then you'll try to label it, so I think maybe this is the pyramids or the renal arteries. So ya

**Researcher:** Ohk, and then are they conducted frequently enough, do you think they are conducted frequently?

**Teacher A:** I do not think they are, because firstly you look at the time we have 30 minutes to do everything. In that 30 minutes you have to do everything, corrections and then the next topic if you have to introduce it, then the practical work and obviously the practical work goes with a worksheet after that and we have a problem our learners are very slow. And you find that you have a double period, you can do a practical work in the double period, but the cleaning after, we do not have labs where you can ask someone to prepare for you that you going to have an experiment maybe during period 3 and 4. You have to prepare for yourself and all that you know. Sometimes when you are free, maybe you have double period and next period you are free and someone has to come to your class and they would love to find your class in a positive manner for learning

**Researcher:** So I guess you will say it is because of time, the time allocated for periods are not enough

**Teacher A:** They are not

**Researcher:** And the resources as well...

**Teacher A:** Ya we do not have resources

**Researcher:** Eeh... okay you have actually answered my next question that are there sufficient resources.

**Teacher A:** Well ... let me not say we do not have resources, the government sometimes sends small sciences kit you know, maybe half foot boxes the, maybe with electricity you find conductive insulators, bulbs, and all that. Sometimes they send kit for life and living which means it is photosynthesis, food samples and iodine solutions. And you can use it in class it is smaller things which means you cannot really do a practical but a demonstration. You cannot give each and every learner. There are there but just to touch on the skills not really enforce the skills you know.

**Researcher:** Okay and then do you use worksheets for the practical activities

**Teacher A:** Yeah I do, I use I like there is a website when I work with NS is called e-classroom, it's got everything, they even after the practical to ask you what you saw, conclusion like a normal scientific method you know like when you are carrying out the practical. So I believe that the practical have to go with the worksheets. You cannot test something and not assess it you know. You cannot give someone a skill and not asses that skill.

**Researcher:** And since you saying you use e-classroom does that mean you do not allow your learners to conduct like their own practical work like unguided.

**Teacher A:** They do, you know some, what I do, I know I have to have my own as a demonstration but sometimes you get lucky a class that learner are very energetic. So you can tell them that tomorrow we are going to test for starch, aah... and then you like if you can bring smaller portion of this and that. And then if you are lucky you find the whole class brought the stuff. Now you see then it is no longer demonstration all you do, obviously you cannot give them the iodine all you can do is you just tell them or you walk around with a bottle of iodine and you give each group a dropper, you drop it on the bread and you let them tell you what they see, it is now a practical it is no longer a demonstration per say. It is no longer focused on you only and the kids are only looking at you. So sometimes they can you must challenge them, do it and tell me what you think. Go home and do this and that and tell me what you think.

**Researcher:** And then what are the challenges or the challenges that you have face so far when conducting practical activities?

**Teacher A:** Yoo...Okay one I will start with maybe the place to conduct the practical work and the safety of the learners. Like for example on my first year I was trying to do you know matter the states of matter, obviously you have to use hot water or something to boil the ice changing form from solid to liquid, from liquid to gas. So you will need maybe a source of heat, so that is not safe if you in the class. So another thing is the learner ratio, you find that you have learners and you have one kettle and whatever, so it also limits you because you cannot trust the learners by giving them Bunsen burner especially in the primary level. They are very requisites,

the next thing you find the class is on fire and you are alone you do not have an assistance you see. So that's the safety. Another thing is the time, sometimes you do not finish, and these learners are not like in high school where you didn't finish you can continue tomorrow they will forget. Not everyone will remember what happened. I know they say when they see they remember that is not everyone because 99 % of our kids have cognitive challenges it is not that they do not want they just can't because of cognitive issues that's another thing. And lack of interest.

**Researcher:** Eeh... from the learners?

**Teacher A:** Yes, and also lack of interest from the science team, that how about instead of building a new kitchen build us a lab, something like that so where we can have even our materials are just stored anywhere in the library. If you looking for like next term we doing matter and material so you like have to say "oh last year who had it" and you go to her and they do not remember where they are. See that's, there's no consistency. You lose time looking for things

**Researcher:** Ohkay, let's go back to the point where you said lack of interest from the learners, is it because it is in primary, maybe it differs that you find learners in high school are more interested, maybe because they are more matured

**Teacher A:** But I wouldn't say it is because we in primary, you know what I would always tell my fellow colleagues is that never underestimates these learners. Even though the lack of interest is there you must still instill it and then it will be their choice whether they wanna do it or not. When I say lack of interest it is like maybe you find, especially those who are cognitively challenged they do not see the reason why or the purpose, why are we doing this. So it is like they just make noise, like even that interest of school is not there. So you find out of 50 learners, 30 are cognitively challenged and you only have 20 that are interested. But then you have to come up with discipline for those 30 learners.

**Researcher:** So in other words we should motivate the learners

**Teacher A:** Because even though you are doing a normal lesson no practical nothing, you always find that others are not interested they do not write they do not care as long as they are here.

