An exploration of Grade 10 Life Sciences teachers' views on the implementation of the Practical examinations in Life Sciences at selected high schools in the Estcourt region

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ABSTRACT

Practical work is a quintessential part of the Life Sciences (LS) Curriculum Assessment Policy Statement (CAPS) as introduced to South African high schools in 2012. The new policy specifies the type of practical work expected of learners, as well as the types of process skills that should be developed in learners by means of practical work. In addition, teachers of Life Sciences are required to set and administer a practical examination for their grades 10 and 11 LS learners.

This interpretive study explores grade 10 LS teachers' views on practical work and the practical examination that they have to implement, how they implement practical work in terms of CAPS requirements and their experiences of their capacity to innovate for implementation of the practical examination. Rogan and Grayson's (2003) theory of curriculum implementation framed this study. In particular, their profile of implementation pertaining to practical work and their capacity to innovate guided the development of the research instruments and the data analysis. A qualitative case study approach was used. Purposive and convenience sampling were used to obtain the respondents (Grade 10 LS teachers) for this study. An open ended questionnaire and individual semi-structured interviews were used to collect data from LS teachers at selected schools of the Umtshezi ward of Estcourt region.

The findings indicate that grade 10 LS teachers have four core views on practical work: to promote learning, stimulate interest, assist with class behaviour control and to integrate "hands on" with "minds on" activities. An overwhelming 24 out of 25 grade 10 LS teachers had negative view of the practical examination, due to, among others, large classes, lack of resources, time and support from school and parents, teachers' lack of expertise and appropriate re-training. Some dilemmas that teachers encounter during curriculum reform are unveiled. Furthermore, the discrepancy between Grade 10 LS teachers' views on practical work, their classroom practice and the LS CAPS requirements in terms of practical work is exposed. The mismatch between policy intention and practice is illuminated and it signals the need for both effective teacher professional development and a supportive school ethos.

Key words: capacity to innovate, Life Sciences teachers, implementation, practical examination, practical work.

DECLARATION

I, Furirwai Samaneka, declare that "An exploration of Grade 10 Life Sciences teachers' views on the implementation of the practical examinations in Life Sciences at selected high schools in the Estcourt region" is my own original work and that all the sources I have used or quoted, have been indicated and acknowledged by means of complete references.

Researcher:

Supervisor: Dr Asheena Singh-Pillay

Co-Supervisor: Dr Doras Sibanda

DEDICATION

This thesis is dedicated to my daughters **Mitchelle and Munashe Samaneka**: you are my centre of gravity. Thank you for your unconditional love, patience, support and motivation. You have encouraged me to aspire to greater heights and have prevented me from throwing in the towel when I felt overwhelmed on this journey. I love you dearly.

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Finally my Lord and Saviour who gave me strength, hope and faith that through perseverance nothing is impossible with God.

Luke 1 verse 37.

LIST OF TABLES

LIST OF FIGURES

LIST OF GRAPHS

TABLE OF CONTENTS

CHAPTER 1

1.1. Introduction and background

Life Sciences teachers in post-apartheid South Africa have been bombarded by three major curricula changes in the Further Education and Training (FET) phase (grades 10-12). Until 1995, the 'apartheid' curriculum, NATED 550, directed their teaching; during the period 1995-2006 the Interim Curriculum (IC) was used, which was based on the NATED 550 curriculum; and in 2006 the National Curriculum Statement (NCS) for Grades 10-12 was introduced. Since 2006, the subject that was previously known as Biology has been called Life Sciences in Grades 10-12 in the FET phase. The NCS-FET Life Sciences curriculum policy was subsequently revised thrice between 2006 and 2012. In 2012, the National Curriculum Statement – Curriculum Assessment Policy Statement (NCS-CAPS) Life Sciences policy document was introduced at grade 10. During these three waves of curriculum reform (IC, NCS-FET, CAPS) Life Sciences teachers had to endure the added burden of simultaneously engaging and teaching two curricula, due to the overlap period of phasing out one and introducing another (Singh –Pillay & Samuel, 2015). During these curriculum reforms, the very foundation of what constituted the discipline of Life Sciences came under review, as new forms of content and process knowledge came to be incorporated into the new Life Sciences curriculum. In the Life Sciences CAPS curriculum for grades 10 &11, a formal practical examination is now mandatory, in addition to the two theory examination papers. Put simply, this means that the compulsory practical examinations in grades 10 and 11 are part and parcel of the Life Sciences curriculum For the intended curriculum reform as outlined above to be successful, its implementation is vital. It is worth noting that any curriculum reform and its implementation hinge on teachers and the training they receive for such implementation (Lieberman & Mace, 2008).

With regard to the latest curriculum reform, the paucity of training that Life Sciences teachers received for curriculum implementation should be noted. To elaborate, subject advisors conducted a short “once off, just in time”, “one size fits all” workshop (Singh-Pillay & Alant, 2015). According to Singh-Pillay (2010) such “one size fits all” training treats all Life Sciences teachers as homogenous, which means that it ignores many variables, such as the teachers’ training history, their experiences, pedagogical content knowledge, expertise, uncertainties as well as their learning needs and the learning needs of their learners.

The frequent revisions in the Life Sciences curriculum have also resulted in new accountabilities, and teacher “reskilling and deskilling”. Such demands have contributed to teachers’ uncertainty about their role, their content knowledge and pedagogical knowledge (Singh-Pillay, 2010). To elaborate, Cronje (2011, p.3), maintains that more than “56 percent of high school science teachers are under-qualified”. As a result they often struggle with planning, preparation and completing the scheduled work. In addition many South African teachers lack understanding of fundamental concepts in Sciences (Kriek, & Basson 2008; Onwu, Botha & de Beer, 2006; Cronje, 2011). Cronje, 2011 argues that this deficit means that many teachers struggle to apply “shoestring”[1] science when laboratory materials are not available, or they may not know how to set up and conduct experiments or investigations, even with the necessary materials. The lack of resources (both human and physical) can impact the implementation of practical work in schools and hence the gazette practical examination.

In summary, the frequent curriculum reforms in Life Sciences mean that teachers were overwhelmed with the many demands made on them.

1.2. Rationale for this study

I have been a qualified teacher of Life Sciences for the past twenty years. I have engaged with the three Life Sciences aforementioned policies, namely NATED 550, Interim curriculum and NCS-FET. I am currently teaching the NCS-CAPS Life Sciences curriculum from grade10 -12. In 2012 I was teaching a grade 10 Life Sciences class when I had to implement a practical examination for the first time. Practical work is an integral part of Life Sciences and its aim is directly related to the purposes of studying Life Sciences, which are to develop science process skills in learners while developing scientific knowledge and understanding as well as understanding of the role of science in society (DoE, 2011). Specific Aim (SA) 2 of the CAPS Life Sciences policy is concerned with investigating phenomena in Life Sciences. SA2 focuses on seven sets of skills that need to be developed in learners so that they can embark on practical work. These skills are the abilities to follow instructions, handle apparatus,

[1] Shoestring science: innovation teachers demonstrate when they improvise and use materials found in the local environment (Cronje, 2011).

make observations, record data, measure, interpret, design and plan investigations. The practical examinations must assess at least four of the seven practical skills described in SA2. They are scheduled for the fourth term and are of one hour duration (DoE, 2011). It is the responsibility of the teacher to ensure that the necessary chemicals, specimens and equipment are available for the practical examinations (DoE, 2011). One invigilator needs to be appointed for every 30 learners; it is the responsibility of the Life Sciences teachers to make arrangements for suitably qualified invigilators. One invigilator will ensure the credibility of the examinations whilst the second invigilator is a Life Sciences teacher, who will assist with the technical aspects of the practical examination as well as learner queries (DoE, 2011). Life Sciences subject advisors are supposed to be informed of the practical examination date so that they can randomly visit schools to monitor the practical examination.

Notwithstanding my twenty years of experience as a qualified teacher of Life Sciences, I was overwhelmed by the experience of having to set and implement the practical examination at my school. In the absence of a laboratory technician or support from within the school structure, and in addition to my existing workload and responsibilities, I found this task daunting. Therefore I was curious to explore other LS teachers' views on practical work and the practical examination, how they implement practical work in terms of the LS CAPS requirements and their experience of the capacity to innovate for the implementation of the practical examination. Kriek and Basson, (2008) contend that knowing teachers' views and experiences about a curriculum change is crucial, as they are the ones who have to implement the change. Furthermore they argue that any educational change depends on what teachers think. It is likely that the changes to a curriculum may not be implemented as expected if, for any reason, teachers show negative views or have negative experiences about these changes. It is emphasized by Van Driel, Beijaard and Verloop, (2001) that ignoring teachers' views and experiences during an educational reform will hinder the primary purpose of introducing changes. If teachers are to respond meaningfully to the challenges of the new curriculum, they have to have an incisive understanding of the effected changes and much clearer views about these changes (Webb, Cross, Linneman & Malone, 2005). Therefore, determining teachers' views and experiences about implementing the practical examination will not only help identify difficulties, deficiencies and gaps in the curriculum delivery; it might also provide valuable information about what needs to be done in order to sustain the change as well as to ensure that the ideals of the new curriculum are realized. In addition, Life Sciences teachers' experiences should inform possible curriculum changes and improvements with respect to the kind and type of training that teachers need to ensure curriculum implementation.

1.3. Purpose of this study

The purpose of this study is to:

- Explore what are grade 10 LS teachers' views on practical work and the practical examination they have to implement?
- Establish how grade 10 LS teachers' implement practical work in terms of the CAPS requirements.
- Explore what are grade 10 LS teachers' experiences of the capacity to innovate for implementation of the practical examination?

Therefore the research questions guiding this study are:

- What are grade 10 LS teachers' views on the practical work and the practical examination they have to implement?
- How do grade 10 LS teachers implement practical work in terms of CAPS requirements?
- What are grade 10 LS teachers' experiences of the capacity to innovate for implementation of the practical examination?

1.4. Significance of this study

This study will be beneficial to Life Sciences subject advisors, curriculum developers, Superintendent Education Manager (SEM), principals because determining teachers' views and experiences about the implementation of the practical examination will not only help identify difficulties, deficiencies and gaps in the curriculum delivery; it might also provide valuable information about what needs to be done in order to sustain the change as well as to ensure that the ideals of the new curriculum are realized. Furthermore, Life Sciences teachers' experiences should inform possible curriculum changes and improvements. The findings of this study will help me personally to engage in reflective practice and this could contribute to a more nuanced practice.

1.5. Limitations of this study

It would have been appropriate to explore all grade 10 Life Sciences teachers' views on the implementation of the practical examinations in the UThukela District. However, this study was limited by finances, logistics and time constrains. Consequently, this study was confined to 25 schools in the Umtshezi ward of the Estcourt region and hence the findings of this study cannot yet be generalized to all South African classrooms.

1.6. Clarification of terms

Practical work: There are many definitions of practical work. For the purpose of the study and the context of this study Pillay's (2004) notion of practical work will be adapted. Pillay (2004) describes practical work as all science activities that can be done in the laboratory, classroom as well as in the garden or kitchen and it involves scientific method as well as both basic and integrated science process skills. This means that practical work is not confined to a laboratory and it depends on the teachers' ability to innovate and improvise.

Process skills-: Padilla (1990) describes science process skills as a set of broadly transferable abilities to many science disciplines and reflective of the behaviour of scientist. The process involves scientific method, scientific and critical thinking".

Basic process skills: includes observing, inferring, measuring, recording information and classifying (Padilla, 1990).

Integrated process skills: controlling variables, defining operationally, hypothesizing, interpreting data, translating data, formulating models, designing experiments and critiquing experimental designs (Padilla, 1990; Duggan & Gott, 2002).

Hypothesis testing: A hypothesis is a conjecture based on observation, formulating a question, deriving predictions from them as logical consequences, and then carrying out experiments based on those predictions (Isacc, 2015).

Hands on: refers to practical activities involving the manipulation of material or apparatus in order to investigate, inquire and find solutions (DoE, 2011). A hands on approach thus entails learning by doing.

Minds on: refers to hypothetical problem, hypothesis testing activities that will involve critical thinking, problem solving and translation of data (DoE, 2011).

1.7. Overview of chapters to follow

This research report is presented in six chapters.

Chapter 1 describes the background to the study. Also outlined in the chapter is the purpose of the study, the critical questions guiding the study, rationale, the significance of the study, limitations and clarification of terminology used. This chapter is closed with a brief description of the overview of the study and a conclusion.

Chapter 2 presents a detailed review of relevant literature in response to the research questions posed.

Chapter 3 pays attention to the Rogan and Grayson (2003) theory of curriculum implementation, which frames this study.

Chapter 4 explores the philosophical assumptions underpinning this study and explains why this study adopts a qualitative approach, as well as why a case study design is used. The research site and the method of data generation employed in the study are also described. The chapter also gives an account of how various gatekeepers at each stage of the research were approached in order to gain access and also outlines the challenges encountered by the researcher during the data collection phase of the research. The data generation instruments as well as the sampling procedure used in the study are described. This is followed by the description of data generation procedure and the method of data analysis. The chapter ends with the description of the validity and reliability of the instruments used.

Chapter 5 presents the analysis of data and findings in order to answer the three research questions that guide the study

In Chapter 6 the findings are discussed, along with the recommendations and reflections relating to them. Limitations of the study, together with suggested areas for further research, are also highlighted before the chapter conclusion.

1.8. Conclusion

This chapter provided a detailed overview of this research study. The chapter presented the rationale and context of the study. Furthermore, the research questions, significance of the study, limitations and outline of the research report are illuminated. The next chapter will focus on the review of relevant literature and the theoretical framework.

CHAPTER TWO

Literature review

2.1. Introduction

The inclusion of a practical examination within the school Life Sciences curriculum is a significant feature that distinguishes it from most other subjects in secondary schools. This chapter presents a review of related literature in order to establish a theoretical basis for addressing the research questions posed and achieve the purpose of this study. This study addresses the following research questions:

What are grade 10 LS teachers' views on practical work and the practical examinations they have to implement?

How do grade 10 LS teachers implement practical work in terms of the CAPS requirements?

What are grade 10 LS teachers' experiences of the capacity to innovate for implementation of the practical examination?

Practical work is a core component of secondary school science curricula in most countries, although its value, aims and purpose in the school science curriculum has been debated by many scholars (Miller, 2004; Moeed & Hall, 2011; Ramnarian, 2011). Bearing this debate in mind this literature review has been arranged into six themes so as to foreground this debate, as well as teachers' views and attitudes towards practical work and the challenges they encounter during curriculum reform. The six themes around which the literature review is arranged are reflected below:

- Scholars' conceptions of practical work
- The purpose of practical work
- Teachers' views and challenges pertaining to practical work
- CAPS requirements for practical work
- Critiques by SAARSTE of CAPS practical examination
- Challenges that teachers encounter during curriculum reform

2.2. Scholars' conception of practical work

Practical work in science education is acknowledged and widely accepted as an important component in teaching and learning of science concepts (Toplis & Allen 2012; Kibirige & Teffo, 2014). It appears to be a complex idea with multiple definitions and seemingly conflicting purposes (Donnelly, 2000; Abrahams, 2009) and corresponding disagreement as to where it must occur (Lunetta, Hofstein & Clough, 2007; Millar & Driver 1987; Pillay, 2004). Thus, it is important to analyse scholars' conceptions of what constitutes school science practical work and where it occurs. I will first examine where practical work occurs and then what it is or entails.

Some scholars such as, Ottander and Grelsson (2006), Kask and Rannikmäe (2006) and Tasi (2003) maintain that practical work in school science means laboratory–based experience. The definition used by these scholars thus confines practical work to a laboratory and does not allow for innovative improvising in the absence of a laboratory or suitable equipment; a scenario all too prevalent in many under resourced or previously disadvantaged schools in South Africa. Therefore these authors' notion of practical work is not espoused in this study. By contrast, Millar (2004, p.1) maintains that practical work is "…any science teaching and learning activity in which the students, working individually or in small groups, observe and/or manipulate the objects or materials they are studying". This means that practical work entails hands on activities, as it entails the manipulation of materials. Furthermore, it is considered to be an important tool for teaching about experimental design as well as an appreciation of the ever-presence of uncertainty in science (Millar, 2004). The space within which these observation and manipulation can occur is also not confined to a laboratory or a school setting. Instead, it could occur outside the school setting or as field work. A broader definition of practical work is put forth by Lunetta et al., (2007, p. 394) who maintain the practical work is "…learning experiences in which students interact with materials or with secondary sources of data to observe and understand the natural world". The definition of practical work by Lunetta et al., (2007) espouses the idea that it is both a "hands on" and a "minds on" activity. Therefore according to such definitions practical activities are not confined to a laboratory.

Practical work in the literature has been referred to in different ways: ‘experimental work; scientific investigations (Ramnarain, 2011); ‘practical and investigative activities’ (Science Community Representing Education (SCORE), 2009), and ‘laboratory investigations’ (Kibirige & Tsomago, 2013). Even though practical work is referred to in different ways, Hodson (1996) maintains that the purpose of “practical work” is to gain an understanding of scientific investigation and so it is inherently linked with doing science. Furthermore, according to Benner (2011) practical work fosters the development of a range of practical skills, thought and processes that constitute doing science as ‘what scientists do’.

An alternative view on how practical work is defined is offered by Pekmez, Johnson & Gott (2005), who maintain that school practical work can be defined from the perspective of the educational movements influencing it. For example the discovery learning movement depicts practical work as the means for discovery learning wherein learners develop their understanding. Alternatively, the process approach movement depicts practical work as the methodology that will give opportunities for learners to practice what scientists do when they are acting as a scientist and it is not directed by the content. The investigation movement construes practical work in a more holistic approach. In this idea “learners have to be thinking about what lies behind what they are doing rather than simply applying a practiced process” (Pekmez et al, 2005, p. 11).

Gott and Duggan cited in Pekmez et al. (2005) call the ideas which make the thinking behind the doing of science, concepts evidence. Concepts evidence represents procedural understanding operating alongside substantive understanding. Procedural understanding concerns process skills and substantive understanding refers to the understanding of concepts laws and theories (Pekmez et al., 2005).

Within the South African context, Stoffels, (2005, p. 148) defines practical work as “teaching and learning situations that offer learners opportunities to practice the process of investigation”. This means that practical work involves hands-on or minds-on practical learning opportunities where learners practice and develop various process skills. According to Stoffels, (2005) these process skills include observation, identifying, hypothesis testing, prediction, translation of data, recording of data, analysis and interpretation of data. This means that both basic and integrated process skills are foregrounded in Stoffels (2005) notion of practical work. It is worth noting that the Department of Education document (2008) definition of practical work is also aligned with the investigation movement perspectives and embraces both the development of procedural understanding as well as substantive understanding with the goal of developing problem solving skills.

From the preceding ideas it is worth noting that there is a similarity between the process approach movement and the investigation movement on what practical work is. The process approach movement is concerned with the doing of science whilst the investigation movement moves a step further by being concerned with the thinking behind the doing of science. This means the investigation movement does not separate theory from practical doing of science. In other words, in this movement theory and practical are closely intertwined. So, according to the investigation movement practical work is the approach to teaching and learning that will enable learners to develop process skills (procedural understanding) and also enhance their understanding of concepts laws and theories of science (substantive understanding). This approach is two-fold in that it caters for the content learners' need to understand as well as the process skills they have to practice and develop with the ultimate aim of developing problem solving skills and critical thinking. What comes to the fore is that there is no single way of conceptualizing practical work.