**Researcher:** That's true

**Teacher A:** So even if you come up with something different, they do not see the reason, the motive behind. Even okay you say let's play a game boys vs. girls or this group vs. that group, to you as a teacher you doing a revision but to them it is a game. What is photosynthesis, a girl answers it is a point, just like diagnosis you want to see how far you are and to them they see it as a game not that they learning which is wrong because they must be aware that this is game but it is more educational it is not just for fun.

**Researcher:** Ohk I understand, and does the school or the department support/encourage teachers to do practical activities especially in science.

**Teacher A:** Okay when we go to workshops they do, but they reinforce more on technology, because technology itself also has steps, you must plan, design, make, evaluate and communicate your findings. So they normally encourage it because theyrealise that teachers focus more on the science and even on the science part they do not do the practical's, they do not give learners a chance to test for starch, they do not give learners maybe to separate things you know matter. So I'll say they do but only to a certain extent. Its only to a certain extent.

**Researcher:** Okay I am almost done ahm... so far that you have conducted practical activity. How do learners behave during a practical activity?

**Teacher A:** It is upsetting, but those who are... you know they are kids who are just not there and they are those who really want to see what will happen. And you even ask them what do you think? Like you must instill this inquisitive nature in them. Like have you ever just to diverge, if you ask them do you every think what will happen if you put sugar in the fridge. They will be like hai you cannot do that, I would ask but why, you must try and see what will happen. So even when I group them, I ask them what do you think it is going to happen. Then they will be like we think it will turn blue black, some will say but it is not from the plant, some you will

see they are still confused. So it brings back that inquisitiveness and excitement but for only those who are interested. So you cannot win everyone. Like some especially in high school some like dissections some don't. Some just wanna write copy down they do not wanna think. You know others just prefer writing down and not answering. Some prefer writing question and answer. So there is a different in interest in the class. It is very rare to win them all. And say okay today we are going to the garden or to say today we are going to walk around the school to look for different kinds of frogs. Others will be excited that they are outside the class and others will say sir is this our...you know, the interest will be there.

**Researcher:** Okay does it mean that from the learners' behaviour practical activities are productive?

**Teacher A:** Yes they are, because for me just because someone said that's red then we have to believe it is red because if we test it how we know that it is red, why do they say it is red. Does it really turn blue black or does it really shrink if it is under certain temperature you see. So then they see that we are not teaching you something that is not there, it is real. I believe that practical's are the only thing almost close to the only way we can bring our theory to the real life. It is more or less the only way, even if you use models it is just that part that narrows down from what is written to what it is really there. Even though it is not exactly how it should be but you can see this is what is really going on.

**Researcher:** Okay and when you conduct your practical activities do learners do them in groups, pairs or individually.

**Teacher A:** It is best to do them in a group in my case due to lack of materials. But most efficiently, well with primary learners a group works better because they get ideas. Because you can pair them and find that both of them are just not good, so if they are in the group at least they will be work done. They can tell that this one didn't do anything and this one, because they are still kids you cannot rely or trust them to that extent that I'm just gonna give them and they will do it they won't. Maybe in the group and then you balance your group, the group must be from the strongest to the weakest. Don't put all the good ones in one group

**Researcher:** So you saying that learners work more effectively when they are in groups in primary level

**Teacher A:** Yes for me.

**Researcher:** Ahm... second last question, what do you think can be done to improve practical activities in science classrooms?

**Teacher A:** I think, I don't know it won't happen. But you know some schools when they build schools they are classes that are specifically built in such a way that this can be a class and a lab you know. So maybe in the near future when they build schools there must be classes, maybe in every block there's one class that is built in such a way that it can be a class and also a lab. Maybe there's another room behind where they are chemicals and all that you know. That can also improve that we do not have to walk around there basins, specimens and all that. Two they must change the curriculum the way they the way it is, it is more on theory than practice. So even if they... when they send out the pay sitter whatever, they must say week one photosynthesis and reproduction, week two practical test for starch, week three plants and earth and week four practical and what's not. It must be there so that we know we must do it.

**Researcher:** More like we are forced to it and we are given time to do it

**Teacher A:** Yes, because you cannot assume that we are doing it and then the more kids get their hands dirty, the more they will remember. Like in high school I'm sure everyone will remember the sulphuric acid the one of the egg, the funny smell. Everyone will remember that because you are there you smell it, so they must include the practicals as much as they say want documentation the practicals must also be there. And they must also be smart to come up with a tool to show that practical's were conducted.