Due to the conflicting views amongst scholars about what practical work is and what it entails it is necessary to review literature on the purpose and value of practical work.

2.3. The purpose of practical work in school science

The purpose of practical work in this context of this study refers to the intentions of, or objectives for, doing practical work. The debate on whether practical work is an essential part of school science education is long standing. Proponents for practical work posit many benefits of engaging in practical work. It allows learners to expand their knowledge in an attempt to understand the world around them (Kolucki & Lemish, 2011); develops learners' understanding of ideas, theories and models (Millar & Abrahams, 2008); involves learners experiencing the basic and integrated processes of science (NARST, 1990; Millar et al., 1999; Pillay, 2004) improves achievement and acquisition of process skills (Kerr, 1963; Aladejana & Aderibigbe, 2007; Watts, 2013). However, studies by Chang and Lederman (1994), Jackman and Moellenberg (1987) and Watson (1995) indicate that practical work is not valuable in learning science.

From the review of relevant literature I have come up with five categories for the purpose of practical work, which are discussed next. These categories are:

- Developing practical or experimental skills
- Developing a conceptual understanding of science content
- Fostering motivation in learning science
- Developing an understanding of the nature of science and of scientific process and
- Enhancing social and learning skills

2.3.1 Developing practical or experimental skills

Scholars such as Shulman and Tamir (1973), Kolucki and Lemish (2011), and Millar and Abrahams (2008) emphasize the use of practical work for enhancing learners' skills and abilities in, for example, formulating hypotheses, designing experiments, observing, interpreting data, handling errors, and reporting. Lunetta et al.,(2007) label such skills as "experimental and analytical skills", while Hodson,(1996) calls them "scientific practical skills and problem solving abilities". So I have merged this range of related aspects to the domain, entitled "developing practical or experimental skills".

2.3.2 Developing a conceptual understanding of science

Studies on practical work conducted by White (1996), Shulaman and Tamir (1973) and Millar and Abrahams (2008) maintain that an important purpose of practical work is to promote conceptual understanding and learning of content amongst learners. White (1996), for instance, emphasizes that practical work should reveal links between different topics and that learning with a deep understanding of facts and explanations should be the core purpose of practical work. In support Woolnough (1994) argues that learners' personal knowledge of scientific phenomena should be developed by engaging in authentic science. Welzel et al., (2005) reported that the science teachers in their study, when questioned about the purpose of practical work, agreed that practical work should connect the science concepts and theories discussed. By contrast, some opinions have been expressed about the effectiveness of practical work in developing learners' understanding of the science content of their subject. For instance Millar and Abrahams (2008) indicate that learners seldom learn the things that we want them to learn from practical tasks and, when asked later, learners tend to recall only a few of the details of the experiment and cannot remember exactly why the experiment had been undertaken. Similarly, according to Hodson (1996) it cannot be claimed that practical work would be the best method for delivering scientific knowledge, if empirical evidence about its efficacy is taken into account. However, the use of practical work can offer learners an opportunity to examine scientific knowledge from a perspective that is different from purely theoretical instruction, and thus it is possible that it is fruitful to use it combined with other types of instruction (Pillay, 2004).

2.3.3 Fostering motivation in learning science

The fostering of motivation to learn science has been posited as a purpose of practical work by White (1996), Woolnough (1994) and Welzel et al., (2005). Similar findings by Wilkinson et al. (1997) and Etkina et al. (2006) confirm enhanced interest, enjoyment, and satisfaction as suitable affective outcomes of practical work. Furthermore, Hofstein and Lunetta (2004) contend that learners' enjoyment of practical work can create positive attitudes and interest in science. While White's (1996) argument that laboratories are not built to provide enjoyment is noted, fortunately, my personal experience has been that many learners enjoy the use of laboratories when they study science. One can gather from White's position that fostering motivation should be considered to be an implicit objective of practical work, whereas the "serious purposes", as he states, are the explicit ones. Even though learners may be more interested and want to conduct practical work, because the context has become more relevant, merely engaging in practical work does not necessarily imply furthered cognitive learning (Adey, 1997). Therefore, just because learners find doing practical work 'enjoyable' does not mean that they will be thinking or learning about what they are doing. Rather, the practical class could simply be the opportunity and freedom to do something different in science lessons. Therefore, the purpose suggested for practical work, of enhancing scientific knowledge, seems elusive.

2.3.4 Developing an understanding of the nature of science and of scientific process

Scholars such as Shulman and Tamir (1973), American Association of Physics Teachers (AAPT) (1999), Hofstein and Lunetta (2004) and Woolnough (1994) propose that the primary purpose of practical work is to promote an understanding of the nature of science (NOS) as well as the processes of science. According to McComas, Clough, and Almazroa (1998, p.5) the nature of science describes “what science is, how it works, how scientists operate as a social group and how society itself both directs and reacts to scientific endeavors”. Researchers, for example Shulman and Tamir (1973), Woolnough (1994) and Welzel et al., (2005), state that learners should learn about how scientists develop their scientific thinking. They should also learn about the multiplicity of scientific methods and about the relationship between science and technology. AAPT (1999) emphasizes that learners should understand that science is not only a collection of equations but also a structure of concepts, hypotheses, and observations along with theories indicating their interrelationship. As an outcome of the teaching that they receive, learners should understand not only the content of science but also the nature of scientific knowledge. According to Palmquist and Finley (1997), understanding the processes of science is a part of understanding the nature of science *per se*. Millar (2004), Padila, (1999) and Pillay, (2004) concur that the processes of science include activities such as observing, classifying, recording, inferring, interpreting, translating data and hypothesizing. Skills such as developing statements from collected data and justifying them in the classroom can be considered the equivalent of gaining an understanding of the processes that scientists use in constructing their knowledge of the natural world (Hofstein and Lunetta, 2004).

Despite the suggested value of practical work in promoting learners’ understanding of the nature and processes of science, Windschit, Thompson, and Braaten (2008) claim that the scientific process is typically oversimplified in teaching, while teaching itself may distort the epistemology and goals of science. In particular, teaching of scientific process is no easy task for teachers, especially if they are not able to engage in process skills themselves. In such instances they may over simplify the scientific process when presenting it to their learners. A balancing view comes from Driver (1983) who strongly posits that during practical work learners should undertake their own investigations; that is design their own experiments, record and analyse their data as well as find their own answers. In other words, Driver (1983) recommends that instead of learners following 'cook book' instructions that deal with already known answers, such as determining constants, learners need to work with contextual problems that will support the development of scientific skills, thinking skills and understanding of how scientists work. In this way, practical work caters for learning in different ways such as experiential, independent, team and peer dialogue (Zimbardi, Bugarcic, Colthorpe, Good & Lluka, 2013).

2.3.5 Enhancing social and learning skills

The American Association of Physics Teachers (AAPT) (1999) advocates that practical work should also help learners to develop their social and learning skills. Similarly, White (1996), Beatty and Woolnough, (1982) and Hofstein and Lunetta (2004) state that engagement in practical work should help develop learners' social skills, such as cooperation, team work and their ability to communicate. Welzel et al., (2002) refer to this purpose of practical work as the "social dimension" and confirm that practical activities have the potential to facilitate collaborative social relationships and to provide opportunities for interaction between learners and teacher. A more recent idea in the literature concerns safety.

SCORE (2009) argue that practical work allows students' to acquire skills for safety; that is risk assessment and precaution against hazards in the laboratory (SCORE, 2009).

According to Swain, Monk, and Johnson (2000), teachers in the United Kingdom of have used practical work as a means for teaching mixed achieving classes. With this strategy, Swain et al., (2000) identified three further aims as reasons for teachers doing practical work: "to reward pupils for good behaviour; to allow students to work at their own pace; to add variety to classroom activities" (Swain et al., 2000, p. 288).

In summary, the lack of clarity in the purpose of practical work within science education may influence chosen learning outcomes and so lead to an array of approaches to practical work in schools (Millar, 2004).-The purpose of practical work in the science class remains an unsettled debate. This study attempts to extend the debate by focusing of the practical work as an examination component of the school science curriculum.

2.4. Studies on teachers' views on practical work and challenges pertaining to practical work

Views are "more general mental structures, observation, assessments encompassing beliefs, meanings, concepts, propositions, rules, mental images, preferences and the like" (Brown, 2004, p. 303). They thus represent different categories of ideas that teachers have of how they experience educational phenomena and provide frameworks for understanding, interpreting, and interacting with the teaching/learning environment. Teachers' views of teaching/learning and curricula influence classroom practices and chosen learning outcomes (Calderhead, 1996). In addition, changes in teachers' views of teaching/learning and curricula precede changes in their practice (Brown, 2004). Hence, teachers' views determine their pedagogic approaches and choices of materials, content, and learner activities. Teachers' views about a curriculum change are crucial, as the teachers are the ones who have to implement the change. Fullan and Hargreaves (1991) adds that the success of any educational change depends on what teachers think. It is likely that the changes to a curriculum may not be implemented as expected if, for any reason, teachers show negative views about these changes. Indeed, ignoring teachers' views during an educational reform will hinder the primary purpose of introducing changes (Van Driel et al., 2001). If teachers are to respond meaningfully to the challenges of a new curriculum, they need an incisive understanding and clear views of the proposed changes (Webb et al., 2005). Research by Zipf and Harrison (2003) indicates that teachers' views can act as filters through which new knowledge and experiences are screened for meaning. Therefore in this study I am interrogating Grade 10 Life Sciences teachers' views on the implementation of the compulsory practical examination.

In this section I review literature pertaining to the South African context, because this study is located in South Africa. The existing studies on teachers' views on practical work will contextualize this study and will be drawn upon later during the data analysis. Thus "teachers" in this review refers to South African teachers.

According to Kibirige & Teffo, (2014) teachers' views towards practical work are poor and they engage in practical work to merely satisfy the minimum curriculum requirements. The reason for teachers' poor views and attitudes to practical work is suggested in Ownu & Stoffels (2005 p. 79) study where, using mixed methods research with 53 practicing teachers in Venda, Limpopo they established that most of the teachers had "little experience, meagre training, and operated in large and poorly resourced science classrooms".

There are numerous factors that can explicitly contribute to the poor views and attitudes of teachers towards practical work. Teachers in some South African schools are not confident in teaching science using practical work (Kibirige & Tsamago, 2013). According to Bradley and Smith (1994) teachers' poor views and attitude towards practical work is perpetuated by an education system that did not groom them to do experiments or practical work. They maintain that the lecturers in pre-service training lacked appropriate knowledge and experience in conducting practical work. Consequently teachers resort to chalk-and-talk, lecturing and demonstrations when teaching Sciences. The implications are that pre-service and in-service teacher training institutions should inculcate practical skills, confidence and positive views and attitudes towards practical work when training future science teachers.

Haigh (2003) identifies three pertinent reasons for teachers' non engagement in practical work, first the availability of equipment as a significant issue for teachers, second there is not enough teaching time and the third is that the classes have too many learners. Another important reason for teachers' poor views and attitude towards practical work and their non-engagement in practical work, according to Ramnarain (2011); Hatting & Rogan (2007) and Mokotedi (2013), is that some teachers are teaching out of field. or instance a teacher who may have trained in Geography, but, because of teacher shortage and the school post provisioning norm (PPN)[2], may be required to teach in the sciences. Such non-specialist teachers are known to be reluctant to do practical work and this is in agreement with findings by SCORE (2009); and Abrahams & Millar (2008).

In addition it was found that many schools lack both appropriate equipment and laboratory technicians to support teachers (Onwu & Stoffels, 2005; Pillay, 2004). When teachers have to double up as technicians there is chance that they miss teaching the relevant content at the desired depth and or providing the required guidance to learners

[2] PPN: is a value that determines the number of teachers a school is entitled to depending on the 10 day enrolment of learner

during practical work, as much time is spent on setting up for the practical Laboratory technicians manage laboratories, equipment, stock, set up equipment and they ensure its proper and safe use. More importantly, technicians support teachers, which is particularly important for those teachers who may not be adept with the practical work. With training and experience, technicians become repositories of practical skills. Thus, less experienced teachers can effectively benefit from such technicians. Whilst the study by Onwu & Stoffels (2005) illuminates teachers' lack of essential physical (i.e. equipment) and human resources needed to engage in practical work, it also points to teachers' dependence on a "laboratory setting" for conducting practical work and brings to the fore their lack of ability to be innovative and use local resources in the environment to engage in practical work (Lubben et. al., 2010). Furthermore, with regard to the lack of science equipment, a study conducted by Muwanga-Zake (2008) showed that in many schools the headmasters kept science equipment for display in their offices. Consequently it is never used in the science classrooms. The study highlights and confirms that many principals lack understanding of the purpose of practical work and its role in the science curriculum. Muwanga-Zake (2008) also draws our attention to schools that have laboratories but where the teachers lack the skills and confidence to engage in practical work. Hence these teachers who use practical work normally depend on textbooks and conduct experiments in a cookbook recipe format. As noted in work earlier by Driver (1983), such teaching strategies do not inculcate an understanding of the scientific process and, furthermore, they often fail to inculcate conceptual understanding in learners (Muwanga-Zake, 2008).

One of the major compulsory requirements for Life Sciences is that learners should do two practicals in per term, for the purpose of formal assessment, in addition to the end of the year practical examination (CAPS, 2012). This study will contribute to the literature by illuminating teachers' views of the execution of the practical examination in a South African context.

2.5. CAPS requirements for practical work

The CAPS Life Sciences policy (DoE, 2011, p. 11) stipulates in the assessment guideline the skills learners have to acquire while undertaking practical investigations. These skills are as follows:

- Follow instructions,
- Handle equipment or apparatus,
- Make observations,
- Measurement,
- Record information or data,
- Data Interpretation and
- Design of investigation or experiment

The skills stipulated above are a mix of both basic and integrated science process skills. Pupils are expected to develop these skills by engaging in “hands on”, “minds on” and “hearts on” activities during the Life Sciences lessons. According to Kapenda, Kandjeo-Marenga, Kadandra & Lubben (2002) there are five types of practical work that can be used in the teaching of sciences. These include:

- Exercises to develop specific skills,
- Investigations including hypothesis testing or problem solving,
- Experiments to introduce students to particular phenomena,
- Demonstrations to allow the teacher to develop a scientific argument or create a dramatic impression and
- Fieldwork

The different types of practical work identified above achieve different purposes. This means that, in order to develop the skills specified in the CAPS document, teachers have to make judicious selection of the type practical work; in particular teachers need to choose an appropriate sequence to practical activities. To be able to do this, teachers should have tacit knowledge of how to do practical work by themselves. According to LaFemina, (2002) tacit knowledge is hard to verbalize because it is the implicit knowledge used by people to do their work and to make sense of their worlds. The tacit skills involved in practical work therefore cannot be transferred to learners through chalk-and-talk method, but by hands-on activities. So, each type of practical work will target the development of a selection of the required skills, but not all of them at once. Hence learners have to experience different types of practical work. Therefore it is imperative for teachers to match the type of practical work to the proposed purpose and outcomes that the CAPS document has prescribed for Life Sciences learners. Simply put, this means that practical work intended to develop one objective cannot be intended to improve performance or develop other areas of cognition.

2.6. Critique of the CAPS policy by SAARSTE

The principal concern raised by the South African Association of Research in Science and Technology Education (SAARSTE), (2009) relates to disparity in requirements between Physical and Life Sciences. To elaborate, the number of formal (theoretical and practical) assessments in Life Sciences has increased from seven to 16, in addition to the compulsory practical examination. Furthermore the form of the examination is of concern. There is little clarity as to whether it should be a "pen and paper" practical examination, such as Cambridge Practical examinations, or a "hands-on" and "minds-on" practical" examination, such as in the IEB examinations. According to SAARSTE, more details need to be provided in respect of the practical examination, in terms of skills to be tested and weighting of marks. They advocate that, with our South African, context of under-resourced schools/ laboratories and large classes, a practical examination which includes "hands-on" and "minds-on" assessment of each learner at the end of the year is not manageable in most schools. The critiques by SAARSTE of the CAPS LS policy brings to the fore the contextual challenges that plague schools in South Africa in terms of resources and it draws our attention to the overly ambitious nature of a top down curriculum reform approach,

2.7. Challenges that teachers encounter during curriculum reform

In South Africa, during curriculum reform, teachers are subjected to the 'once-off, just-in-time' cascade model of teacher professional development (TPD) conducted by subject advisors (Bantwini, 2009; Singh-Pillay & Alant, 2015). It appears that authorities assumed that, armed with this professional development orientation, teachers can then simply change the way they teach. As already stated, the 'once-off, just-in-time' approach to teacher professional development generally treated teachers as homogenous: The cascade model of TPD ignores the different experiences, life histories, professional and personal biographies, training, contexts and learning needs of teachers, their learners as well as the multiple possibilities for engaging learners in divergent learning context. A ‘one-size-fits-all’ approach of teacher professional development restricts teachers to a culture of ‘robotic script following’ that oftentimes suits neither their needs nor the needs of their learners.

Rather than creating an engaging platform where teachers could deepen their knowledge, practice and learning, the current cascade model of teacher professional development negated the variations of how teachers teach, as well as how they and their learners learn. Such policy orientation approaches to curriculum reform should be understood in historical context. The vast majority of teachers were trained to be simply technicians of the former apartheid era, and so would need major professional re-direction to enact the idealism of the LS practical examinations envisaged by the LS CAPS policy. Teachers’ professional identity defines who they are to themselves, and to others: it is a quintessential part of a teacher’s capacity and includes qualities such as personal commitment and willingness to become empowered (Lasky, 2005). A teacher’s professional identity is, however, not cast in stone: it can be re- sculptured in a nurturing and enabling environment. So the agency that a teacher displays arises from both his/her biographies and the surrounding environment. This means that agency is mediated and it can be initiated.

The introduction of a new curriculum heralds new responsibilities for teachers which impacts their workload as shown in studies conducted by Jansen and Christie (1999), Chisholm et al., (2005) and Singh-Pillay (2010). According to Singh-Pillay (2010) whenever a new curriculum is introduced, teachers are de-skilled and re-skilled. Re-skilling contributes to anxiety about teachers’ inability to implement the curriculum properly. Teachers question their “old” classroom practice and compare it to what is expected of them in the new curriculum. This creates a feeling of uncertainty and unease among teachers concerning their knowledge and the classroom routine they have developed over a number of years. Teacher motivation is very low due to teacher overload, confusion and stress (Task team report, 2009). To engage in the implementation of a new curriculum teachers need to be involved in many activities, such as teaching, planning new lessons, studying the curriculum documents, assessing learners' work, administration pertaining to the new curriculum and school requirements, counselling learners, extra-curricular work, and meetings (Singh-Pillay, 2010).

Whilst the above mentioned challenges encountered by teachers are certainly real, they are exacerbated by a passive dependency shown by some teachers; a culture that "Pretoria must provide" (Samuel, 2014). As a consequence such teachers may do little to improve their subject content knowledge (Kriek et al 2005, Taylor, 2008) or knowledge of how to handle and set up the equipment needed for practical work (Rollnick, 1997).

The challenges teachers encounter during curriculum reform influences their enactment of the curriculum ideas. Therefore the kind and type of professional development offered to teachers should allow for their agency to develop in order to re-shape their professional identities, take ownership of their professional development and change their teaching practice.

2.8. Conclusion

This chapter presents a review of related literature to establish a theoretical basis for addressing the research questions posed in this study. With the implementation of the LS CAPS policy, practical work is a core component of the national secondary school Life Sciences curriculum. The literature reviewed focused on the scholars' conceptions of practical work, the purpose of practical work, teachers' views and challenges pertaining to practical work, CAPS requirements for practical work, critique of the CAPS policy by SAARSTE and challenges teachers encounter during curriculum reform. The literature surveyed highlights the judicious role that teachers play with respect to the selection of practical work to develop the skills specified in the CAPS document, as well as their perceived inadequacy in this regard. The next chapter presents the Rogan and Grayson's (2003) theory of curriculum implementation which underpins this study.

CHAPTER THREE

Theoretical framework

3.1. Introduction

As mentioned earlier in Chapters 1 and 2, the purpose of this study is to explore grade 10 Life Sciences (LS) teachers' views on practical work and the practical examination, how they implement practical work in terms of the CAPS requirement and their experiences of the capacity to innovate for the implementation of practical examination. Implementing the compulsory practical examination in Life Sciences is a comparatively new demand being placed on LS teachers. Rogan and Grayson's (2003) theory of curriculum implementation is underpinned by theories situated in the change literature (e.g. Fullan and Hargreaves 1991; Hargreaves & Hopkins, 1991; Spady, 1994; Verspoor, 1989). It is ideal to ground this study because the teachers' views on implementation of practical work and the practical examination, and their experiences in terms of support and innovation for these, are being explored within the context of the recent CAPS LS policy. Significantly, the Rogan and Grayson framework of curriculum implementation was developed with the characteristics of a developing country in mind (and South African is a developing country). This framework was used to design the research instrument and guide the analysis.

3.2. Rogan and Grayson (2003) Theory of curriculum implementation

Rogan and Grayson (2003) recognize the relationship triad between curriculum implementation, teachers' capacity to innovate during reform, and the professional development or support teachers receive for curriculum implementation within the school and beyond. In a subtle way Rogan and Grayson (2003) allude to curriculum reform hinging on teachers; their ability to innovate and the professional development or support they receive for curriculum implementation. Therefore the framework has at its heart three constructs; namely a Profile of Implementation, Capacity to Innovate and Outside Support. The three constructs together contribute to the ideal ecosystem for curriculum implementation. The constructs of Rogan and Grayson's framework can be used to help understand, analyse and express the extent to which the ideals of a curriculum, with respect to implementation of the practical examination, are being realized in a particular context. Furthermore, in the South African context, the terrain for curriculum implementation is uneven. In other words, LS teachers have heterogeneous professional and personal biographies, and there is marked diversity in their capacity to innovate so as to meet the curricula requirements (Rogan and Grayson, 2003). The three constructs of the Rogan and Grayson framework are not isolated, but are instead intrinsically interlinked and interwoven with each one informing the other two. So deficits in one aspect will, inevitably, affect the other two.

In the Rogan and Grayson framework, each of the three constructs comprises four levels. The initial two levels encompass the period of becoming aware of and preparing to implement the new curriculum, with the third levels covering mechanical and routine use levels. The highest levels are when the teacher begins to take ownership of the curriculum and may enrich it by making major modifications, representative of sophisticated learner-centred practices. In moving through the levels, there is an increasing growth towards learner-centred approaches and away from teacher-centred ones. However, unlike earlier developmental models, the Rogan and Grayson profile does not imply 'progressing' from one level to another, and is therefore not linear. Rather, the higher levels are inclusive of the lower practices. Hence the levels are not prescriptive of what should be done at any given point in time, but rather suggest the mastery and use of an ever-increasing repertoire of teaching and learning practices. This implies that a teacher may, for example depending on a particular situation, jump from level 2 practices to level 4 practices and back to level 3. It is important to note that level 4 practices are not superior to a level 1 practice; it depends on circumstances. Thus, for instance teacher-directed demonstrations may be appropriate for large classes. Accordingly, all practices have merit in science education, and may be used to achieve the outcomes of CAPS for the practical examination.

The three constructs of the framework (Profile of Implementation, Capacity to Innovate and outside Influences) are shown below in Figure 1, and described below. As explained earlier, they are interrelated, so the sequence of description should not suggest a sequence of events.

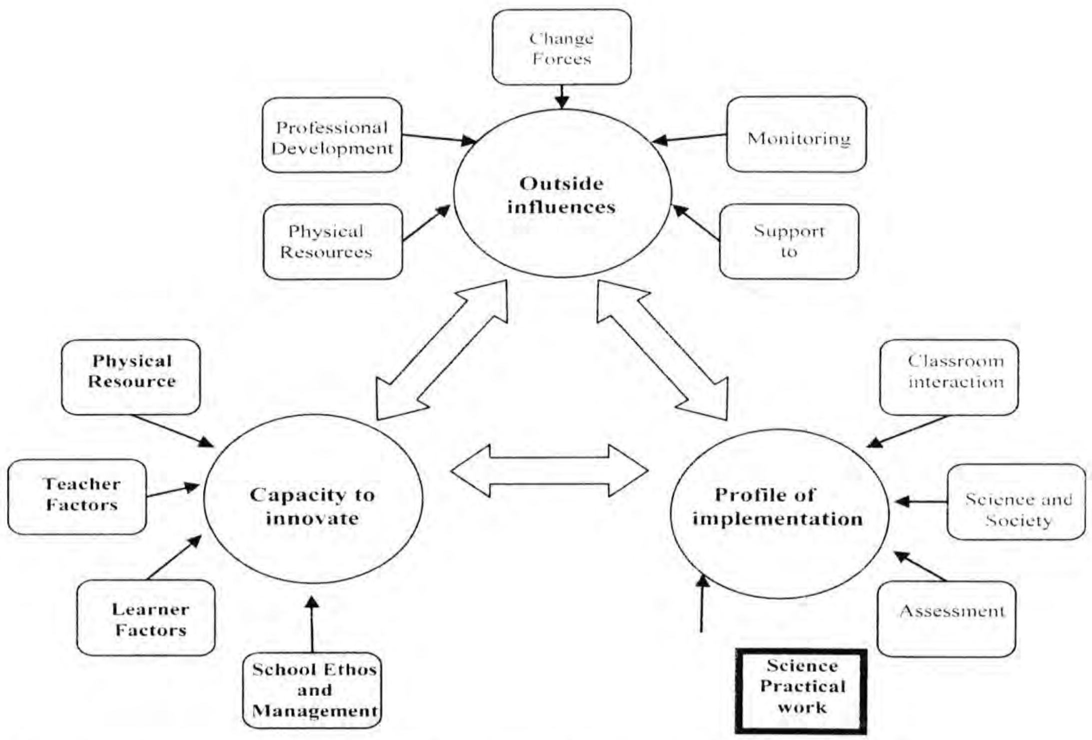


Figure 1: Framework of Curriculum Implementation
(Rogan & Grayson, 2003). Parts of the framework analysed in this study are shown in bold.

The construct Profile of Implementation is an attempt to understand and express the extent to which the ideals of a set of curriculum proposals are being put into practice. According to Rogan and Grayson (2003) the Profile of Implementation is viewed as a 'map' of the learning area and so it offers a number of possible routes that can be taken to a number of destinations. It includes four sub-constructs, namely, the nature of classroom interaction (what teachers and learners do in relation to one another); use and nature of science practical work; incorporation of science in society; and assessment practices. This study focuses only on the implementation of the practical examination in Life Sciences and so it is concerned with only the practical work sub-construct. Examples of what might constitute each of the four levels of science practical work in the Profile of Implementation are shown below in Table 1.

Table 1: Profile of implementation for science practical work

Level	Types of science practical work
1	• Teachers use a classroom demonstration to help develop concepts. • Teacher uses specimens found in local environment to illustrate concepts
2	• Teacher uses demonstrations to promote some form of learner inquiry. • Some learners assist in planning and performing the demonstration. • Learners participate in closed (cook-book style) practical work. • Learners communicate data using graphs and tables.
3	• Teachers design practical work in such a way as to encourage learner discovery of information. • Learners perform guided discovery type practical work in small groups, engaging in hands on activities. • Learners can write a scientific report in which they can justify their conclusions based on the data collected.
4	• Learners design and do their own open-ended investigations. • Learners reflect on the quality of the design and data collected and make improvements when and where necessary. • Learners can interpret data in support of competing theories or explanations.

As can be seen, the Profile of Implementation is not an ‘all or nothing’ approach but that implementation is considered to occur in different steps, stages or degrees. With such a profile, implementation of the practical examination becomes a long term process and not a ‘quick fix’, ‘once off process’. The Profile recognizes that there will be as many ways of putting a curriculum into action as there are teachers teaching it. The Profile of Implementation is thus about how the new curriculum (in this case the practical examination) is being put into practice. As such it can help a Curriculum Planner at school level to determine where the school is in implementing a new curriculum. The Curriculum Planners can take into account the context and capacity of their schools and eventually find a suitable route to follow in trying to implement CAPS. The Profile of Implementation will be considered in its relationship to the four Capacity to Innovate factors. These are described next.

According to Rogan and Grayson (2003) the construct Capacity to Support Innovation is an attempt to understand and elaborate on the factors that are able to support, or hinder the implementation of new ideas and practices in a system such as a school.

There are four possible indicators for the construct Capacity to Support Innovation. These are physical resources, teacher resources, learner factors, and the school ethos and management. In South Africa physical resources are certainly a major factor that influences capacity, as many schools do not have the necessary infrastructure or basic essentials like running water and electricity. Poor resources and conditions can limit the performance of even the best teachers and undermine learners' efforts to focus on learning. Many schools have a lack of basic science equipment (Muwange-Zaka, 2008; Rollnick, 1997). A second factor pertains to the teachers' own background, training and level of confidence, and their commitment to teaching (Singh-Pillay & Samuel, 2015). In South Africa teacher factors are very diverse and many teachers lack the necessary motivation (Taylor, 2008), to be innovative in their teaching practice (Horak & Fricke, 2004), content knowledge (Gouws & Dicker, 2007) and knowledge and skills pertaining to practical work (Pillay, 2004). In addition to these basic factors, there are those that relate more directly to the extent to which teachers will embrace innovation. Johnstone & Al-Shuaili, (2001) point out that new practices are only able to survive if there is a fit with the environment. Change is essentially a learning process, which entails a willingness to try out new ideas and practices, to improvise, to be exposed to uncertainty, and to collaborate with and support others. Such awareness on the part of teachers that, being isolated from their colleagues is a problem as they will lack support and not be part of a community of practice, is one of the starting points in the Bell and Gilbert (1996) model of teacher development. The third factor relates to the background of the learners and the strengths and constraints that they might bring to the learning situation. Learners might, for example, come from a home environment where there is no place for them to do homework, no one to support and help them in their studies, child-headed families, poverty and HIV/AIDS. Family and culture related commitments might mean an absence from school for significant periods of time. Another major challenge in South Africa is that the language of instruction is mainly English, which is not the home language of many learners. A fourth factor, or set of factors, pertains to the general ethos and management of the school. If the school is in disarray and dysfunctional it is obvious that no innovation can or will be implemented. Research has shown that the leadership role of the school principal is crucial when it comes to implementation (Berman and McLaughlin 1977; Hall and Hord 1987; Fullan and Hargreaves, 1991). A shared vision as to how the innovation will play out depends largely on this leadership. As the innovation begins to become a reality, so the role of the principal takes on new dimensions. Change has to be realistically planned and subsequently monitored. Those charged with the implementation of change need to be supported in a variety of ways, and need to be enabled to communicate and collaborate with one another. These four factors together paint a picture of the capacity of a school to innovate.

Rogan and Grayson (2003) define outside agencies as organizations, including the Department of Education, that interact with a school in order to implement some kind of change. This definition will be applied in this study. Support bases in the education system in South Africa include the National Department of Education, which is responsible for policy decision making, and the Provincial Departments of Education, which are responsible for policy implementation and monitoring of schools. Outside influences could also be donors, teacher unions and NGO's. The outside influence can bring about changes which might help in the implementation of the curriculum, such as donating equipment, which could rescue those schools without equipment. These outside influences might even put pressure on schools to bring about change, for example pressure from teacher labour unions.

Rogan and Grayson (2003) identify two forms of support, namely, material and non-material. Material support may be further divided into two categories, the provision of physical resources such as building, books or apparatus or alternatively, direct support to learners. This latter support can include field trips including practical work. Non-material support can include overt professional development. The time offered for support is also important.

The two constructs that are used in this study, Profile of Implementation, and Capacity to Support Innovation from Rogan and Grayson's (2003) framework, will be used as tools to gauge the level at which the practical examination has been implemented in the chosen schools. I will specifically focus on the level at which the teacher is operating for each dimension of each construct. Examples of behavior at each level for each aspect of the two constructs are presented below in Tables 2 and 3 respectively. As mentioned previously, each construct in the original framework has four dimensions. Because the teacher is the driver of curriculum reform and the desired change hinges on teachers, I have included a fifth dimension for the Profile of Implementation construct, so as to take the affective aspect into account, with teachers' feelings of personal well-being.

Table 2: Profile of implementation:

level	Classroom practice	Science practical work	Science and society	Assessment	Personal well being
1	Teacher: • presents content in a well organized way • has a lesson plan • uses textbook effectively • engages learners with questions	Teacher: • uses demonstrations to develop concepts • uses specimens found in local environment for illustration	Teacher • uses example and applications from everyday life	Teacher: • uses written tests • mostly recall type questions • some questions are higher order thinking • tests marked and returned promptly	Teacher experiences feelings of : • Pressurized • Confused • Challenged • Frustrated
	Learners: • stays attentive and engaged • respond to and ask questions	**Learners** • observe • ask and answer questions	**Learners** • stay attentive and engaged • ask and answer questions	**Learners** • mostly apply rote learning • sometimes apply higher order thinking	
2	**Teacher:** • Uses textbook in conjunction with other resources • Engages learners with questions to encourage deep thinking	**Teacher:** • Uses demonstrations to promote a limited form of inquiry	**Teacher:** • Uses specific problems /issues faced by local community	**Teacher:** • Uses written test with 50% of questions requiring higher order thinking • Some of the questions are based on practical work	**Teacher feels:** • Reasonably confident • Good self esteem • Capable

	Learners: • Use additional resources to compile own notes • Engage in meaningful group work	**Learners:** • Assist in the planning and performing of demonstrations • participate in cook book practical work • communicate data using graphs/tables. Ask and answer questions	**Learners:** • Teachers assist the learner to explore the explanations of scientific phenomena by different cultures	**Learners** • Apply practical knowledge • Apply higher order thinking	
3	**Teacher:** • probes learners' prior knowledge • structures learning activities on relevant knowledge and problem solving techniques • introduces learners to the evolving nature of scientific knowledge	**Teacher:** • Designs practical work to encourage learner s' discovery of information	**Teacher:** • Facilitates investigations	**Teacher:** • Uses written tests • Tests include seen and unseen guided discovery type activities • Uses other forms of assessment as well as tests	**Teacher:** • Confident • Finding footing • Motivated organized
	Learners: • Engage in minds on activities • Make own notes on the concepts learned, from doing activities	**Learner:** • Perform guided discovery type practical work in small groups • Write a scientific report • Can justify a conclusion in terms of data collected	**Learners:** • Actively investigate science application in own environment	**Learners:** • Apply practical knowledge • Apply higher order thinking	
4	**Teacher:** • Facilitates learners as they design and undertake long-term investigation	**Teacher:** • Facilitates learners with design and data collection strategies • Facilitates learners on data	**Teacher:** • Facilitates learners with the community project and identifying the needs	**Teacher:** • Creates opportunity for different types of assessme	**Teacher feels:** • Empowered • Self-directed • Respected

	s/project • Assist learners to weigh theories that attempt to explain the same phenomena	interpretation and conclusions		nt • Facilitates in compilation of portfolio	
	Learner: • Takes major responsibility for own learning	**Learners:** • Design and do own open investigations • Reflect on designing and collected data • Interpret data	**Learners:** • Undertake long term community based investigation • Apply science to specific needs in community	**Learner:** • Includes open investigation of community project in assessment • Create portfolio to present best work	

Source: Adapted from Rogan and Grayson (2003)

Table 3: Profile of the Capacity to Support Innovation

Level	Physical resources	Teacher factors	Learner factors	School ecology and management
1	• Basic building – but in poor condition • Toilets and running water available • Electricity in some rooms • Some textbooks but not enough for all • Some basic science apparatus • No science laboratory or laboratory is present but it is not in working condition	• Teacher is underqualified for the position • Teacher does have a professional qualification • Teacher absenteeism is low • Teacher spends more than half the time teaching	• Learners have some proficiency in language of instruction • Some learners do not receive enough food at home • School has feeding scheme • Learners have socio-economic problems • Learners receive very little academic support at	Management: • A timetable , class list and other routines are evident • The presence of the principal is felt in the school at least half the time • Staff and subject meetings are held at times • Attendance register for teachers exist Ecology: • Teaching and learning occurs most of the time • Teachers and learners return on

			home	time after the break • School governing body exists • School is secure
2	• Adequate basic building- good condition • Suitable furniture • Electricity in most rooms • Textbooks for all learners • Reasonable amount of apparatus for science	• Teacher has minimum qualification for position • Teacher is motivated and diligent • Teacher participates in professional development activities • Teacher has good rapport with learners	• Learners attend school regularly • Learners are well nourished • Learners are given activities • Teacher has good relationship with learners based on respect	Management: • Teacher attends school regularly • Principal is present in school most of the time and there is regular contact with staff • Timetable properly implemented • Extramural activities are organized in such a way they do not interfere with scheduled lessons • Teachers and learners who shirk their duties are held accountable Ecology: • Responsibility for making the school functional is shared by teachers , management and learners • SGB operates well • School functions all the time
3	• Good building- enough classrooms and science laboratories • Running water and electricity in all rooms • Textbook for all learners and teachers • Sufficient science	• Teacher is qualified for position- has sound understanding of subject • Teacher is an active participant in professional development activities • Conscientious attendance of class by teacher	• Learners have access to a safe place to study • Learners come from supportive home environments • Learners can afford extra books and tuition	Management: • Principal takes strong leadership role, is visible during school hours • Teachers and learner play an active role in school management Ecology: • Everyone in the school is committed to

	apparatus • Additional subject reference books for teachers • Reasonably equipped library • Secure premises • Well kept grounds	• Teacher makes extra effort to improve teaching	• Parents show an interest in their child's progress • Learners have access to IT	making it work • Parents play an active role in the SGB
4	• Excellent buildings • More than one well equipped lab • Library is well resourced • Adequate curriculum materials and other textbooks readily available. • Good teaching and learning resources • Well maintained grounds • Good copying facilities	• Teacher is over qualified for post, has excellent knowledge of content • Teacher is very committed to teaching • Teacher shows willingness to change, improvise and collaborate • Teacher shows local and international leadership in professional development activities	• Learners take responsibility for their learning • Learners are willing to try new kinds of learning	Ecology: • There is shared vision • School plans for, supports and monitors change • Collaboration of all stakeholders Management: • There is a visionary but participatory leadership at school

Source: Adapted from Rogan and Grayson (2003)

As can be seen in the preceding tables, the early levels encompass the period of becoming aware of and preparing to implement the planned programme, followed by mechanical and routine use levels. The final levels are when the teacher begins to take ownership of the curriculum and the professional development intervention programme, and may enrich it by making major modifications. Rogan and Aldous (2003) argue that each level includes a mix of "low and high level activities" but a teachers moves to a higher level as new practices are integrated in his/her teaching, thereby moving from teacher centred practices to incorporate more leaner centred practices. Once the current level of the teacher is determined, a plan of action can be tailored by the school management /PLC of how the teacher can be supported to reach the next required level.