**Researcher:** Ahm... thank you very much we are done. What is the best way for me to contact you?

**Teacher A:** You can sms, call or whatsapp its fine

## KEGO

**Researcher:** Thank you very much for agreeing to do this interview. Do you have any questions before we start?

**Teacher B:** No question, thank you

**Researcher:** First question is when did you start teaching?

**Teacher B:** I actually started teaching in 2013

**Researcher:** Okay

**Teacher B:** Yes

**Researcher:** And what subjects are you teaching?

**Teacher B:** I was teaching maths and natural science and I am still teaching those subjects I have not yet changed

**Researcher:** Okay in grade?

**Teacher B:** Grade 6, 4 and 5

**Researcher:** Okay grade 4-6. And how long have you been teaching them?

**Teacher B:** Ever since I started it has been those subjects

**Researcher:** Okay so you have not been teaching anything else?

**Teacher B:** Yes

Teacher asked the researcher to pause and think of an answer before the researcher can continue recording

**Researcher:** As I was saying, how would you describe practical activities or experiments?

**Teacher B:** Okay, I would actually say it is theory done practically. As in like a theory that they do practically. Putting that theory into practice



**Researcher:** Okay so anything that you do practically from theory?

**Teacher B:** Yes, is when theory is put into practice

**Researcher:** So what do you think of practical activities conducted in primary school?

**Teacher B:** I think it is actually good according to me. The reason being it is because you see learners most of time if you have to do theory theory especially learners from primary schools, if you just have to do theory theory without learners having to practice whatever it is that they have learned it is like they turn to forget. Or I can put it like some of them learn better when they put whatever it is that you have said in practice or whatever it is that they have learnt from a particular theory into practice it helps a lot.

**Researcher:** Okay when they see it?

**Teacher B:** Yes when they see it happening. Something that we have already done in theory now we are putting it into practice.

**Researcher:** Ohk I understand what you saying, okay the next question is ahm... does the curriculum, CAPS to be specific suggest any experiment in Natural Sciences.

**Teacher B:** Yes it does it does

**Researcher:** Okay that's good. So do you think these experiments are they relevant to learners?

**Teacher B:** Yes they are

**Researcher:** Do you think the practical activities are conducted frequently enough?

**Teacher B:** Ahm... according to me, I do not actually think they are conducted frequently enough due to the fact that ahm... time doesn't allow us. There is no enough time; they are lots of things in general.

**Researcher:** So you saying us teachers we are not conducting them the way we should?

**Teacher B:** Yes

**Researcher:** Ohk my next question is, are there sufficient resources for these practical activities?

**Teacher B:** In my school yes they are enough

**Researcher:** So are there resources that support conduction of practical activities

**Teacher B:** Yes the resources are enough for us to conduct and support practical activities. Some of the resources we even make them ourselves

**Researcher:** Okay that is interesting. So it is just time that makes us not to conduct them

**Teacher B:** Yes it is just time that makes us not to conduct enough practical activities, but the resources are there in our schools.

**Researcher:** Okay that's good. So when you conduct practical activities, do you use worksheets in the classroom?

**Teacher B:** Yes I do. I use worksheets, I use posters I use a lot of things

**Researcher:** So you do not conduct practical activities without the worksheets?

**Teacher B:** Yes I do not

**Researcher:** So in other words you guide learners with the worksheets that we start in this way...

**Teacher B:** So I use the worksheets to guide the learners and then they will do the activities themselves to show that indeed they did understand the theory work that I have taught them. To see if they are doing it in the right way, accordingly.

**Researcher:** Do you ever allow your learners to do conduct the practical activities unguided, do you ever like give your learners a topic and allow them to conduct their practical work unguided?

**Teacher B:** I normally cause... especially learners from primary school I think it is always best to guide them for the fact that if you just lose them and just get in the class and say do this. You will find that other learners will do certain things. You will find those learners that will do exactly as you told me but there will be the other learners that will take a wrong route, they will be busy with friends and not do what is wanted, they will be running around. So I think it is always best to guide them you know, to check that for real they are doing the right thing and to check them that are they really doing what they supposed to be doing unlike playing and walking around.

**Researcher:** So I guess you saying it is always best to guide them

**Teacher B:** Yes in primary school is always best to guide them, because I do not know about high school I have never thought in high school. But in primary school is best if they are guided, because they are still young, especially if you get to learners in grade 4 they like playing a lot. They cannot even... just sitting down to them is a problem, you will keep on telling them to do this and that, so you have to guide them. As I said you do find those that will do than others, and also those that will want to play around, they will be playing and running around. So educators should guide primary learners.

**Researcher:** So learners find practical activities more like fun not a learning curve?

**Teacher B:** Yes because they will run around, some will not even focus; some will not even put their minds in the classroom. Because you will find that the ones who are clever will be working and the others ones you know see it as an opportunity to call their own friends...

**Researcher:** So practical activities give them that opportunity to play around?

**Teacher B:** Yes, they become yoo I do not know how to put it, they so excited to certain extend that some do not even concentrate and just chat with their friends

**Researcher:** Ohk no I hear you. Another question is that I think you have already given me some of the answers to the questions I have not asked yet. What do you think are challenges when coming to conducting practical work?

**Teacher B:** Okay, when conducting experiments you find that there will be some learners who do not want to sit down they just want to be with their friends. You find that if you group them into groups ahm... there will be those ones who just want to be with their friends, and obviously when they are with their friends they just want to chat instead of doing the work. So normally what I do when I group them I ensure that they are not with their friends. I ensure that I separate them from friends so that they can be able to concentrate at that particular moment. They are also those ones who will want to stand up and check how their friends are doing the work.