In drawing up this plan, the context of the school should be considered. The gap between the level where the teacher currently is and the higher level that the teacher strives to be at, or has the potential to reach, is called the Zone of Proximal Development (ZPD) (Vygotsky, 1978). Vygotsky suggests that learning only takes place when instruction proceeds just ahead of the learner's current level of development. Rogan (2007) refers to this gap as the Zone of feasible innovation (ZFI) in analogy to Vygotsky's ZPD. Rogan (2007) contends that during implementation, support strategies will be effective, only if they proceed within the ZFI, that is just head of the level on which the teacher is currently working.

3.3. Conclusion

In this chapter, I presented the theoretical framework; that is the Rogan and Grayson (2003) theory of curriculum implementation, with some modification, that guides this study and I justified the choice of two constructs within this framework. The next chapter focuses on the research design.

CHAPTER FOUR

Methodology

4.1. Introduction

This chapter reveals the research methodology of the study. The research methodology is a series of steps or stages needed to fulfil the requirements of the study, in terms of data generation so as to produce answers to the research questions posed (Cohen, Manion & Morrison, 2011). According to Creswell (2013) the research design and methodology include all activities and planning of the study. This chapter outlines the procedures undertaken in carrying out this qualitative study, which sought to explore grade 10 LS teachers' views on practical work and the practical examination, how they implement practical work in terms of the CAPS requirement, and their experiences in terms of capacity to innovate for their implementation of the practical examination. Also discussed in the chapter, are the reasons for adopting a qualitative case study approach for this study. In addition, the research site and the data generation method employed in the study are revealed. An account is provided of how various gatekeepers at each stage of the research were approached and overcome, in order to gain access. The instruments and the sampling procedure used in the study are also explicated. This is followed by the description of data generation procedure and the method of data analysis. The chapter ends with a discussion of the validity and reliability of the instruments.

4.2. Research design

According to Cohen et al., (2011) the nature of the research question determines the type of research design, as well as the methodology and techniques to be used in a study. A research design is the schematic layout or plan that is used in conducting research in order to generate data that will provide answers to the critical research questions set for the study (Leedy & Ormrod, 2005). The research design spells out the procedure to be undertaken including when, how, from whom and under what conditions the data will be collected. For the purpose of this study, a qualitative research approach was considered to be suitable. Qualitative research is the type of research that emphasizes gathering data in form of words rather than numbers, in order to explore a deeper understanding of the phenomena (McMillan & Schumacher, 2006). According to Creswell (2013), the strength of a qualitative approach is that it can provide understanding and description of people's personal experience and exploration of the phenomenon's context. Therefore in qualitative research, the ability to control variables is usually not present; instead, it involves the collection of a large amount of data from a small number of participants (Veal, 2005). According to Cohen et al., (2013), qualitative research the type of inquiry that uses different techniques in data collection with the purpose of carrying out a realistic analysis of the situation, based on the notion that reality is socially constructed. With regard to the preceding point Denzin and Lincoln (2011) posit that qualitative research is one that situates the researcher within a world or group of interpretive activities that makes the world observable to the researcher. In other words, the researcher is intimately involved in the process, the data generated conveys the views, actions, and motives of individuals, including the researcher, and the environment in which they find themselves (Myers, 2009). This method is most preferred for this study because qualitative inquiry provides an understanding and description of an individual's experiences of a phenomenon (Cohen et al., 2011). In this case grade 10 LS teachers' views and experiences pertaining to the practical examination they had to implement.

4.3. Research paradigm

This study is located within the interpretivist paradigm. According to Cohen, et al., (2011) this paradigm aims to understand, describe and interpret in detail the lived experiences of participants in a study. Within this paradigm the grade 10 Life Sciences teacher is seen as a social being situated within a particular social background. The social background within which the grade 10 LS teacher works is influenced by contextual factors. These factors such as resources, support and types of training are considered when examining teacher views on the implementation of the practical examination, and their experiences in terms of capacity to innovate for the implementation of the practical examination. Hence, the study draws from the assumptions of the interpretivist paradigm. This paradigm will enable me to gain insight from grade 10 Life Sciences teachers about their views on the implementation of the practical examination, and their experiences in terms of capacity to innovate.

4.4. Case study

The ontological position of an interpretative paradigm directs this study to adopt a qualitative case study approach in order to explore grade 10 Life Sciences teachers' views of practical work and the practical examination, the implementation of practical work, and their experiences in terms of capacity to innovation for the implementation of the practical examination. The key characteristics of a case study is that it aims to explore in order to understand things in detail (Creswell, 2013), within its real-life context (Yin, 1989). According to Cohen et al., (2013) the case study approach allows participants to freely share their ideas, views, perceptions and experiences in their natural settings, making it possible for the participants to provide in-depth information or data. In effect, this means that a case study method is most appropriate and useful when a researcher is seeking an in-depth understanding of a specific event, process, phenomenon, group/groups of people in a particular place. In case study research methodology, the context (real-life context) is of great significance as it gives the researcher the opportunity to interact with the participants in their natural setting, thereby leading to in-depth understanding and interpretation of the phenomenon under investigation.

The hallmark of the case study approach, according to Lapan et al., (2012, p. 245) and Cohen et al., (2013), is that case study methodology provides thick descriptions of participants' lived experiences of, or thoughts about and feelings for, a situation using multiple data sources. These authors further contend that the strengths of the case study approach lie in its being concerned with rich and explicit descriptions of events relevant to the case; its focus on individual actors or groups of actors, seeking deep understanding of their views; and that the researcher is involved in the case because the case study may be linked to the researcher on a personal or professional level. For example, I am declaring upfront that I am a practicing LS teacher, at a well-resourced private school, who, like the participants, also had to implement the practical examination with my grade 10 (in 2012) and grade 11 (2013).

Drawing from the foregoing insights, it can thus be argued that a case study research approach allows for in-depth, thick, rich descriptions that will generate words, vivid descriptions and insightful personal comments, which will facilitate understanding of the phenomenon under investigation within a particular context. The phenomenon under investigation for this research is grade 10 LS teachers' views on the practical examination and practical work and their experiences in terms of capacity to innovate for implementation of the practical examination.

According to Creswell (2013) and Cohen et al., (2013) there are three different categories or types of case study approach from which a researcher can choose. The appropriate category would be determined by the size of the case, that is, whether the case involves one individual, many individuals, or a group of individuals; or whether it involves a process; an institution or an activity. The three different categories of case studies are namely, intrinsic, instrumental and collective case studies.

Intrinsic case studies are undertaken in order to understand the particular case at hand. The focus is on the case being studied, answering questions about that entity or object and to convey the illuminated operations to its participants and stakeholders (Cohen et al., 2013). The purpose is not to understand some abstract generic phenomenon, but rather to develop a detailed understanding of the case at hand. In other words intrinsic case study focuses on developing a deep insight of a particular case.

Instrumental case studies examines a particular case or instance so as to build new theories or to compare previous findings to new ones, for corroboration or to question their validity (Lapan et al., 2012,).

A collective case study involves studying a number of cases (multiple case studies) jointly, in order to investigate a phenomenon (Creswell, 2013). This method is believed to offer better understanding of the phenomenon/case.

In another classification of case study research approaches, Yin (1994), cited in Cohen et al., (2013 p 291), categorizes case studies with regards to their outcomes. These include exploratory, descriptive and explanatory case studies. An exploratory case study serves as a suitable means of eliciting information in order to seek new insights and clarify ones understanding of process or a problem. The exploratory approach provides new and detailed information or insight about a phenomenon such as a problem or a process, through the research findings, which could inform policy or serve as the background for further research. Descriptive case studies focus on providing narrative accounts, while an explanatory case study would deal with hypothesis testing.

Bearing Yin's classification in mind, this study embraces an exploratory case study approach. The choice of exploratory case study method is based on the purpose or intent of the study, which is to explore grade10 LS teachers' views on practical work and the practical examination, how they implement practical work in terms of the CAPS requirement and their experiences in terms of capacity to innovate for the implementation of the practical examination. This approach suggests the methods of generating data for this research.

4.5. Data source

Our data source is grade 10 Life Sciences teachers who implemented the practical examination at their schools.

4.6. Sample and sampling method

For the purpose of this study, the selection of participants was based on purposive and convenience sampling. According to Cohen et al., (2013), purposive sampling serves the aim of providing the researcher with those people who are likely to possess the necessary information for the study. To generate the rich data needed to answer the research questions in this study, only grade 10 LS teacher who taught the CAPS policy and implemented the practical examination were selected for inclusion in the sample.

Convenience sampling was used to select the location of this study, namely, the Estcourt circuit of UThukela District as the researcher lives and works in this area, and it was economically viable for traveling to capture data. Cohen et al., (2011) state that convenience sampling can lead to researcher bias because the sample may not be considered representative of the entire population, hence the research findings may not be generalisable beyond the study sample. Nevertheless, in order to minimize potential bias an attempt was made to cover schools of different quintile rankings[3] in the chosen sample to represent the schooling contexts found in South Africa in terms of funding and resources.

[3] Quintile ranking: determines the funding and resources that a school has. The quintile range is from 1 – 4. Quintile rank 4 = poor resources, no paying of school fees

4.7. Location of the study

This study is located in the Umtshezi ward of Estcourt region. There are thirty five schools which offer Life Sciences in the ward. The schools in this region are a mix of ex-House of Delegates schools, ex-model C schools and township schools. The Quintile ranking ranges from 1 to 4. Quintile 1 consists of ex-Model C schools, which have all the required resources and are based in town or cities. There is one such school in the chosen region. Quintile 2 schools are schools that have some resources and are based in townships, Quintile 3 schools are based in semi-rural areas. These are previously disadvantaged schools that have minimal resources but they are not too far from towns. Quintile 4 schools are situated in deep rural areas; they are poorly resourced and the access to the school presents a challenge in bad weather conditions. Learners travel long distances, often having to walk more than 3 km each way to and from school. The standard of living in the area is low, with the majority of the people are not employed.

4. 8. Ethical considerations

Ethics is centred on moral justification for doing the right or wrong thing, when there is interaction with humans, animals or the environment and must be given due considerations at different stages in the research process (Miller & Brewer, 2003). While dealing with participants in a study, the following responsibilities were assumed: the rights of participants taking part in the research, circumventing harm to participants, avoiding undue intrusion, obtaining informed consent, rights to confidentiality and concealment and the rights of participants during data dissemination (Laws, Harper, & Marcus, 2003).

In this study sensitive information was gathered from Life Sciences teachers concerning their preparedness, ability to innovate, the school ecology and the nature of the support they received for the implementation of the practical examination. As a result there was a need to ensure that identities of both the teachers and their schools were protected. I ensured their anonymity and confidentiality by the use of pseudonyms. The previously mentioned ethical considerations gave the participant teachers the confidence to share their views and experiences of the implementation of the practical examination without fear of victimization and without fear of exposure. Moreover, it contributed to a trustworthy environment that allowed high level of participation and openness during interviews. As a result participants were quite willing to be involved in the study because they really wanted to share their views and experiences of the implementation of the Life Sciences Practical Examinations in 2012/13/14.

Gaining access means dealing with various gatekeepers at each stage of the research and obtaining informed consent. The rights of individuals (participants/respondents) taking part in a research study is expressed as informed consent, anonymity, privacy and confidentiality (Cohen et al., 2011). Informed consent entails ensuring that the participants taking part in a study must have the legal and mental capability to accept taking part in a study, and also reserves their right to withdraw as and when they wish to, particularly if the purpose of the study was not clearly understood by the participants. Formal permission to conduct the research was obtained from UKZN's research office. The certificate to this effect is included in this thesis (see page iv). Permission was also sought from the principals of the 30 school within the Estcourt region to conduct research at their schools. I experienced difficulty in contacting the principals of certain schools as they were attending a series of principals' meetings. After many fruitless visits, some of them were eventually contacted and formal permission was obtained for the study to be conducted in those schools. In spite of all my efforts, the principals of two schools refused to grant me entry into their school premises as they were not *au fait* with the new regulations pertaining to permission to conduct research at schools.

Permission was also sought from the individual Life Sciences teachers who had implemented the practical examination for their participation in the study. This involved informing them about the background to and purpose for the study. Participants were made aware that they could withdraw from the study at any time they chose to and they would also be guaranteed confidentiality and anonymity. I have come to realize that gaining access is an iterative process. It entailed dealing with various gatekeepers at each stage of the research. A total of 25 LS teachers consented to participate in this study.

4.9. Research Instruments

In order to answer the research questions posed, two instruments were used to capture data; a questionnaire and semi structured interviews. These instruments were chosen as they were suitable for collecting the qualitative data needed in this qualitative study.

4.9.1. Questionnaire

An open ended questionnaire was designed with the assistance of university researchers and piloted with Life Sciences teachers who have implemented the practical examination (see appendix for questionnaire). The questionnaire was piloted to check the clarity of the questionnaire items, and to eliminate ambiguities or difficult wording. The outcome of the piloting indicated that the questionnaire items had good construct validity. According to Cohen et al., (2011) a pilot study serves to increase the reliability, validity and practicability of the questionnaire.

Using an open ended questionnaire to collect data for this study was deemed suitable because open ended questions capture the specificity of a particular situation (Cohen et al., 2011), which in this study is the views of grade 10 Life Sciences teachers on the implementation of the practical examination. Furthermore, Cohen et al., (2011) add that open ended questions make it possible and easy for the respondents to answer the questionnaire without any restrictions on what they wish to say. This makes it suitable for enquiring into complex issues, which demand more than just simple answers. Questionnaires have several advantages over other research instruments. Firstly, they are relatively economical in terms of both time and money (McMillan & Schumacher, 2006). Furthermore questionnaires provide similar questions to a larger sample of participants compared to other techniques and, finally, they allow adequate time for the participants to think about their responses.

The rationale for using the questionnaire as the first instrument of data capture was twofold. First, it allowed participants the opportunity to answer the questions privately, with the information is written down by the participants in their own words. These aspects reduce the possibility of the researcher misunderstanding information and then misrepresenting it in field notes. Second the analysis of the responses to the questionnaire helped in the selection of the sample for the second phase of data generation. The questionnaire targeted biographical data as well as information on teachers' views on practical work and the implementation of the practical examination, their experiences of the implementation of the practical examination, the support they received for the implementation of the practical examination as well as how they innovated to implement the practical examination. The information obtained from the questionnaire was then used to map the topography of grade 10 Life Sciences teachers' views on practical work and the implementation of the practical examination, their experiences of the support they received to innovate and how these views impacted their implementation of the practical examination within the Estcourt ward.

4.9.2. Semi- structured interview

A semi-structured interview (See appendix for semi-structured interview questions) was used as the second data generation instrument as it allowed the researcher to further probe participants' responses to the questionnaire. According to Hesse-Biber and Leavy (2011) a semi-structured interview provides valuable information from the context of the participants experience, because it does not limit the respondent, it allows for probing of responses and encourages elaborate responses.

In explaining a semi-structured interview, also referred to as informal, conversational or soft interviews, Longhurst (2010, p. 35) explain that " interviewing is about talking, but it is also about listening. It is about paying attention. It is about being open to hear what people have to say. It is about being non-judgmental. It is about creating a comfortable environment for people to share". The interview was semi-structured in that respondents were asked questions in the same order, and in this was it served the purpose of sampling the respondents' responses and thereby increasing comparability of responses (Cohen et al, 2011) n accordance with the suggestions advocated by Longhurst (2010) the following issues were taken into account during the interviews:

- Establishing rapport and trust with the interviewee
- Empathy and neutrality
- Using non-verbal nods and verbal "um-hms" to show interest
- Monitoring yourself
- Sensitivity towards gender and cultural differences
- Providing sufficient time for the interviewee to respond
- Maintaining control of the interview and keeping the interview focused

Participants were purposively selected for the interviews based on analysis of their responses to the questionnaire. The constructs from my theoretical framework, namely, the profile of implementation in respect of practical work and capacity to support and innovate guided the questions posed during the interview. The interview questions focused on the types on practical work teachers engaged in, the training they had received for implementation of the practical examination, the support structures available to them for the implementation of the practical examinations, their lived experiences of implementing the practical examination, impact of practical examinations on them and their teaching. From their questionnaire responses, I sought a selection of participants who provided interesting responses about the implementation of the practical examination as well as their capacity to innovate. All interviews were video recorded.

4.10. Data Generation

The terms data generation is used in qualitative research rather than data collection (Mason, 2007), because the process entails intellectual, analytical and interpretative activities, rather than measurements. Data was generated in in two phases**.**

4.10.1 Phase 1:

A questionnaire was used to collate the data needed to answer all three research questions. As mentioned earlier, the rationale for starting with the questionnaire is to get a broader picture /context about grade 10 LS teachers' views on practical work and the implementation of the practical examinations, how they implement practical work in terms of the CAPS requirement and what their experiences are in terms of capacity to innovate for implementation of the practical examination, in the Estcourt region. Copies of the questionnaire were delivered personally to 30 grade 10 Life Sciences teachers in the Estcourt Ward at their respective schools for completion. Teachers were given a timeframe of one week to complete the questionnaire before it was collected from them. As a follow-up measure, telephone calls were made to respondents after four days to remind them to complete the questionnaire in time (Kerruish, Settle, Campbell-Stokes, & Taylor, 2005). Contrary to my expectation, it took two weeks to retrieve the distributed questionnaire. One teacher, who had agreed to participate in this study, returned a blank questionnaire as he had no clue as to how he could answer the questionnaire items and he was only able to complete the biographical data part. He also stated that he did not comply with the CAPS requirement as he was not a trained LS teacher. Another teacher failed to complete and return the questionnaire. It appeared he had had no time to complete the questionnaire since he had earlier kept on asking for extensions. The returned questionnaires were coded from T1 up to T25 (Teacher 1 up to Teacher 25) to represent the 25 respondents and then analysed. The return rate for the questionnaires is high (25 out of 30 i.e. 83%), probably due to their having been distributed and collected personally. The analysis of the questionnaire was used to select five teachers for the semi-structured interview (phase 2). The criterion for the selection of the five respondents was based on analysis of their biographical data and responses to the questionnaire items in terms of their views on the implementation of the practical examination and their ability to innovate. These five LS teachers represent 20 % of phase one population.

4.10.2 Phase 2:

Phase two followed the analysis of the data from the questionnaire. Participants were purposively selected based on their responses in phase one. I had selected 5 participants altogether for the interviews, however only 4 of the 5 participants agreed to be interviewed. The participant who did not want to be interviewed did not want to discuss individual practice in terms of practical work or the implementation of the practical examination in Life Sciences. Separate interviews were conducted with the four remaining participants so as to allow them confidentiality to discuss their practice with respect to practical work, their ability to innovate or improvise during the practical work and their experiences of the practical examination. Individual interviews also allowed me to probe their responses given to the questionnaire. The interviews were video recorded in order to capture non-verbal data such as facial expression or body language, which would not be captured in an audio recording. The interviews were transcribed and then sent to the participants for their personal verification before they were analyzed.

The next step after data generation is data analysis.

4.11 Data Analysis

Scholars such as, Creswell (2013), Mouton (2001), Cohen et al. (2013) posit that data analysis consists of the following tasks:

- Preparing and organizing the data
- Reducing the data into themes
- Representing the data in figures, tables or discussions

In this study data analysis included the preceding three steps in order to answer the research questions posed.

The unit of analysis in this study is teachers' views on practical work and their experiences of the implementation of the practical examination. As mentioned previously in Chapter 3, only one of the four sub-constructs of the Profile of Implementation from Rogan and Grayson's (2003) Theory for curriculum implementation will be used as tool to gauge the implementation of the practical examination. This sub-construct is science practical work, and it will be used together with its relationships to the capacity to support innovation. I will specifically focus on the level at which the teacher is operating for each dimension of each construct. The research questions posed in this study will be used for organizing the analysis.

4.11.1 Stage 1: Content analysis of data

For research question 1 (What are grade 10 LS teachers' views on practical work and the practical examinations they have to implement?) I engage in content analysis. Content analysis, according to Cohen et al., (2011), is a systematic set of procedures for rigourous analysis, explanation and verification of the content of written data. It is a technique for making replicable and valid inferences from the text (in this case the questionnaire) to the contexts of their use. The data was read several times before coding of the open ended questions could begin. The five categories pertaining to the purpose of practical work identified in the literature (see section 2.3.for more details) influenced the identification of codes during analysis. The categories identified from the data did not correspond one on one with the 5 categories from the literature survey, for example the category pertaining to developing an understanding of the nature of science and science processes was translated into the category hands on and minds on activities as per the responses from participants. Hence codes sharing the same characteristics were grouped into categories and finally four categories emerged from the data (promotes learning, stimulates interest in learning, mechanism for behavioural control and hands on and minds on activities).

4.11.2 Stage 2: Rogan and Grayson's conceptual framework for curriculum implementation

To answer research question 2, (How do grade 10 LS teachers' implement practical work in terms of the CAPS requirements?) I used Rogan and Grayson's (2003) construct, the profile of implementation, pertaining to science practical work because this study focuses on implementation of practical work and practical examination as stipulated in the LS CAPs policy. The data from the questionnaire and interviews were read several times in order to code them into the categories as per the descriptors of the Rogan and Grayson tool. The video recordings of the interviews were re-examined to check if they were accurately transcribed and to study nonverbal gestures. This coding helped to identify the kind and type of practical work in which teachers engage, the level of teachers' and learners' involvement and the teacher well-being The resultant categories, in terms of kind and type of practical work and level of teacher and learner involvement, were used to match the level at which implementation of practical work occurred.

To answer research question 3 (What are grade 10 LS teachers' experiences of their capacity to innovate for implementation of the practical examinations?) I used Rogan and Grayson's construct, capacity to innovate (physical resources, school ethos, teacher factors and learner factors), to identify categories in the data during open coding. The data from the questionnaire and interview were read many times in order categorize them according to the descriptors of the Rogan and Grayson tool. This was done to establish how each dimension of the capacity to innovate enhanced or inhibited the implementation of the practical examinations. Eventually the level for the capacity to innovate was established for the teacher.

4.12. RESEARCH RIGOUR

In qualitative research, reliability and validity of research is often referred to as the *credibility* of data, or believability of the findings (Guba and Lincoln, 1994; Creswell, 2013). The activities used to increase the credibility of the qualitative findings in this study included video recording of semi structured interviews, thick descriptions, member checking, reflexivity and triangulation (Guba & Lincoln, 1994).

4.12.1 Video recordings

I consider video recordings to be a means of enriching the data and so enhancing rigour and credibility of the findings, because in addition to verbal data that would be captured in audio recordings, it provides a record of non-verbal data, such as facial expressions or body language. All 4 semi-structured interviews were video recorded.

4.12.2 Thick descriptions

In order to ensure credibility of my qualitative study, there needed to be detailed descriptions of the settings, participants and themes of my study (Creswell, 2013). The settings of the schools were foregrounded through their quintile ranking. As mentioned previously, the school's quintile ranking indicates its resources and the socioeconomic background of the area. The topography of the participants is visible via their biographical data, given in Chapter 5. The themes that emerged are supported by excerpts from participants' responses, (see appendix for interview transcripts).

4.12.3. Member checking

Member checking is a research procedure used to ensure credibility and validity of the research. According to (Creswell, 2013), member checking involves taking back the interview transcripts to participants and requesting them to verify their accuracy. By this process participants are given the opportunity to elaborate, clarify or confirm aspects of the interview, in order to ensure that participants' views, experiences and perceptions had been captured accurately during the interview. Thus, member checking was adopted to guarantee the credibility of the research. After each video recorded interview was conducted, the interviews were then fully transcribed. Once transcriptions were completed I made telephonic appointments with each the grade 10 LS teachers interviewed to have the transcripts delivered to them. I explained to the LS teachers what member checking entailed and the purpose of member checking. I also fetched the checked transcripts from each of the participants. In retrospect, from an ethical perspective, I have learnt that member checking would also have to be negotiated with the participants before the interviews because they also required the consent of the participants and it also impinges on their personal time.

4.12.4. Reflexivity

Reflexivity was used to enhance the credibility of the data. I have already declared upfront (see Section 1.2.) how my role as a grade 10/ 11 Life Sciences teachers and my background holds the potential for shaping my interpretations. The results of the data collected and analyzed, and the findings of this research will be open to critique by other academics and researchers in this field of study. This is to ensure the soundness, accuracy of the findings and conclusions reached.

4.12.5 Triangulation

Triangulation is also a means of ensuring credibility. It entails obtaining data in multiple ways and then cross referencing the data during analysis (Creswell, 2013). To prevent bias and improve trustworthiness in this study, data collected through an open-ended questionnaire and one-on-one semi-structured interviews, were juxtaposed in order to answer each research question. In this way I triangulated the data collected from the questionnaire,

4.13. Limitations of this study

As this is a case study and sampling was purposive, the results of this study cannot be generalized beyond the group of participants. Nevertheless it provides insight into the implementation of the compulsory practical examination in LS in grades 10 and 11 which adds to the debate on the purpose of practical work and teachers' views and challenges pertaining to practical work.

4.14 Conclusion

In this chapter, the philosophical assumptions underpinning the study were discussed. Explanations were given as to why this study adopts a qualitative approach and uses a case study approach within the interpretivist paradigm. The chapter also justified the generation and use of qualitative data to answer the research questions. The research design, including a description of the research site, the data generation method, issues relating to gaining access to the research site as well as to the respondents, sampling and sampling procedures together with the instruments used were also discussed. The chapter also gave a description of the methods of data analysis and ended with a discussion of issues of validity and reliability which ensure the credibility and trustworthiness of the study (Nieuwenhuis, 2012). In the next chapter I present the analysis of the data collected and research findings.

CHAPTER FIVE

Presentation of findings and analysis

5.1. Introduction

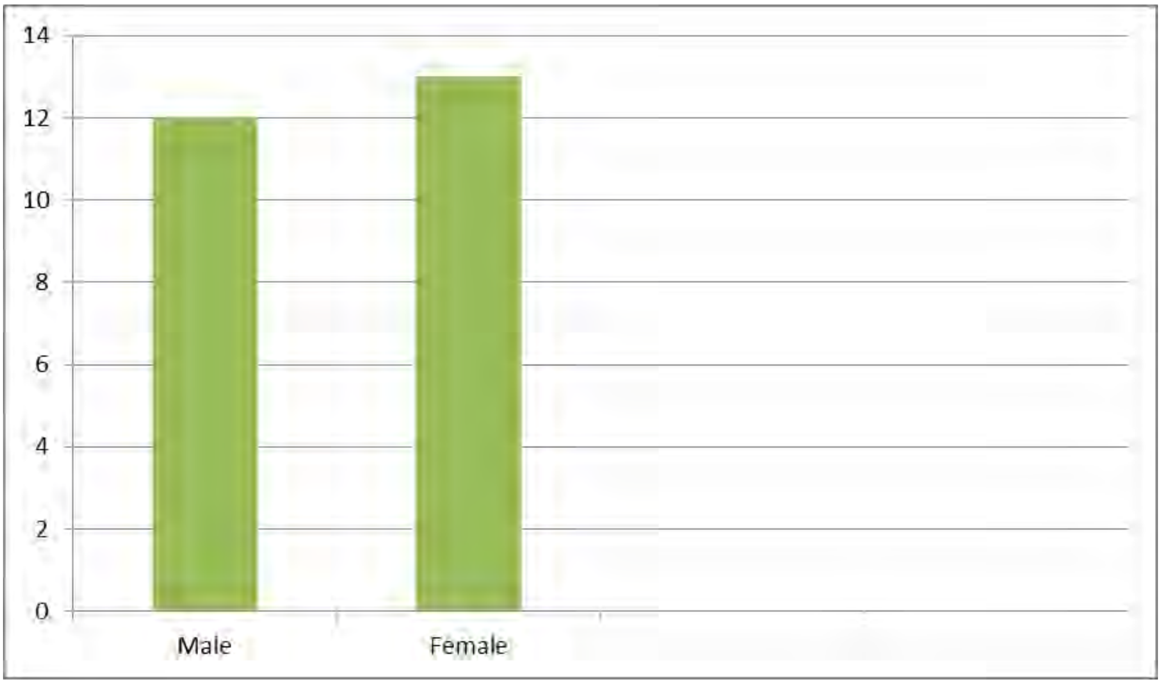
This chapter aims to answer the three research questions posed, specifically: (1) What are grade 10 LS teachers' views of practical work and the practical examinations they have to implement? (2) How do grade 10 LS teachers implement practical work in terms of the CAPS requirement? and (3) What are grade 10 LS teachers' experiences of the capacity to innovate for implementation of the practical examination? As mentioned in the previous chapter, data was collected using a questionnaire and semi-structured interview. This chapter is divided into 4 parts, A, B, C and D. In part A the biographical responses from the questionnaire were used to create the topology of the LS teachers in the Umtshezi Ward. Parts B to D aims to answer the three research questions in sequence. Finally the chapter summary is given.

Part A

5.2.: Biographical responses

The data acquired from the biographical section of the questionnaire was used to create a context for Life Sciences within the Umtshezi ward of Estcourt region. This section of the questionnaire focused on teacher qualification, gender, teaching experience in LS, other learning areas that may make up the teachers' workload, as well as any training for Life Sciences that teachers had received so as to assist with implementation of the practical work and the practical examination.

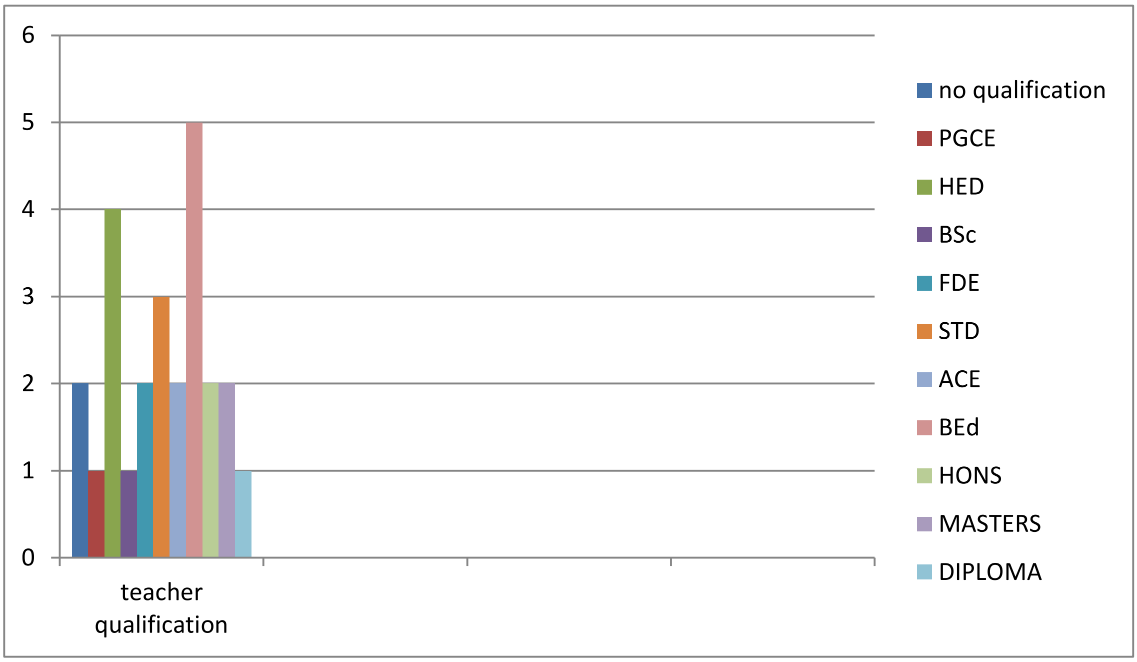
The gender distribution of the LS teachers who responded to the questionnaire is shown below in Graph 1.



Graph 1: Depicting gender distribution of teachers in this study

From Graph 1 it can be seen that the gender distribution of the teachers who responded to the questionnaire was approximately equal, with 13 out of 25 being female and 12 male. This shows that Life Sciences, contrary to possible common perceptions, is probably not a male dominated teaching area.

Graph 2 below shows the qualifications of the teachers in this study.

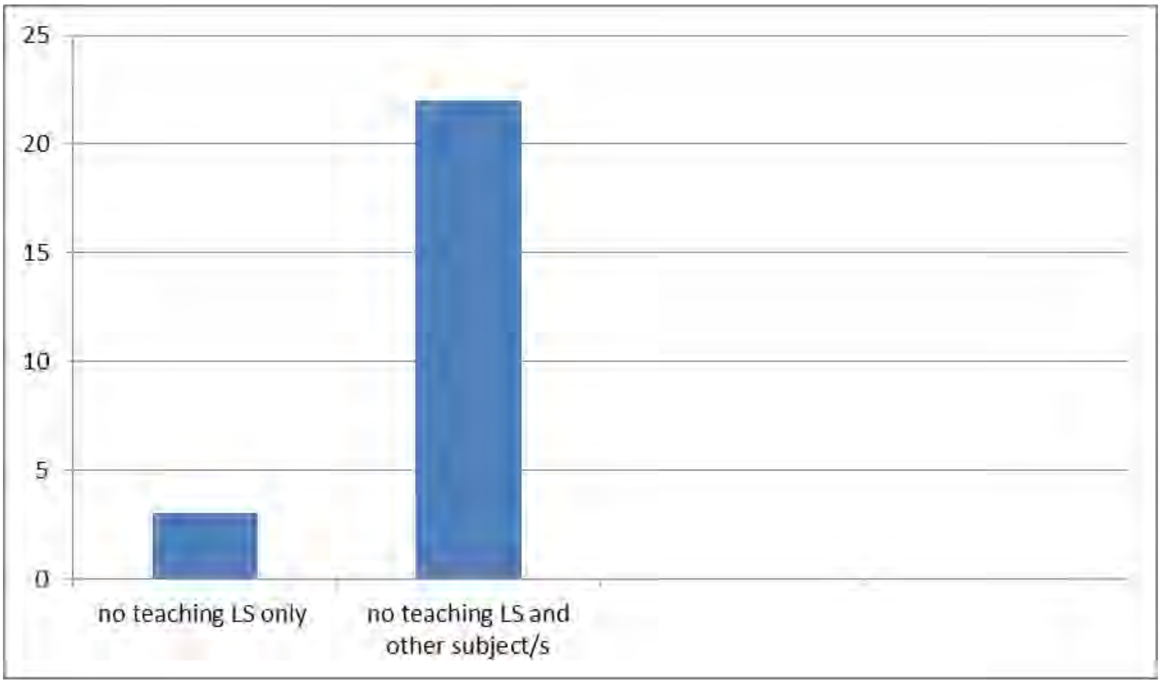


Graph 2: Reflecting LS teachers' qualifications

With respect to teacher qualification, 23 of the 25 teachers have some type of qualification in LS. However, there were 2 out of 25 teachers with no formal qualification at all in LS. It is of great concern that 16% of the teachers are expected to engage their learners in an area for which they are not qualified. It raises questions about the teachers' subject matter knowledge as well as his/her pedagogical knowledge. Moreover, in Life Sciences such knowledge is essential for engaging in practical work, including the examination.

A presumable expectation is that these 23 teachers should be *au fait* with practical work and should be able to engage their learners in practical work as well as cope with the logistics of the practical examination they have to implement.

Graph 3 shows data regarding the teachers' teaching load in LS and other learning areas.



Graph 3: Showing number of teachers teaching LS and other subjects

The data above shows that only 3 out of 25 teachers have a full workload of only LS classes. The remaining 22 LS teachers are teaching other subjects to make up their work load. In essence, these teachers have to meet the curriculum demands and CASS requirements of another learning area in addition to LS. Furthermore, the LS teachers may have needed to be re-skilled to teach other learning areas. The demands of such retraining or re-skilling may have, in some imperceptible way, impacted their views of practical work and the implementation of the practical examination.

Part B

5.3. Research question 1

The first research question, namely, "What are grade 10 LS teachers' views on practical work and the practical examinations they have to implement?" is answered by using data from the questionnaire and semi-structured interviews. This question focuses on two aspects,

Grade 10 LS teachers views on practical work and

Their views on the implementation of the practical examination

Being open ended, the questionnaire used to elicit teachers' views on practical work generated multiple views on practical work. By means of the content analysis coding as was described in Section 4. 11.1 four core categories of teachers' views of grade 10 LS teachers on practical work emerged from the data, which are discussed in section 5.3.1. Similarly, the two core teachers' views on the implementation of the practical examination are examined in section 5.3.2.

5.3.1. What are grade 10 LS teachers' views on practical work?

Data analysis from the questionnaire indicates that grade 10 LS have four core categories views on practical work, as depicted in Table 5 below:

Table 4: Grade 10 LS teachers' views on practical work

Categories	**Number of teachers**
Promotes learning	25
Stimulates interest in learning	20
Mechanism for behavioural control	10
Hands on and minds on activities:	
Hands on :	17
Minds on :	22

Each of the above mentioned views will be elaborated in the paragraphs below.

5.3.1.1. The view that practical work promotes learning

Three categories can be identified within the view that practical work promotes learning, namely, reinforcement of theory, promoting team work and dispelling gender bias.