**Researcher:** Ohk, and how many learners do you have per class?

**Teacher B:** 40 something, 42 or 43

**Researcher:** So you will be dealing with like 43 learners in class doing the running around?

**Teacher B:** So it will not be like all of them, there will be just those ones who want to be with their friends. So normally it is not most of them who will want to play around. It will be those few, but immediately when they go around to their friends they start disturbing other learners.

**Researcher:** Okay, thank you for that. Do you think the school or the Department support/encourages support us teachers to conduct practical activities.

**Teacher B:** Yes yes

**Researcher:** Okay, so even the school I'll say from your department since you are from science department MST, do they support like your HOD?

**Teacher B:** Yes yes, my HOD is very supportive, too much.

**Researcher:** Do they encourage you guys to do practical activities

**Teacher B:** Yes they do, that is why we enforce that practical activities should be conducted but the challenge is that time does not allow us to conduct them in every topic

**Researcher:** Ahm... You have answered a part of this question as well, how do learners behave during practical activities?

**Teacher B:** They became yoo excited and they become way to excited because they enjoy it especially in primary school they enjoy them a lot, because they are putting that theory into practice now so they now see that ohhh... it is even easier for them to remember, even when coming to tests it is easier for them to remember when they have conducted practical activities because they have tested the theory and saw the results of it. So I think, I would actually advice all educators especially who teach science subjects to conduct practical activities as often as they can, but if time does not allow them then there's nothing they can do about it, because most of the time, time is always a challenge but me I do try to conduct them. When I get time I do conduct them, I do fit in practical activities so that my learners can understand better

**Researcher:** As you said that learners are interested in practical activities

**Teacher B:** Yes indeed they are interested

**Researcher:** So the interest of the learners is not a challenge?

**Teacher B:** No it is not learners are interested, you find that during practical activities they are very excited. And as I said according to me, according to my perspective these learners the way I see them especially when they do something practically they remember very fast and easy

**Researcher:** Okay and when you conduct practical activities how do you divide the learners, in groups, pairs or they do them in individual?

**Teacher B:** I prefer to organise them in groups

**Researcher:** Why is that?

**Teacher B:** I prefer for my learners to be divided in groups because.....

Teacher asked the researcher to pause and think of an answer before the researcher can continue recording

**Researcher:** Ahm... let me just repeat the question, how do you organise your learners during practical activities?

**Teacher B:** I normally divide them in groups, I actually think it is best that they work in groups which improve skills such as communication skills, being able to socialise with each other, get to know each other as learners in one class. And it also helps again for those learners who are you know...

**Researcher:** Slow

**Teacher B:** Yes slow, so that the clever ones can assist the slow ones, to remind them on how things are done so that they slow ones can also have ideas to see when something is like this we conduct it like that. But sometimes they do conduct them individually, but in most cases I prefer in groups

**Researcher:** Okay so when you do them in groups in you ensure that each group has that one learner who is clever?

**Teacher B:** Yes so that that one learner can motivate them. When the slow learners see the clever learner she/he motivates them especially when they are in groups so that the slow learners become motivated that they can also do it. So in groups it helps a lot.

**Researcher:** Do you think practical activities are beneficial to our kids?

**Teacher B:** Yes they are.

**Researcher:** So you said they are taking theory into practice so they are able to see what they were taught practically?

**Teacher B:** Yes, yes.

**Researcher:** Okay, last question. What do you think can be done to improve practical activities, according to you what do you think can be done generally to improve how teachers conduct practical activities in class?

Teacher asked the researcher to pause and think of an answer before the researcher can continue recording

**Teacher B:** Okay on that part I think aah...

**Researcher:** What can be done to improve how we conduct practical activities?

**Teacher B:** I think as long as the educator can bring all the required resources in class for that specific practical activity it would be best

**Researcher:** So in other words when they do whatever topic it should relate to a specific practical work?

**Teacher B:** Yes yes everything that should be there, everything that is required to be there they should actually bring it in class to help the learners understand.

**Researcher:** No I understand. Thank you very much we are done. But if I want to clarify maybe any answer can I contact you is it okay?

**Teacher B:** No problem

**Researcher:** Okay how best can I contact you, email, phone call, facebook, or whatsapp?

**Teacher B:** Aah all.

**Researcher:** Thank you very much.

## LERATO

**Researcher:** Thank you very much for agreeing to be interviewed. Do you have any question or want to make any comment before we start

**Teacher C:** No

**Researcher:** Okay, my first question is when did you start teaching?

**Teacher C:** I started teaching in 2001

**Researcher:** Okay tell me about you teaching career?

**Teacher C:** The first 6 years of my teaching career I was teaching in a government school.

**Researcher:** Okay let me break it down, which subjects are you teaching?

**Teacher C:** I teach Sciences and technology for the grade 5 and I enjoy it a lot I prefer that. I used to teach maths as well but I prefer the sciences to the maths. I find the science a bit more interesting because the reactions to doing things are going to be different to the maths, maths tend to be the same and the maths is also very high profile subjects and the parents tend to worry about it quite a lot.

**Researcher:**How long have you been teaching science?

**Teacher C:** Ahm... (Thinking).... about 12 years.

**Researcher:** Wow you have such an experience hey. And then how would you define or explain what practical activities or experiments are according to you?

**Teacher C:** Practical activities would either be something that they are able to do themselves or something that we do in class so that they can see. The ones that we do in class that they won't do themselves it can either be something impractical for all of them to do it or it can be something that needs more supervision while the ones they are able to do themselves will be something like building the skeleton there's no danger involved they are able to build



themselves it is more hands on activity so it is not just listening it is actually practically getting to do something.

**Researcher:** So if they are being hands on something else that is practical activity, okay. And then ahm... what do you think about practical activities in primary school?

**Teacher C:** About sorry

**Researcher:** What do you think about practical activities as they are being hands on, what do you think about it in primary school?

**Teacher C:** I think it is very important because they get to experience something themselves. A lot of the time they have to build something it means that they have to find a... they think they might be able to do it one way and then they see it doesn't work, they also... it teaches them how to solve problems. I think it develops another set of skills that other activities won't necessarily do.

**Researcher:** Okay so it is good, it is okay for primary learners to be involved in?

**Teacher C:** Absolutely

**Researcher:** Okay aah... does CAPS tell us teachers what kind of practical activities we should do?

**Teacher C:** it does ahm... what I sometimes find with the grade 5's it doesn't always lend itself to practical activity. Ahm... the content that we have to teach isn't necessarily something that will always be a practical activity. But yes we do... and it does say the ones where they would suggest but I often think that a practical activity is better than just writing the answers.

**Researcher:** Really, wow. And are these activities relevant to our learners though, are they relevant?

**Teacher C:** It is very basic, right so I think it is relevant but for some kids who will be a bit more advanced might not always be that challenging. But yes I think it is relevant.

**Researcher:** Do you think us Natural science teachers, do you think we conduct practical activities frequently enough?

**Teacher C:** Say if I think about the science teachers in the schools, I think we do. Because we also try to bring in like we got tablets, iPads available and we try to bring that and that's another type of practical activity. But I do know sometimes science teachers do tend to try and keep away from the practical activities, because it is a lot more preparation and the kids tend to get very excited and then if you do not have certain structures in place and then it is very difficult to keep them under control. They get so excited and it gets louder and louder. And it is exhausting, practical activity is exhausting because it is so hands on, you got five million questions because this one didn't listen the first time around and then now they coming to ask questions. So ya I think it is not always the easiest activities to do because it does require a lot of prep and it is also very hands on while it is easy to give them something to write, they sit they write and they quiet. But when they are busy with the practical activities of course they going to make the noise.

**Researcher:** Okay. And then do you think they are sufficient resources to conduct practical activities?

**Teacher C:** Because I taught in the government school, I can tell you definitely not always in the government school. We very fortunate we got lots of facilities available. But I also think that if you creative you can make a plan. You can adjust the activity for something that you got the things available.

**Researcher:** So you saying you need to be creative as a teacher, even if resources are not there?

**Teacher C:** Ya, we did an activity about the effect of removing calcium from bones. And chicken bones, vinegar and water, and I mean we have that...

**Researcher:** Oh yeah we have that. So it is more of an excuse when we say we do not have resources?

**Teacher C:** Yeah, I mean you can be creative. It is a lot easier if you do have the resources but it is not impossible. It is definitely not impossible.

**Researcher:** Okay. And do you ever allow your learners to set their own question unguided during practical activity in primary school?

**Teacher C:** No that is not something I would often do.

**Researcher:** So you prefer guiding them

**Teacher C:** Yes, ahm... the questions that they will set will then be the questions that they ask in class but not as part of the activity that will be part of the explanation of the work that type of a way. They ask questions but not setting of questions?

**Researcher:** So it will be a bit challenging for them in primary school?

**Teacher C:** I don't know, because they can come up with some very interesting question when you explain the work like what I also find is that with the amount of work that will need to cover in science you have to have a very structured or else you not going to get through everything

**Researcher:** So time?

**Teacher C:** Time constrains especially the grade 5 science seems to be a lot. And I do not like rushing through work just for the sake of getting it done then there's no use to that. So I would then rather spend a little bit longer and then maybe later do a practical work, something like the setting of questions and that type of thing not always sure how relevant it is going to be for them.

**Researcher:** Oh okay interesting. What do you think are challenges during practical activities, the challenges that are there?

**Teacher C:** okay being prepared, having everything set up, the discipline in the class, and keep them from carrying on and making the noise and not actually then doing the activity because

they are busy with something else and then finding something that is interesting. We can do a lot of practical activities but end up being mmm...

**Researcher:** They not interested

**Teacher C:** It was kind of boring, while if you find something that they enjoy then they tend to find something, so it's basically those factors that I think...

**Researcher:** Okay the next question is, does the school or the department support or encourage us teachers to conduct these practical activities?

**Teacher C:** Our school definitely, I think definitely they give us the necessary resources; we got subject meetings every week where all the grade 4, 5 and 6 science and technology teachers get together. And they very encouraging on doing that type of thing. I think the department as well because they know what the benefit is, but I'm not always sure if it then gets followed through in the schools.