All 25 of the grade 10 LS teachers involved in this study were of the view that practical work in LS was intricately intertwined with theory as can be seen in the excerpts below:

> "*Pract work can show learners the difficult terms in Life Sciences, that they don't see in their everyday life like mitochondria, golgi body- even our language has no words for these terms*" T6 (questionnaire response)

"Pract work helps learners to understand concepts like osmosis… when I teach they don't know what osmosis is – when I demonstrate osmosis and show endosmosis and exosmosis then they link it to their daily live – like cooking" T10 (interview response- see appendix)

The specific "language associated with Life Sciences" comes to the fore in the above excerpts. If such "language" that is unfamiliar to learners in their daily lives remains unfamiliar and abstract, learning could be impeded. This means that the LS teachers in this case study are of the view that practical work helps to make a concrete link to abstract concepts. The above finding resonates with those of Millar and Abrahams (2008) and White (1996), whose studies confirm that practical work can be used to enhance conceptual understanding. Observing these structures or processes helps learners conceptualise them. In other words, such practical work demystifies the abstract terminology associated with LS. It thus creates an excellent context in which to expand and develop their LS language skills, (*have no words for these terms*) when they talk about the aspects of their learning in practical work they may link it to theory. In this way learners make a connection between the LS content that is covered and its relevance to everyday life (*daily life like cooking*). The above excerpts illustrate that practical work is indeed viewed as reinforcing theory, by making abstract concepts more concrete, as for instance with mitochondria and osmosis.

It should be noted that 12 out of 25 grade 10 LS teachers in this study claimed that practical work promotes team work amongst learners. As is visible in the excerpts below:

"They each get a chance to play a different role during practs so they work together as a team" T15 (questionnaire response)

"I watch them interacting, getting along, during practs-its division of labour in action-to complete the pract and get the pract report in on time - when it's done they feel good about themselves, it's the only time they work together" T6 (interview response- see appendix)

For the above excepts it is evident that by engaging learners in practical work that entails group work, affective learning such as team work, collaboration (*work together*) and collegiality amongst learners is promoted. Furthermore by engaging learners in group practicals, learners can learn to work independently (*division of labour*) within a group, learn organisational skills, and also become aware of the time constraints for different tasks; in other words, time management skills (*get report in on time*). The above finding is in agreement with that of SCORE (2009) as well as Millar and Abrahams (2008) who posit what engaging learners in practical work enhances their social skills. Team work also engenders feelings of self-esteem, self-confidence (*feel good*) that could be transferable to a wider world outside the science classroom.

An unexpected finding was that practical work dispels gender bias, as seen in the excerpt below

> *"In my classes girls and boys are equal – in fact I encourage girls to answer question. Girls are actively involved in practs, they are taking on roles as investigators and not recording and observing. They are not only observing or identifying, they set up, manipulate equipment, do the practs, interpret and write the report - they are more involved that boys nowadays*" T10 (interview see appendix)

The role of practical work in dispelling gender bias may be regarded as an unexpected finding, because this study is located in a semi-rural area where female learners are known to encounter both cultural and educational barriers that impede their learning and limit their access to sciences (Ofoha, 2013). With only one out of 25 LS teachers mentioning the view that practical work dispels gender bias in the questionnaire responses, this view was traced back to the biographical data of the teacher concerned, and the teacher was then purposively selected to be interviewed. Data from the interview revealed that this LS teacher embraced a feminist worldview in her teaching and was involved with an informal programme to address gender based violence in her community. Her personal biography and positionality thus sculpts her view on practical work. Practical work it seems can be used to challenge and debunk gender stereotyping (*role of investigators, manipulate equipment*) and patriarchal roles working against girls in a rural setting. This means that this particular LS teacher does not allow the girls in her class to self-perpetuate gender bias (*not recording and observing*) in the science classroom, but rather encourages their active participation.

5.3.1.2. The view that practical work stimulates interest in learning

The use of practical work as leverage to stimulate interest in learning was indicated by 20 out of the 25 LS, as depicted in the questionnaire excerpts below:

> *"Practs makes the lesson more appealing" T17*
>
> *"Learners pay more attention during demonstration" T25*

When probed during the interviews on how practical work stimulates interest in learning teachers responded as follows:

> *"This is the only time learners are curious, they ask questions" T9 (interview see appendix 2D)*
>
> *"Learners can see the link between theory and their lives – so they get excited and want to know more" T5(interview- see appendix)*

From the preceding excerpts, it is visible that practical work stimulates interest in learning as it clarified the link between theory and everyday experiences. The above finding corresponds with that of the Hofstein and Lunetta (2004) study which also illuminates that practical work does motivate an interest in learning science.

5.3.1.3. The view that practical work can be used as a mechanism for behavioural control

The view that practical work can be used as a mechanism for behavioural control is reflected in the excerpts below:

> *"Learners are less disruptive during practical work – they pay attention and want to see what is happening" T19 (questionnaire response)*
>
> *"Learners behave badly when I teach, the classes are so large, it's hard to control them, but when I do practs they are all quiet and very well behaved" T5 (interview- appendix)*

From the questionnaire responses, 10 out of 25 (40%) LS teachers rely on practical work to maintain discipline in their classes. This finding is similar to that in the Swain, Monk, and Johnson (2000) study, which highlights the role of practical work as a mechanism for behavioural control. If practical work is used by teachers primarily to instill class discipline, then the more fundamental values and learning associated with doing practical work are being overlooked. Instead, perhaps the teachers should reflect on their approach during theory lessons, so as to engage learners more effectively in all lessons.

5.3.1.4. The view that practical work involves "hands on" and "minds on" activities

The data from the questionnaire regarding "hands on" and "minds on" activities is thought provoking. It indicates that while 17 out of 25 LS teachers in this case study view practical work as involving "hands on" activities, 22 out of the 25 view it as entailing "minds on" activities. The questionnaire responses are typified by the extracts below:

> *"I only use hands on activities for practs" T21*
>
> *"Minds on it is so easy to do with large classes" T3*

The interview was used to probe further what teachers view as "hands on" or "minds on" activities. It is noteworthy that teachers' view of "hands on" could be reduced to a single descriptor, namely, manipulation of apparatus, as is elucidated by the excerpts below:

> *"Hands on is when learners handle apparatus"T6 (interview – see appendix)*
>
> *"When learners manipulate and use apparatus" T5 (interview – see appendix)*

It is evident from the above excerpts that these teachers see "hands on activities" as limited to manipulation of apparatus. Skills such as observing, identifying, drawing to scale, measuring, critical and creative thinking, problem solving or designing experiments are not embraced in their view of "hands on".

In the interview the idea what of "minds on" activities entail was also probed. Excerpts given below illustrate typical responses.

"Minds on is when they fill in a worksheet after the demonstration… you can't ask hard questions they will fail… the worksheet only has questions on the demonstration" T 10 (interview see – appendix)

"It when they are quiet and they do an exercise or write up the report after my demonstration, its straight forward aim, results, conclusion" T9 (interview – see appendix)

From such responses, two main issues emerge. Firstly, it appears that the LS teachers in this case study construe "minds on" as little more than completing a worksheet, or formulaic report (*aim, results , conclusion*). It does not embrace the idea of higher order thinking (*can't ask hard questions*) such as hypothesis testing, critiquing experimental design, critical thinking, or problem solving. Secondly, these results confirm that the teachers engage in demonstration (*demonstration*) in their classes. As mentioned by Rogan and Grayson (2003) demonstrations are appropriate in particular circumstance, but if the goals of the CAPS LS policy are to be embraced in terms of the development of particular skills then demonstrations should not be the main type of practical work learners are exposed to.

In summary, it has been shown that the LS teachers view routine practical work as generally useful, particularly for instilling conceptual and social learning, and for motivating learners and engaging them in the lesson. However, it is evident that the teachers have a limited view of what practical work could entail, with regards both "hands on" and "minds on" activities. Their views on the practical examination are considered next.

5.3.2. What are grade 10 LS teachers' views on the practical examination they have to implement?

In contrast to the overall positive view on routine practical work, the data from the questionnaire reveals that an overwhelming 24 out of 25 grade 10 LS teachers have a negative view on the implementation of the practical examination, with only one grade

10 LS teacher expressing a positive view on it. Moreover, this positive view is associated with only one factor; learners now take practical work seriously. So the positive response could in itself be construed as negative: the practical examination provides a “stick” rather than a “carrot” for learners. The expressed negative views on the implementation of the practical examination are reflected in table 5.

Table 5: Grade 10 LS teachers negative views on the practical examination

Category	**Number of teachers**
Lack of support at school and DoE level	24
Poor resources	20
Need for re-training of teachers	23
Lack of expertise	10
Increase in workload	24
Time constrains	24
Large classes	15
Lack of consolation about policy implementation	24
Prior professional history	24

A concern in table 5 that warranted further probing during the interview was the discrepancy in numbers between the teachers who indicated that they need re-training for the implementation of practical work and those that lack expertise in implementing practical work.

Further insight into the positive and negative views, acquired via the questionnaire, are explored further in research question 3, concerning the implementation of the practical examination, which follows in Part C Section 5.4.

Part C

5.4. Research question 2

In this section I present and analyse data in response to research question 2, "How do grade 10 LS teachers implement practical work in terms of CAPS requirements? As mentioned previously in Chapter 3, in this study the focus was on the science practical dimension of the profile of implementation. Data from the questionnaire and interview were used to answer research question two.

Table 6 below is a summary of data from all of the questionnaire and interview responses according to the constructs as described earlier in section 3.2(for detailed table see appendix).

Table 6: Summary of questionnaire and interview evaluation on grade 10 LS teachers' implementation of the practical work in terms of LS CAPS requirements

Category	**Number**
Frequency of practical work:	
Teachers who conduct no practical work	2
Number of teachers who do not meet the minimum CAPS requirement	2
Number of teachers who meet CAPS minimum requirement	13
Number of teachers that go beyond CAPS requirement	6
Type of practical work:	
No practical work conducted	2
Demonstration conducted	17
Theoretical practicals conducted	4
Dissection conducted	2
Method of practical engagement	
No engagement	2
Teacher lead engagement	18
Learner centred engagement	2
Both teacher and learner centred	

engagement used	3
Teacher welling being Not qualified to teach LS Uncertain, overwhelmed, inadequate Competent	 2 19 4

In the next section I discuss the frequency of practical work undertaken and the type of practical work teachers engage in

5.4.1 Frequency of Practical work

Despite the CAPS requirement (that practical work is mandatory) there were two teachers (see table 6) who do not conduct any practical work at all neither do they engage their learners in practical work. Their biographical data reveals that these teachers do not have any formal qualification in LS. (See section 5.2.). These two teachers do not even fit onto Level 1 of Rogan and Grayson's profile of implementation, (See section 3.2. for table on profile of implementation). While there are also two teachers who do not meet the CAPS minimum requirement for practical work (i.e. one practical per term), 13 teachers do comply with the CAPs requirement for practical work. These teachers tend to be those that are requiring more guidance and upskilling for the implementation of practical work. Lastly there are 6 teachers who go beyond the CAPS requirement in terms of practical work. These teachers tend vary in terms of their level of confidence in engaging in practical work (see detailed table in appendix).In the next section I discuss the type of practical work undertaken by teachers.

5.4.2 Type of Practical Work

From the questionnaire and interview it emerged that the grade 10 LS teachers who do implement practical work use one of the following method:

- Dissection

- Demonstrations
- Theoretical discussions

In the discussion that follows some of the reasons for the teachers' choice of activity are illuminated by excerpts from the questionnaire or interview responses. The teacher behaviour for each activity is then classified according to Rogan and Grayson's profile of implementation for practical work (see table 2, Chapter 3).

5.4.2.1. Dissections

It is encouraging that 2 out of 25 grade 10 LS teachers provide the opportunity for their learners to engage in dissections, as can be seen in the excerpt below:

> *"I got learners to dissect the heart- I demonstrated and they follows…they enjoyed the lesson and asked when they will do dissections again" T9 (interview see appendix)*

These teachers are thus facilitators who embrace a learner centered approach, and in so doing they adopt the teaching philosophy espoused in the CAPS policy. A closer examination of these teachers' well-being indicates that they are above necessary baseline threshold to be confident when engaging in practical work. These teachers are therefore functioning between level 2 and 3 of Rogan and Grayson's profile of implementation for practical work (see table 2, Chapter 3).

5.4.2.2 Demonstrations

From Table 6 it is evident that 14 out of the 25 grade 10 LS teachers engage in teacher led demonstrations for their classes, and also require their learners to complete a worksheet based on the observed demonstration. In the teacher led demonstrations, learners enjoy only observer statuses and are not involved in manipulating equipment, controlling variables, or redesigning the demonstration process. This is explicit in the excerpts below which illuminate the overarching contextual challenges that impinge on these LS teachers' practice:

> *“.....the lack of materials and chemicals, the learners only see the demonstration done by me and they in turn will complete the worksheet” T12 (questionnaire response)*

> *"I have three classes of 61 children doing Life sciences. For me to manage equipment for such large classes is impossible, learners pinch small items, like the test-tubes, spatulas, scalpels, and put them in their pockets, or break them. Controlling the equipment is very difficult."T6 (interview see appendix)*

It can be seen that these grade 10 LS teachers are operating between levels one and two of Rogan and Grayson’s profile of implementation (see table 2, Chapter 3) and that their learners are exposed predominantly to only basic process skills. These teachers’ steadfast reliance on teacher dominated demonstrations also raises the following question: What is such reliance a symptom of? I suggest two possible reasons. It may be teacher resistance to embrace the practice of learner centered pedagogy as advocated by the CAPS policy. Or it could be that their baseline personal and professional biographies are static and un-evolving. A closer examination of these particular teachers’ well-being factors elucidates that these teachers are feeling overwhelmed, lack confidence, are unhappy or sad about having to engage in practical work, due to their own inadequacies, inexperience and the lack of effective teacher professional development during curriculum reform. They have thus been unable to embrace the necessary change.

5.4.2.3 Theoretical “Practical Work”

It is startling that 4 out of 25 grade 10 LS teachers engage in practical work theoretically, as is depicted in the excerpts below:

> *“there is an average of 60 learners in my small class, there is not enough desk or chair, there is a chalkboard and some textbooks, I can’t move around in this class, its overcrowded, how can I do practical or the pract exam without training, equipment and chemicals”T1 (questionnaire response)*

In other words, the LS teacher merely explains the concepts which should have been explored or investigated through a learner centered practical activity. The theory on which the practical work is based is provided by the teacher and presented to the learners, on the assumption that they will understand the concepts. The question is what type of practical skills can learners gain from "practical work" presented in this limited fashion?

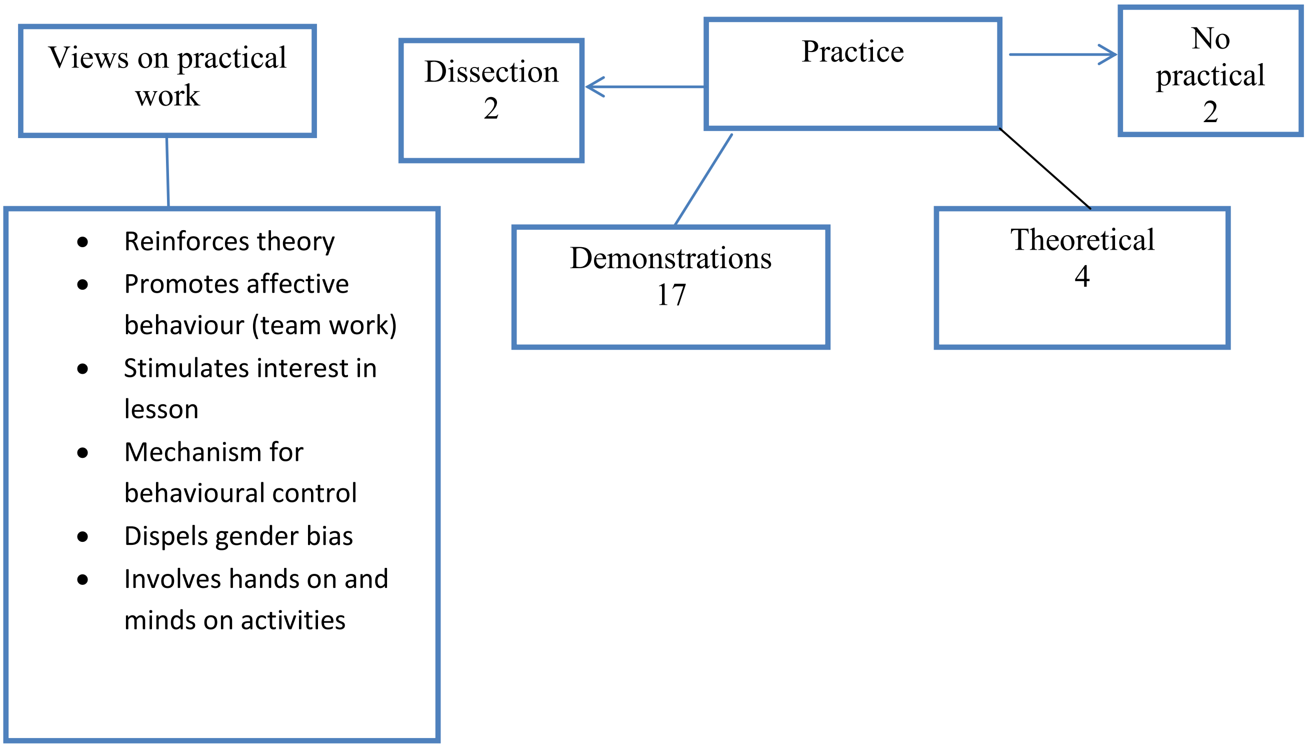
5.4.2.4 No Practical Work

It is alarming that 2 out of 25 grade 10 LS teachers do not engage in any form of practical work. These teachers' practice does not begin to embrace the required stipulations for practical work in the CAPS policy. Their non-compliance with the CAPS requirement raises pertinent questions about their professional biography. A review of these teachers well-being exposes that they lack a qualification in LS and have not been re-trained or re-skilled to teach LS. These teachers will also be on level zero of Rogan and Grayson's profile of implementation for practical work.

5.4.3 Discussion.

The preceding analysis of data regarding the nature of practical work undertaken by the grade 10 LS teachers indicates a discrepancy between their views of practical work as "hands on" and "minds on" (in Section5.3.) and their actual practice. This discrepancy is captured in Figure 2 below.

Figure 2: Model for grade 10 LS teachers' views of practical work Vs actual practice



From figure two it is evident that "minds on" practical work is a theoretical view for these LS teachers and it takes a back seat in their actual practice.

It has been shown that "hands on" is limited to a few teachers using dissections, most teachers relying on demonstrations and 6 out of the 25 indulging in nothing of real practical nature.

The above discussion also highlights a golden thread that runs through all the methods deployed by grade 10 LS teachers in their attempts to engage in practical work: lack of physical and human resources. The impact that poor physical and human resources have on the kind and types of practical work undertaken by grade 10 LS teachers is highlighted

It is evident that despite the attention and emphasis by the CAPS policy for compulsory practical work and examinations to be implemented, very little effort has been made to address implementation constraints (*how can I do .. without training, equipment*). The constraints that these grade 10 LS teachers encounter when trying to engage in practical work and implement the practical examination is thus unveiled, foregrounding the slippage between policy intention and policy implementation . This means that learners in these schools are denied the opportunity of observing, let alone doing, any practical work. Moreover, an inspection of these grade 10 LS teachers well-being uncovers their feelings of discontent, uneasiness and lack of confidence (*no training*) when they are required to engage in practical work with the "once off just in time" teacher professional development offered for curriculum implementation. Is this disparity a signal of the slippage between policy, teacher professional development and practice? Or perhaps Rogan and Grayson's profile of implementation which begins at level one (see table two, Chapter 3) needs to be thus extended to level zero to accommodate teachers how do not engage their learners in real practical work.