**Researcher:** If do we follow, as you said that time, sometimes it is time.

**Teacher C:** And the resources you know. There are some things that you just can't do, you can be creative with certain things but you can't always it is difficult. I think it is very difficult, we are really fortunate to be in a school that we are in because I think there is a lot of schools out there they do not get the support that they need and it is almost as if, we expect them to do certain things but we do not enable them to. We do not give them the necessary support that they need. And I think that can be really frustrating for a teacher who's desperate to teach and encourage the kids. While we very fortunate because we got all that whole system in place.

**Researcher:** Okay part of this you have answered, how do learners behave during practical activity?

**Teacher C:** Okay, they are going to be very excited because it is hands on. Ahm... you get your different groups, there is going to be the one that takes over everything and doesn't want anyone to do anything else. And there's going to be the one that sits at the back and try to hide and not do anything, ahm... then that's why as a teacher then you have to have a look and say

hey hold on give somebody a chance. Ahm... ya that is why you would also get different groups like this time I will say you can choose your own group, and next time I will say okay you number one, two, three and four so then I choose the groups. So it is all going to depend but on the whole they are actually very good, they enjoy it, they behave themselves, they can get very excited but then you just have to...

**Researcher:** And is it productive though even though they enjoy it and they excited?

**Teacher C:** Yes absolutely

**Researcher:** Okay so you do see the results that it really worked. Mmm... during practical activities when do learners work effectively, is it when they are in groups, pairs or individually during practical activity?

**Teacher C:** It is all going to depend on the group that they are in and the type of an activity. Some activities like these (building of the skeleton) you wouldn't do with a group that is too big that is why it works better in pairs. Some activities it is almost better for them to do on their own. So it is going to depend on the activity, so it all depend what type of an activity and what you want to achieve through that activity.

**Researcher:** Wow that's interesting, so you do not always put them in groups it all depend on the type of an activity, wow okay I like that so much. We are already done, last question is that, what do you think can be done to improve the way we conduct practical activities in the science classrooms, what do you think can be done?

**Teacher C:** I think it is the variety, trying to get the variety of activities, it doesn't help that you get one type of an activity and try and force everything into that. Some activities might work better when you do it in groups and some activities might work better when you do it as a class demonstration and they do certain part, they come and help you to do something. So it is all going to depend on the type of activity and how you plan it. Ahm... I do not know if that's enough?

**Researcher:** No it is enough. Okay I am done, if I want to contact you and I want to clarify any answer can I contact you?

**Teacher C:** Yes you may

**Researcher:** Okay, thank you

## TLOU

**Researcher:** Okay my first question is, when did you start teaching?

**Teacher D:** My first year teaching was in mmm... I started studying tertiary level in 1999, 2000 and 2001. Then my first teaching was in 2002 in a very small rural town in New Zealand that is when I started.

**Researcher:** Okay wow. What subject were you teaching when you started teaching, which subjects?

**Teacher D:** In New Zealand it works a little bit differently. I taught all subjects, so basically from grade 000 all the way up to the same as Grade 7 in South Africa. You teach all subjects. So I taught Grade 6 and 7 and mmm I taught all subjects, so will have certain time frame during the day where I will be teaching Maths, English, Natural Science, History, Geography all basically.

**Researcher:** Mmm... okay that's interesting. So when did you start teaching Natural Science to be specific?

**Teacher D:** Mostly... Before I left New Zealand it is when we started to focus more on mainly the hidden maths in my school, and when I came over here I started teaching only maths and natural sciences, I dropped my English component and I only started teaching maths and science so that was in 2012.

**Researcher:** Okay. And then how would you describe experiments or practical work according to you, how would you describe them?

**Teacher D:** Might keeping as hands on as possible, make sure that all children feel like it is enjoyable, fun, engaging and energetic. Make sure that safety first is covered if the experiments need safety. Go through the steps in order and make sure that the children know where exactly you going and why. Start with maybe a lesson about what you doing, what you learning to do and go through mmm... your aim, your hypothesis, observations and your deductions and your conclusions. And then I would have a reflection at the end, where we basically talk as a group about what you have learnt and have a collaborative learning as much as possible.

**Researcher:** Okay. What do you think about these practical works in primary level?

**Teacher D:** Very important. Ahm... in terms of importance, it is very important. Ahm... basically what you doing is teaching children to not only have sort of like steps that they can follow that sets up any science that they want to do in the future. But at the same time also you teaching them to bring things into details to different expects of science specifically. It is important to let them have an aim and a hypothesis where they know where they going and have a clear production about what they want to do. And then with those steps you want to cover your apparatus that you going to use. And your observation and your deductions and your methods primarily, you need to basically be clear about where you going. Those steps just help children to think to themselves that I need to logically sequence what I'm going to do, priorities about what's going to be in what order. Mm... and then after that it makes it a lot clear to get a deduction and have reasoning for what's happened. Ahm... the hardest thing to bring in my opinion is basically making sure that you doing a fair testing and making sure that testing is fair, accurate and precise, those are the things that children tend to kind of passed over.

**Researcher:** Does CAPS document suggest which practical activities we should use?

**Teacher D:** It does, it's got a very good list of practical activities that you should kind of follow as example. Primarily the main thing we should focus on within CAPS is however the four main areas will be the life and living, matter and material, energy and change, and earth and beyond. Its' got some of other strands or the activities that you should primarily cover. Then it's got suggested activities, now that's the key word "suggested activities" to get that content out. Some of those activities are brilliant and wonderful and some I would suggest that they need modification and you can work on and elaborate on. So that is the key word within the CAPS document "suggested activities", because if you want to do it there are brilliant ones, but otherwise come with your own be innovative, think outside the box.

**Researcher:** And those activities that CAPS suggest are they relevant to our learners?

**Teacher D:** Most of them are, but once again it depends on what kind of school you teaching in, and not to be... I'm not trying to be selective between public and private sectors, but a lot of



activities that are mentioned some of the activities are not relevant to some of our children and some might not be relevant to the public sector children. So basically what you have to do, you have to priorities what are the activities that you can talk about and discuss and then practice, look at, investigate, solve and look at them in more detail.

**Researcher:** Do we Natural Sciences teachers conduct practical activities frequently enough?

**Teacher D:** If time table and set aside yes, I think naturally science it is becoming unfortunate a bit of a lose there and I'm worried about that because I feel we should spend more time on it especially in today globally economy and environment, I think we should spend more time promoting the sciences. There's a drop away in what's called "steam" teaching which science technology engineering and mathematics those types of learning have never more be needed. In the past it was because people wanted to invade, create, now they still exist but there's a need nationally for problem solve, facts and change and inspire and now those words have become more in the science than to create and invade.

**Researcher:** Do you think we have sufficient resources to conduct practical activities?

**Teacher D:** Here at our school we very lucky yes we do. Anything we want but within a specific budget of course, but unfortunately I do think some schools are limited. And it is unfortunate that some teachers really have to think out of the shelter think how to get the message across, what resources I can use that I haven't got. Mmm globally... within the country we probably do not have enough resources to get the science message across. And I think it comes down as a teacher, you have to be creative these days. Even though they are no resources, it can come to a stage where you have to use secondary resources. I mean we doing science expo with my kids at the moment, and I tell them that do not go and buy new things use what is laying around the house, containers, and boxes things like that.

**Researcher:** Oh okay. And then do you personally use worksheets during the practical activity?

**Teacher D:** Not as much I try to stay away from them. I would rather children have a good discussion, or work collaborative to try and solve a problem or have a hand on activity that they are doing. I'm not saying I do not use worksheets, but I'm just saying one should be very

carefully about what type of worksheets they use. I'm not a fan of multiple choice worksheets; I would rather see things that promote creative thinking that promotes analysis and synthesis and all those things that are high on the bloom taxonomy. I think I should rather see people on a worksheet that ask questions like "why do you think we have a problem at the moment nationwide on pollution, how do we battle the problem of fossil fuel", you know those sort of questions. I should rather see a worksheet that is not busy work not regurgitation and not throwing back what you have learnt.

**Researcher:** So in other words you do allow your learners to set their own questions during an activity?

**Teacher D:** Absolutely, the more discussion questions I ask during the lesson the better.

**Researcher:** Wow that's interesting. And what do you think are challenges during practical activities?

**Teacher D:** Background knowledge, children background knowledge it is sometimes limited and then you have to spoon feed and give information before you get anything back. I think children do not get out and do things enough so their background knowledge it's lacking. I think sometimes time it's always against any teacher, I think you have to budget your time very effectively these days and try to be really on to it. I think some other barriers might be the influences like children might have a busy workload and they might not have the time to do it at home. And I also I do think that lots of teachers might be going on the stage where they trying to tick boxes rather than inspiring, lot of teachers are trying to get caps out there or get knowledge or get this idea out there, instead of focusing on inspiring children and fostering their interest and their enthusiasm. So yeah those are barriers that are there.

**Researcher:** Okay, so does the school or the department support Natural Science teachers to conduct practical activities?

**Teacher D:** Yes we support each other in terms of conducting practical activities. The more practical the better. We trying basically to support each other, we work together as a very close team. We encourage each other we make sure that things are as practical as possible.

**Researcher:** What about the department, does it support us to conduct practical activities?

**Teacher D:** Are you talking about our department in the school or are you talking about the national department?

**Researcher:** Now I'm talking about the national department.

**Teacher D:** It works different with independent schools, we are supported very well by the independent education board and SASA they support us very well. I actually think the curriculum is one of the better one, I think CAPS is a very good one. Ahm... I do not think we get supported by the government as much will like to be supported. But I think things like SACE they are doing a great job, so yeah.

**Researcher:** How do learners behave during the practical activity?

**Teacher D:** Not a problem, I do not have a problem.

**Researcher:** So you are okay with their behaviour?

**Teacher D:** It is difficult with some children but we are very lucky.

**Researcher:** And how do you organise learners during practical activity, do you group them, put them in pairs or do it individually?