The perplexing question is, how do grade 10 LS teachers engage in practical work and the practical examination if the essential necessities are not available to them? The question then remains: if teachers are so constrained for normal practical work by large classes, and a lack of re-training and physical resources, how are they expected to institute a practical examination for their learners? This is discussed next.

Part D

5.5. Research question 3

In this section I aim to answer the third research question, viz: "What are grade 10 LS teachers' experiences of the capacity to innovate during the implementation of practical examinations?"

Data from the questionnaires and interview are used to answer the third research question. As mentioned earlier in section 4.11.1. Rogan and Grayson's dimensions of the capacity to innovate were used to analyse the data. In the next section the discussion is aligned with the following dimension:

- Physical resources
- Learner factors
- School ethos and ecology and

- Teacher factors

5.5.1. ***Physical resources***

Grade 10 LS teachers identified large classes, lack of laboratories, textbook shortages and lack of equipment as physical resources that alter their classroom practice. How these physical resources impinge the implementation of the practical work and consequently the practical examinations are reflected in the excerpts below:

> *"Learners share textbooks, the classes are large about 60 per class, you don't get to know them or their needs, there is no laboratory, whatever equipment was sent to the school is locked in the store room, it is not processed so I can't use it, this area is very poor, I can't ask learner to bring things, I try my best to improvise"* T3(interview see appendix

> *"It's a challenge to run the practical exams, I have to have many sessions for the exams, there are classes from A-G and each with about60 learners, you can't move freely in the class, the apparatus is not enough to set many workstations, most of it is broken, you can't get money to buy chemicals for food test, or specimens e.g. Heart that are needed for the pract exam- you can't test the types of practs wanted by CAPS if there are no resources" T5 (interview – see appendix)*

The impact that the lack of adequate physical resources has on the implementation of practical work and hence the practical examination is confirmed by such responses. Of the 25 schools, 23 do not have functional laboratories. The above finding concurs with that of Muwange-Zaka, 2008; Rollnick, 1997 who emphasize the many schools have a lack of basic science equipment and that it impacts on the kinds and types on practical work done at these schools. It is evident that the lack of physical resources confines grade 10 LS teachers mainly to engaging in demonstrations and theoretical "practical work" (*set many workstations*). In such a way the lack of resources and space (*can't move freely*) seriously diminishes opportunities for learners to participate actively in the learning of science process skills. Such disabling conditions do not allow for group work, let alone individual practical activities. Large classes and lack of space also limit teachers' opportunities to meet their learners' individual needs (*you don't get to know them or their needs*). Furthermore, the inability to move freely in the classroom impacts classroom control and maintaining order and discipline, as shown further in the next section.

The data from the questionnaire and interview indicate that all the 25 participant grade 10 LS teachers' schools are only at level one for physical resources in Rogan and Grayson's profile of capacity to innovate.

5.5.2. Learner factors

Data from the questionnaire and interview illuminate the learner factors that influence the implementation of practical work and the practical examination. The factors are the mismatch between learners' home language and the language of instruction, learner discipline and lack of parental support. The impact these learner factors have on the implementation of practical work and the practical examination comes to the fore in the excerpts below:

> *"The textbook is in English, the exam is in English for our learners, English is not their first language – it's hard for them, it affect their understanding, and even harder for me to try and explain terms, concepts, plus the terms in LS are difficult and abstract, we don't have words for many terms or equipment in science, I teach in isiZulu and sometime in English " T17 (questionnaire response)*

The discourse of LS, the language of the textbook, learners' home language and the absence of vocabulary for scientific terminology in the home language of the learners all affect the quality of teaching, and hence practical work undertaken. Language thus becomes a barrier to accessing knowledge and process skills in the LS classroom. My finding resonates with that of Vesely, (2000) who argue that when learners have to use a language in which they are not proficient, then mastering content (both practical and theoretical) of a subject becomes very difficult.

Maintaining discipline in large classes is a reality for the grade 10 LS teachers in this study as can be gathered from the excerpt below:

My classes are so larger, there is a shortage of desks and chairs, I can't move, I stand at the board and teach, learners don't pay attention, it's hard to keep them quiet, it's even harder to discipline them, and their parents can't help them, or support their studies" T20(*questionnaire response)*

The large number of learners per class, lack of space to move freely affects classroom control and discipline. Furthermore, it could compromise the safety of learners and the teacher and will invariably influence the type and quality of practical work they choose to engage in. The above excerpt also reveals that parental participation in school activities is almost nonexistent and that failure of parents to support their children with their studies is seen as a hindrance to quality teaching and learning.

Taking the preceding learner factors into account it can be inferred that learners are functioning at level one of Rogan and Grayson profile of capacity to innovate for physical resources.

5.5.3. School ethos and ecology

Through the questionnaire and interview grade 10 LS teachers identified the two elements of the school ethos: school ecology (culture of teaching and learning) and management support (invigilation, timetabling, planning). The influence that these factors have during the implementation of practical work and the practical examinations is illuminated in the excerpts below:

"The learners take so long to come to class after break , they behave badly after break, you can't have tests after the break, many run away from school after break, so I'm always having to repeat lesson, learner don't do their work, the management look the other side when learners are not in class, if you scold them they break the things in the class." T23 (questionnaire response)

The culture of teaching and learning at these schools does not emphasise that learners need to be at school and to report promptly for their lessons (*take so long …run away after break),* for learners to adhere to the school code of conduct and complete their homework (*learners don't do their work*), that the existing resources are to be respected (*break things*). If the management of a school does not instill discipline or the code of conduct amongst learners how does a solitary LS teacher propagate an appropriate culture of learning? The absence of a culture of learning raises several important questions. Who is accountable for learner discipline at schools? What kinds of practical work can be conducted when learners are perpetually late for classes? How does one manage to complete a lengthy LS curriculum with its stipulated practical work and practical examination as well as prepare learner to the examinations if one faces such time constrains?

Most school managers do not have a science background and so may do not understand the dynamics of practical work or the practical examinations. Hence timetabling, invigilation and sourcing apparatus for the practical examinations becomes problematic. The major challenges that grade 10 LS teachers encountered with the implementation of the practical examination were acquiring competent knowledgeable invigilators, having the practical examinations taken seriously, having sufficient time to set up for the practical examinations and having a greater number of classrooms available to set up work stations for learners, as can be seen in the excerpts below:

> *"With large classes it impossible to invigilate for hands on practs, I can't be at three places at the same time, other teachers who are not LS teachers can't respond to learner queries" T5 (interview see – appendix)*
>
> *"I have to make my own arrangements to get teachers to invigilation for the pract exams – the office don't see this as an official exam, they say make you own arrangement, have it outside the exam period" T9 (interview see – appendix)*

The lack of school management support for the logistical organization of the practical examination (*make you own arrangement*) is evident in the above excerpts. If the practical examinations are to be implemented effectively and not viewed as a "tick box activity" then LS teachers need "buy in" from their school management. Like any other examination at the school, invigilators should be appointed for the practical examination and teachers should be credited for their invigilation. Setting up a classroom or laboratory for the practical examination entails acquiring apparatus, chemicals, specimens and micrographs which is a time consuming chore. In the absence of laboratory assistants, setting up for the practical examination is an added responsibility for the LS teacher and it should be factored into the calculation of the teaching workload of LS teachers.

In terms of Rogan and Grayson's profile for capacity to innovate for school ethos these schools are operating at level one.

5.5.4. Teacher factors

Two teacher factors emerged from the data acquired via the questionnaire and interviews, namely: teacher qualification and confidence level.

Two of the twenty five teachers have no qualification in LS and at the other end of the scale, only two have indicated that they confident in engaging in practical work. The rest of the LS teachers (21) have indicated that they need help because they are uncertain, uneasy, and overwhelmed by the new requirements in respect of practical work, as can be seen in the excerpts below:

> *"I need help, I was not trained at college for practical work, and the CAPS training did not cover practical work, they only focus on theory" T9 (interview – see appendix)*

> *"There are too many changes and demands made on us, I can't cope, I need training for practical work, I'm not confident handling apparatus, I feel unsure so I don't like to do practs - I attended the CAPS workshop, it was not about how we can be help to set practs and do practs- it was about the theory, this we know and can teach" T25 (questionnaire response)*

The interplay between these LS teachers' personal and professional biographies and the changing curricular demands becomes visible via the above excerpts. The lack of an interface between changing curricular demands and the personal/professional biographies of the LS teachers results in teachers feeling overwhelmed, uneasy, unsure and ill prepared (*I can't cope, I'm unsure*). From the above excerpts it is apparent that during curriculum reform teachers are treated as equally equivalent, and that their individual histories and divergent training are ignored (*I was not trained at college*). The support offered so far to teachers for curriculum implementation (*CAPS training*) is thus inadequate and does not meet the needs of teachers (*I can't cope, it was not about … to set practs and do practs*). There is a conspicuous disjuncture between support offered and support needed for implementation of the LS CAPS requirements. The above finding concur with those from Singh-Pillay (2010) and Gouws & Dicker, (2007) studies, which elucidate the uncertainty that teachers encounter during curriculum reform with the resultant impact on their personal and professional identities (*I'm not confident… fell unsure*) The preceding discussion begs the question: how can teachers take ownership for curriculum implementation in the absence of adequate training for implementation and a poor school ecology? In terms of Rogan and Grayson's profile for capacity to innovate for teacher factors these teachers are operating between level one and level 2.

5.6. Conclusion

In this Chapter I aimed to answer the three research questions posed by this study.

To answer the first research question (What are grade 10 LS teachers' views on practical work and the practical examinations they have to implement?) I engaged in content analysis of data from the questionnaire and interviews. The analysis highlights that Grade 10 LS teachers had four core views on practical work viz, it promotes learning, it stimulates interest in life sciences lessons, it serves as a mechanism for behavioural control and it involves "Hands on" activity and "Minds on" activity. Only one out of 25 grade 10 LS teachers has a positive view of the practical examinations while a worrying 24 LS teachers had a negative view towards the practical examination. The negative views could be attributed to lack of support at school and DoE levels, poor resources, the need for re-training, lack of expertise, increased workload, time constrains, large classes and lack of consultation with regards practical work and the implementation of the practical examination.

Rogan and Grayson's (2003) framework for curriculum implementation, in particular the constructs for profile of implementation pertaining to practical work, was used to analyse data obtained via the questionnaire and interview to answer research question two (How do grade 10 LS teachers implement practical work in terms of the CAPS requirements?). Grade 10 LS teachers use the demonstrations/micrographs, dissections, "hands on"/ "minds on" and theoretical discussions in order to comply with the LS CAPS requirements for practical work. Our data also shows that some schools still do not engage in real practical work even though it and the practical examinations are a mandated requirement of the LS CAPS policy. Through my analysis for research questions one and two, the gap between LS teachers' views on practical examinations, their classroom practice and the stipulations of the LS CAPS policy in terms of the kind or types of practical work in which teachers should engage learners is exposed. This gap alerts us to a slippage between policy goals, teacher professional development and teacher practice during implementation of policy.

To answer the third research question (What are grade 10 LS teachers' experiences of the capacity to innovate for implementation of the practical examinations?) data from the questionnaire and interview were interrogated using Rogan and Grayson's construct of the capacity to innovate. The physical resources that sculpt grade 10 LS teachers practice in respect of practical work and the practical examination are large classes, lack of laboratories, textbook shortages and lack of equipment. The learner factors that impact the capacity to innovate are learners' home language and the language of instruction, learner discipline and overcrowding, and lack of parental support. The factors that influence the school ethos are school ecology (culture of teaching and learning) and management support (invigilation, timetabling, planning) whilst personal and professional biographies mould the teachers factors for the capacity to innovate. The encounters and experiences of the grade 10 LS teachers in terms of capacity to innovate for the implementation of the practical examination begs the question: how can teachers take ownership for curriculum implementation the absence of adequate training and resources for implementation and poor school ecologies? In the last chapter, I discuss the implications of the finding of this study for teacher professional development.

CHAPTER SIX

Conclusions and recommendations

6.1. Introduction

In this chapter, I first reflect on the use of Rogan and Grayson's framework for curriculum implementation. Second I consider the implications of the findings and make recommendations for future practice. I also evaluate the limitation of this study.

6.2. Reflections on the use of Rogan and Grayson's theory of curriculum implementation and findings

In this section I first focus on the use of Rogan and Grayson's (2003) theory of curriculum implementation as a framework for the study and then I provide a summary of the main findings.

Rogan and Grayson's theory of curriculum implementation was an apt framework to use in this study as it highlights the continuous tensions between the profile of implementation and the capacity to support innovation. The usefulness of the frameworks becomes apparent when one looks at how Rogan and Grayson's constructs of profile of implementation and capacity to innovate interact. That is, how the two are affecting, influencing or impacting each other. Rogan and Grayson (2003) attempted to categorise practice, capacity, and support in stages called levels of operations, progressing from lower to higher levels of development (level 1-4). Levels of operation are identified by the level of development of practice going on in a particular situation. I found the notion of levels, useful in identifying readiness for, and progress toward reform. The level of operation clarifies that different schools and teachers have irregular starting points in terms of physical resources, school ethos, learner factors and teacher factors. For instance, when classroom activities are not linked to the contexts at play, according to this framework the curriculum implementation becomes trivial. Hence, it is important to know the effects of factors coming from capacity to support innovation.

Rogan and Grayson's (2003) model for curriculum implementation vividly exposed the overall build-up that is needed after the design of a curriculum. Rogan and Grayson's profile of implementation gives a concrete description of what takes place inside the classroom in terms of practical work, its frequency, the type of practical work and the level of engagement. The second part of the model, the construct, 'capacity to support innovation', outlines a number of indicators (Physical resources, teacher factors, learner factors and school ethos and ecology) that are internal to the school that may affect implementation. These are crucial structures in determining what leads to effective implementation of practical work and the practical examination. Such factors can either promote or act as hindrances to implementation of the CAPS LS policy. Work and study conditions of teachers and learners, language of instruction, school ethos which includes functionality of school and leadership patterns, easily influence the extent of teaching and learning in terms of practical work. These broad areas depict the importance of well-developed capacity in carrying quality teaching and learning.

The finding of this study crystalises the relational interplay between the capacity to innovate and the profile of implementation as well as the dislocation between the intended and implemented CAPS LS curriculum. Put simply this means that effective curriculum implementation demands commitment to developing the necessary capacity to support changes. This includes amongst other factors, physical resources, teacher factors, learner factors and school ethos and ecology as well as much needed continuous teacher professional development.

Due to the disparity in both physical and human resources, my finding reveal that Rogan and Grayson's level of operation needs to be extend to include level zero as some teachers and school ethos do not support innovation and hence curriculum implementation suffers. Within a short space of time Life Sciences teachers, in South Africa, have been subjected to three major waves of curricular reforms (IC, NCS-FET, CAPS), with several iterations of the curriculum during the NCS-FET wave, therefore there was a need to extend Rogan and Grayson's (2003) framework for curriculum implementation to include the personal well-being of the teacher. The personal welling being of the LS teacher's signal the curriculum reform fatigue teachers are encountering in the absence of supportive environment for curriculum implementation.

The finding of the study confirms that for practicing teachers to be able to implement the curriculum two key factors are essential, viz, continuous teacher professional development (CPTD) and the capacity to innovate. These two key factors are discussed further in section 6.3. Figure three below captures this intricate triad relationship between CTPD, capacity to innovate and profile of implementation.

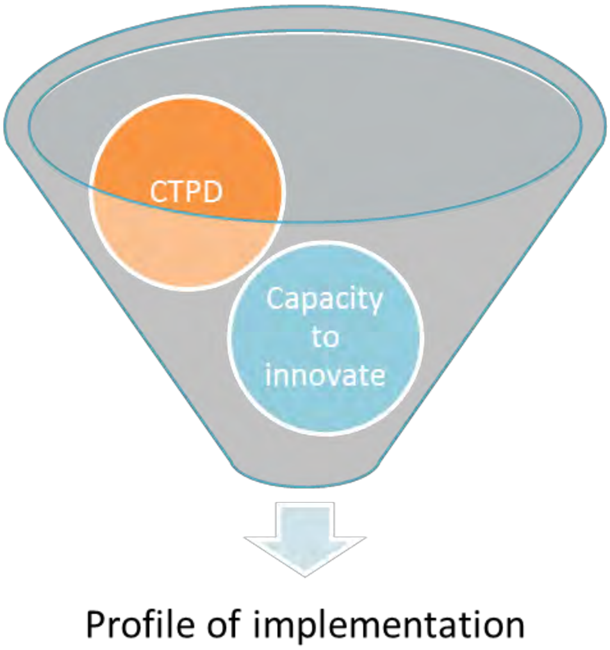


Figure 3: Shows the inter-relation between capacity to innovate, continuous teacher professional development and the profile of implementation.

6.3. The implications of this study

In this section I focus on the discrepancy between the gazetted LS CAPS policy and the grade 10 LS teacher's implemented practice, in terms of the kinds and types of practical work conducted and tested. The above discrepancy has serious consequences for the types of science process skills developed in learners. The CAPS policy is prescribes and foregrounds the competencies that should be developed in learners via practical work and the practical examination; it also advocates that a learner centred approach should be embraced during teaching. The competencies emphasised by the CAPS LS policy are following instructions, handling equipment or apparatus, making observations, recording information or data, measurement, interpretation and design of investigation or experiment.

As stated in the CAPS documents the type of practical work that learners should be exposed to are exercises to develop specific skills, investigations including hypothesis testing or problem solving, experiments to introduce students to particular phenomena, demonstrations to allow the teacher to develop a scientific argument or create a dramatic impression, and fieldwork. However, in reality they are exposed to teacher lead demonstrations that follow a “cook book recipe”. The prescriptiveness of the CAPS policy in respect of curriculum content and assessment is intended to regulate and homogenize teacher practice, but in reality nothing has changed. Grade 10 LS teachers practice is divergent and in the process the ideals of the LS CAPS policy are abandoned. The uncertainty that teachers encounter during curriculum reform becomes explicit. The deviation from the ideals of the LS CAPS policy can be linked directly to the neglect of effective teacher professional development for policy implantation, the lack of capacitation of school managers to buy into and support LS teachers to implement the practical examinations, and the provision of adequate resources for implementation of practical work. All three of these factors mean that implementation of the CAPS LS requirements for practical work and examinations falls far short of the stated intention.

6.4. Recommendations

In line with the findings of this study some recommendations have been outlined below so as to improve the implementation of practical work and the practical examination. These are better teacher professional development, capacitation of school management teams to support the implementation of the practical examination at schools, and the provision of resources to conduct practical work.

6.4.1. Teacher professional development

According to Singh-Pillay and Samuel (2015), and Lieberman and Mace (2008) teacher readiness and preparedness to deal with curriculum reform is key to ensuring that the ideals of a new curriculum are realized. They maintain that it is only through good quality and effective professional development that the classroom practices of teachers change.