**Teacher D:** All of the above. You basically look at the lesson you want to teach if it lends itself to whole class teaching and what's not while I talk and they listen to be it. But I rather have small collaborative groups or big groups working together or children sharing ideas with each other or one person feeding back, whatever lends itself to positive learning absolutely.

**Researcher:** Okay, So it is not about when they are in groups they work effectively they are in pairs it depends...

**Teacher D:** It does depend on a situation and a good teacher will make sure that the pairs or the group situations are appropriate. So in other words you wouldn't do small group discussion when you might be looking at for example ahm...you wouldn't do a one on one lesson when

you want an investigation in small groups where everyone works together and everyone have a turn. You know you got to think and try to manage that people bring lots of ideas in a group than individually. When they are out of the classroom they have to learn to work with others and brainstorm ideas with other people, they cannot do that on their own.

**Researcher:** Okay last question, what do you think need to be done to improve practical activities?

**Teacher D:** Okay within the South African system we need to... if we want South African pupils to be globally in science and we want them to use practical activities, we have to make sure that we provide them with everything that they can possibly need and have in order to get there and the teachers as well need to have them. I mean I see we very lucky we do not need to worry about that, but lots of schools do not have resources. Teachers are not trained in how to incorporate practical lessons, in how to teach it, use resources, and communicate with the pupil. Training in resources is so vital; if there's no training in skills of using resources in our pupils and teachers then it is not gonna work.

**Researcher:** Okay because how are they gonna conduct something effective if they do not know what is that.

**Teacher D:** And people are curious, it is in our nature we see something and we are interested we want to know how it works. Why education is powerful it's because we can empower that we tell people what they should learn that is not fostering development it is not fostering their growth and interest we are saying you must know this and you must know this. We should make children interested in the content we are teaching.

**Researcher:** Thank you very much

## APPENDIX H

### WORKSHEETS

#### Tebogo's worksheet

##### Plants and food

A plant's food, as we discovered is called **glucose**. **Glucose** is a simple sugar and gives the plant all the energy it needs. The glucose has to change for the plant to store it. It is changed and stored in a new form called **starch**. We can test if a food has starch using an indicator called **iodine**. Iodine does this by changing colour or staying the same colour. If a food has starch in it, the iodine will change from a yellow-brown colour to a blue-**black colour**. If a food does not have starch in it, it stays a **yellow-brown colour**.

##### ACTIVITY: STARCH TEST

**Aim:** To test which food items contain starch and which do not contain starch

**Apparatus:** Iodine solution, dropper, plates, bread, apple, oil, cheese and maize meal

##### **Method:**

1. Put a small amount of each food item into a different plate.
2. Using a dropper, drop a little bit of iodine onto each item of food.
3. Observe any colour changes.
4. Record your results.

**Results: Fill in the table below.**

Food item	Colour using iodine

##### **Conclusion**

- A. Name the food items that had starch
- B. Name the food item without starch

## Kego's worksheet

Natural Sciences and Technology Grade: 5

Practical activity

Specific aims: 1, 2, 3

Total: 25

### **Metals and non-metals**

Non -metals have properties opposite those of the metals. The non- metals are brittle, not malleable or ductile, poor conductors of both heat and electricity and tend to gain electrons in chemical reactions. Some non- metals are liquids. Metals have a shiny appearance, are good conductors of heat and electricity.

Aim: Compare a metal from a non -metal material

What you will need

- Hammer, coins , boxes , wood, metal spoon and screw
- Plastic, Paper and paper clip

### **Instructions**

- Be in groups of five.
- Divide the given materials into metals and non- metals
- Complete the table below

Metals	Dull or Shiny	What happens when hit with a hammer	Non -metal	Shiny or dull	What happens when hit with a hammer

### **Conclusion**

1. List materials that are metals and that are non- metals.
2. Write 2 properties of metals and of non- metals.

## **Tlou's worksheet**

Practical activity 1

Duration: Two days

Testing for starch with the Grade 6

Date: April 2016

### **Pair work**

#### **First day activity**

Discussion of the activity

Learners encouraged to bring food items for day two

Recapping on work done on starch

#### **Day two activity**

##### **Conducting a practical activity**

**Aim:** Write down what you want to learn or find out?

**Method:** How you plan to achieve this. What steps are you going to do to achieve this aim?

**Apparatus:** Write down the apparatus you will use in this study include the iodine provided by the teacher.

**Observations and deductions:** Write down what you saw or witnessed

**Conclusion:** Present your work and discuss your findings.

## Lerato's worksheet

**Form of assessment:** Practical Work

**Duration:** Completed in two days

**Grade:** 5

**Date:** March 2016

**Topic:** Creating a Skeleton

### Day one

- Discussion of different skeletons and their parts
- Discussion of MES principle:
  - ✓ M-Material, Indicate materials you will use
  - ✓ E-Explain, Label parts of your skeleton and give details about them
  - ✓ S-Size, Give actual measurements of the size of your skeleton part (can guess the sizes)

### Day two

- Work in pairs.
- Create your own skeleton.
- Write materials you used to make your own skeleton.
- Write the purpose of your activity.
- What steps (in order) are you going to use to achieve this aim?
- Conclusion: Write the reflection of your practical activity