Effective professional development integrates teachers' inputs regarding what and how they need to learn and the pace of their learning. Furthermore, it must be instructionally focused and connected to teachers' experiences and pedagogical needs (Lieberman & Mace, 2008). In addition, it must strengthen teacher commitment to their professional growth and increase their motivation to learn (Porter et al., 2003). In spite of research by the above scholars, studies by Bantwini (2009) and Singh-Pillay & Alant (2015) illuminate teachers' displeasure with the 'once-off just in time' cascade model of teacher professional development conducted by subject advisors. The 'once off just in time' approach to teacher professional development treats teachers as homogenous. In other words, it ignores their different experiences, training, contexts, learning needs, their learners' backgrounds as well as the multiple possibilities for engaging learners in learning. This means, the 'one size fits all' model of teacher professional development binds teachers into a culture of 'robotic script following', which may not suit their needs or the needs of their learners. Rather than creating an engaging platform where teachers could deepen their knowledge, practice and learning, the current teacher professional development model negates the variations of how teachers teach as well as how they and their learners learn. All planned teacher professional development for future reforms should first ask teachers about their pedagogical needs. Support offered by the Specifically, Department of Education officials must match the support needed by LS teachers. Moreover, in such support, LS teachers should experience for themselves the kinds on "hands on" and minds on learning that they are expected to provide for their own learners.

6.4.2. Capacitation of school management teams to support the implementation of the practical examination at schools

Efforts should be made by the subject advisors to capacitate school managements teams (SMT) about the requirements of the practical examination; specifically, the organizational logistics for the kind of practical examination envisaged in the LS CAPS policy in terms of invigilation, timetabling, and allocating time to LS teachers for laboratory management and setting up of practical work / examinations as part of the LS teachers workload. The number of invigilators required per 30 learners should be brought to the attention of the SMT. All too often the school management teams are unaware of, or ignore, the pleas of the LS teachers for assistance and support to implement the compulsory practical examination.

6.4.3. Provision of resources

If the goals of the LS CAPS policy are to be enacted in terms of practical work and the practical examination then it is imperative that schools receive the essential resources needed to conduct practical work and implement the practical examination. If resources cannot be supplied then it is crucial that practicing LS teachers be shown what can be done to improvise. In other words LS teachers must be trained on how to improvise, if resources are not going to be provided by the DoE.

6.5. Conclusion

At a theoretical level the findings of the study points to the need to include a level zero and teacher well-being component into the Rogan and Grayson's (2003) theory of curriculum implementation. The disjuncture between the LS CAPS policy goals (in terms of practical work and the implementation of the practical examination) with grade 10 LS teacher practice is illuminate via the findings. The contextual challenges that the grade 10 LS teachers contend with when in the absence of adequately provided professional development needs comes to the fore. The recommendations made speak to the need for adequate teacher professional development that suits the pedagogical needs of teachers, the need to capacitate school managements teams about the requirements of the practical examination, the organizational logistics for the kind of practical examination envisaged in the LS CAPS policy and the dire need to ensure that resources are provided to meet the implementation needs.

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APPENDICES ETHICAL CLEARANCE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

17 September 2014

Mrs Furi nwai Samaneka (214581947)
School of Education
Edgewood Campus

Protocol reference number: HSS/1027/014M
Project title: An exploration of Grade 10 Life Sciences teachers' views on the implementation of the practical examinations in LS at selected high schools in the Estcourt region

Dear Mrs Samaneke,

Full Approval – Expedited Application

In response to your application dated 01 August 2014, the Humanities & Social Sciences Research Ethics Committee has considered the above mentioned application and the protocol have been granted FULL APPROVAL.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

....
Dr Shenuka Singh (Chair)

/ms

Cc Supervisor: Dr Asheena Singh-Pillay
Cc Academic Leader Research: Professor P Morojele
Cc School Administrator: Mr Thoba Mthembu

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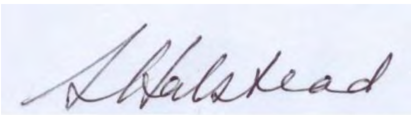
EDITING CERTIFICATE
Furiwari Samaneka,
School of Education, College of Humanities, University of KwaZulu-Natal.
Draft Dissertation:
An exploration of Grade 10 Life Sciences teachers' views on the implementation of the Practical examinations in Life Sciences at selected high schools in the Estcourt region

I confirm that I have edited this dissertation for grammar, appropriate use of academic language or conventions, and coherence of argument. I have also addressed formatting of the preliminary pages, the main text, figures, tables and references. I am satisfied that the student has made the recommended changes in consultation with her supervisors.

I am a native English speaker. As an independent educational consultant, one of my specialisations is writing academic learning material and editing academic documents. I obtained a BSc at the University of Natal, with chemistry and applied mathematics majors. After graduation, I was a Research Officer in the Ministry of Roads and Road Traffic in, as was then, Rhodesia. My duties included writing reports and editing those by other authors. Some years later I entered the teaching profession and studied with UNISA for my postgraduate Higher Education Diploma, achieving a distinction for the English language module. After 20 years teaching at high school, I took up an academic position at the University of KwaZulu-Natal, where I completed an MSc in chemistry education and wrote several research articles. Since retirement three years ago, I have edited numerous academic papers and six theses or dissertations, one of which was judged to be *cum laude*.



Sheelagh Edith Halstead

18 November, 2015

2.A. Informed consent letter –

UNIVERSITY OF KWAZULU-NATAL

School of Education, College of Humanities,
University of KwaZulu-Natal,
Edgewood Campus,
16 July, 2014

Dear Participant

INFORMED CONSENT LETTER

My name is FURIRWAI SAMANEKA, I am a Masters candidate studying at the University of KwaZulu-Natal, Edgewood campus, South Africa.
I am interested in learning about Grade 10 Life Sciences teachers' views on the implementation of the Practical examinations in LS at selected high schools in the Estcourt region.
To gather the information, I will be asking you some questions via a questionnaire and an individual interview. In addition I also require permission to video record the interview.
Please note that:

- Your confidentiality is guaranteed as your inputs will not be attributed to you in person, but reported only as a population member opinion.
- The questionnaire will take 10 minutes to answer and interview may last for about 20 minutes and may be split depending on your preference.
- Any information given by you cannot be used against you, and the collected data will be used for purposes of this research only.
- Data will be stored in secure storage and destroyed after 5 years.
- You have a choice to participate, not participate or stop participating in the research. You will not be penalized for taking such an action.
- You have the right to withdrawal from the research at any time without any negative consequences
- The research aims at understanding Grade 10 Life Sciences teachers' views on the implementation of the Practical examinations in LS at selected high schools in the Estcourt region. .
- Your involvement is purely for academic purposes only, and there are no financial benefits involved.
- If you are willing to be interviewed and have the interview video recorded please indicate (by ticking as applicable) whether or not you are willing to allow the recording by the following equipment:

	Willing	Not willing
Audio equipment		
Video equipment		

I can be contacted at:Tel. No.: 036-3523130
Cell. No.: 0837498124
e-mail : furiesamas@yahoo.com

My supervisor is Dr. A. Singh-Pillay who is located at the School of Education, Science and Technology cluster, Edgewood campus of the University of KwaZulu-Natal.
Contact details: email: pillaya5@ukzn.ac.za Phone number: 031-26053672

My Co-supervisor is Dr. D. Sibanda
School of Education
Edgewood campus,University of KwaZulu-Natal
(Tel): 033-2605847 Email: Sibandad@ukzn.ac.za

You may also contact the Research Office through:
P. Mohun
HSSREC Research Office,
Tel: 031 260 4557 E-mail: mohunp@ukzn.ac.za

Thank you for your contribution to this research.

DECLARATION

I……………………………………………………………………………. (full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project and I am aware that I have the right to withdrawal without any negative consequences

____

Signature **Date**

Appendix 2B

School of Education,
College of Humanities,
University of KwaZulu-Natal,
Edgewood Campus,
16 July 2014

The Principal,

Sir,

Permission to conduct research

My name is FURIRWAI SAMANEKA,I am a Masters candidate studying at the University of KwaZulu-Natal, Edgewood campus, South Africa. I am conducting research on Grade 10 Life Sciences teachers' views on the implementation of the Practical examinations in LS at selected high schools in the Estcourt region.

To gather the information, I will need access to grade 10 Life Sciences to answer a questionnaire and participate in an individual interview. Permission will also be sought from the individual teacher.

- If you are willing to grant me access to your school please indicate (by ticking as applicable)

	Granted	Not granted
Access		

You have the right to withdrawal from the study without any negative consequences
I can be contacted at: Tel. No.: 036-3523130 Cell. No.: 0837498124

e-mail : furiesamas@yahoo.com

My supervisor is Dr. A. Singh- Pillay who is located at the School of Education, Science and Technology cluster, Edgewood campus of the University of KwaZulu-Natal.
Contact details: email: pillaya5@ukzn.ac.za Phone number: 031-26053672

My Co-supervisor is Dr. D. Sibanda
School of Education
Edgewood campus, University of KwaZulu-Natal
(Tel)033-2605847 Email: Sibandad@ukzn.ac.za
Thank you for your contribution to this research.

DECLARATION

I……………………………………………………………………… (full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project. I am also aware that I have the right to withdraw from the study at any time without any negative consequences.

__________________________ ___________________________

Signature: Date

Appendix 3: instruments

3A: Survey Questionnaire

A. Please complete the information needed below:

Age	
Gender	
Number of years teaching in general	
Number of years teaching Life Sciences	
Qualification/s	
Qualification in Life Sciences(Please specify)	
Have you attended any training in Life Sciences for the implementation of the practical exam? Please elaborate about the training and its duration	
How many periods of Life Sciences do you teach per week?	
How many periods of Life Sciences make up your workload?	
Do you teach other learning areas? - Please list them	
Please indicate the number of period's these other learning areas contribute to your workload.	
Level on which you are employed e.g. L1 , L2	Level:

Nature of appointment: Permanent/ temporary	

1. What are your views on practical work? Please elaborate

2. Do you enjoy doing practical work with learners? Please explain.

3. Do your learners enjoy doing practical work? Please explain.

4. What were the most positive experiences that you had when implementing the practical examination? Please explain.

5. What were the most negative experience /problems or difficulties that you had with implementing the practical examination. Please explain.

6. How often do you do practical work in your life sciences classes? Please explain.

7. What type/types of practical work do you engage learners in or prefer to engage learner in? Please elaborate

8. Do you have the resources to engage in practical work as required by the CAPS document? Please explain.

9. Do you feel you are adequately trained to implement the demands made on you in respect of the practical work and the practical examination? Please elaborate.

10. What are your views on the practical exams that the grade 10 and 11 life sciences learners have to write? Please explain.

11. Does having to implement the practical exam impact your workload, teaching, testing? If so, how? Please explain.

12. What impacts the implementation of the practical exam in your school? Please elaborate.

13. What strategies /method do you use to improvise for resources that are lacking at your school for practical work/exams. Please explain.

14. Do you consult with students for resources? Please explain

15. What support structures are available to you for the implementation of practical work /practical exam in your school/ cluster/ ward/ district? Kindly explain.

16. Do you work closely with other Life Sciences teachers when it comes to the practical exams and practical work? Please explain.

3B: Table 6 showing biographical data of LS teachers from questionnaire

no	Gender	qualification	Years of teaching LS	No of period LS per week	Training for practs	Teaching other subjects
1	M	PGCE	2	4	No	y
2	F	Masters	20	20	yes	y
3	M	STD	18	24	yes	Y
4	F	STD	13	16	No	Y
5	M	Chemical engineering diploma	5	18	No	Y
6	F	BSc	27	40	yes	N
7	F	BEd Hons	13	42	No	N
8	F	BA	12	28	No	Y
9	F	Diploma	2	16	No	Y
10	M	HED	21	4	No	Y
11	F	HED	20	18	No	Y
12	M	ACE-LS	20	10	No	Y
13	F	BEd Hons	7	24	yes	Y
14	F	ACE-Technology	18	24	no	Y
15	M	FDE	20	41	Y	N
16	M	BEd LS	4	12	No	Y
17	F	BEd	1	5	no	Y
18	M	HED	19	24	No	Y
19	M	BA	15	24	no	Y
20	M	HED	13	20	No	Y
21	F	STD	8	15	No	Y
22	M	FDE	19	20	No	Y
23	F	Music	5	8	No	Y
24	F	Master	20	42	no	Y
25	M	BPed	24	38	no	Y

3C: Table 8 showing summary of questionnaire and interview responses

Teacher	**Frequency of Practical work**	**Type of practical work**	**Method used**	**Learner involvement**	**Resources/ improvising**	**Teacher well-being/**
1	To meet norm requirement	Theoretical	Teacher lead discussion	Complete cook book worksheet	Use textbook	Uneasy - lacks experience in conducting practs
2	Nil	Nil	Nil	Nil	Locked in HOD office	Not qualified- to teach LS
3	Once a term	Demonstration	Teacher centred	Observation Write report	Get learners to find specimens in environment	Finds pract work challenging
4	Sometimes	Demonstration	Teacher centred	Complete worksheet on demonstration	Use textbook Stock in principal's office	Inadequate, More training need to engage in different types of practs
5	Depends on topic	Micrographs dissections	Learner centred	Help with planning, getting	Use photographs a micrographs,	Love teaching, needs more training in

		demonstrations		materials, making simple apparatus for demonstrations	make simple apparatus e.g. bell jar exp.	practs
6	As per CAPS requirement	Demonstration worksheets	Teacher driven	Complete worksheet	School has limited stock	Uncomfortable – need more guidance for practs
7	As the need arises	Demonstrations	Teacher led	Answer questions based on demonstration	Use local specimens. Make models	Overwhelmed- by pract exam demands
8	Twice a term – as CAPS requires	Hands on Minds on	Teacher/ learner centred	Complete worksheets	Text books local specimens	I don't enjoy pract work
9	Twice per term	Worksheet demonstrations	Teacher centred	Answer questions on demo	Make models - cell division Use local plants parts	I need help with practs/pract exams I'm not ready for this
10	Once a term	Worksheets micrographs	Lead by teacher	Complete worksheet	Use photographs/ charts/ Need equipment	I'm ok, I can do the practs
11	Once a term	Theoretical	Teacher lead discussion	Complete written activity from textbook	Text book No resources	Incompetent – need help and training - for hypothesis Graphs
12	As the need arises	Demonstration worksheets	Teacher lead	Worksheet activity	Whatever is available	I don't like the pract exams- if they want us to have pract exams then we must have resources and be trained properly - this is the cart before the horse
13	Depends on the topic	Demonstration	Teacher lead	Complete worksheet on concepts demonstrated	Local specimens Charts, models made by myself	Partly confident but need training and help
14	Once a year	Worksheet	Teacher lead	Fill in worksheet	Use local specimen	Uncertain - there is no uniformity/ so how do you judge for standards - our learners will always be disadvantaged
15	Not often	Theoretical	Teacher what	Answer questions	textbook	I need help - training, I was not trained to do practs when I qualified
16	Not at all	Nil	Nil	Nil	Nil	Not trained to teach LS
17	Twice per term	Micrograph/models charts worksheet	Learner centred	They make the charts/models and are assessed	Use local materials	Unhappy- we are never asked about changes
18	To meet CAPS requirement	Micrograph Dissection/observation	Teacher/learner centred	Help in getting specimens from local area	Try to use local resources Make models	Confident –did practs at UDW Need physical resources
19	To meet CAPS requirement	Worksheet demonstration	Teacher what	Complete worksheet	Use local specimens from surrounding	Sad - I'm not confident doing practs, I need to be trained to use some equipment - I want to learn
20	To meet CAPS requirement	Demonstration micrographs	Teacher what	Use charts/ photos of microscopic structures	Textbook charts	Confused - too many demands for practs exams suddenly – no training

21	Once a term	Demonstration	Teacher what	Answer questions	Local resources/ make models	Uneasy - I don't know what I will be expected to do when CAPS changes - too many changes to soon
22	Seldom	Theoretical	Teacher what	Answer question from text book	Text book – no equipment	Unhappy- I did not do practs in school or college, we don't have lab and we are not trained for practs but we must do the pract exams
23	As the need arises	Demonstration	Teacher what	Answer worksheet	Local specimens	Tired - to many curricular changes from 1994 - it must stop
24	Depends on the topic	Hands on Worksheets demonstrations	Teacher/ learner what	Write report Complete worksheet Draw and label	Local specimens/make models / borrow equipment	Confident- I did practs at UGZ
25	Depends on the topic	Demonstration theoretical	Teacher what	Answer questions in textbook	Textbook	I'm not confident - but to have this fancy pract exam we need basic resources- we can't find it all – disadvantages schools will not benefit if they are poor in resources

3.D. Questions for semi structured interview:

1. What are your views on practical work?
2. What type of practical do you use in your LS classroom? Please explain why you use these types of practical.
3. What are your experiences of having to implement the practical examination? please elaborate
4. Please explain if and how the following impact the implementation of the practical exam:
   4.1. Physical resources
   4.2. School ethos/management
   4.3. You
   4.4. learners

3E: interview transcripts

TEACHER 5

I: What are your views on practical work?

T5: Practicals are important, Learners can see the link between theory and their lives- so they get excited and want to know more.

I: What types of practicals do you engage learners in? Please explain why you expose your learners to these types of practicals.

T5: hands, on

I: what do you mean by hands on?

T5: When learners manipulate and use apparatus

I: Why do you expose to this type of practicals?

T5: Learners behave badly when I teach, the classes are so large, it's hard to control them, but when I do practs they are all quiet and very well behaved

I: What are your experiences of having to implement the practical examination? Please elaborate

T5: It's a bad experience

I: Please elaborate:

T5*:* It's a challenge to run the practical exams, I have to have many sessions for the exams, there are classes from A-G and each with more than 60 learners, you can't move freely in the class, the apparatus is not enough to set many workstations, most of it is broken, you can't get money to buy chemicals for food test, or specimens eg. Heart that are needed for the pract exam – you can't test the types of practs wanted by CAPS if there are no resources

With large classes it impossible to invigilate for hands on practs , I can't be at three places at the same time, other teachers who are not LS teachers can't respond to learner queries

Teacher 6

I: What are your views on practical work?

T6: Hands on

I: what do you mean by hands on?

T6: Hands on is when learners handle apparatus

I: Please explain why you use these types of practical.
T6: I watch them interacting, getting along, during practs – it's division of labour in action-to complete the pract and get the pract report in on time - when it's done they feel good about themselves, it's the only time they work together.

I:What are your experiences of having to implement the practical examination? Please elaborate
T6: I have three classes of 61 children doing Life sciences. For me to manage equipment for such large classes is impossible, learners pinch small items, like the test-tubes, spatulas, scalpels, and put them in their pockets, or break them. Controlling the equipment is very difficult.

I: Please explain what factors affect the implementation of the practical exam:
T6: Resources, we need to be trained

Teacher 9

I: What are your views on practical work?

It is minds on

I: What types of practicals do you engage learners in?

T9: Minds on

Please explain why you expose your learners to these types of practicals.

T9: This is the only time learners are curious , they ask questions

I: What do you mean by minds on?

T9: It when they are quiet and they do an exercise or write up the report after my demonstration, its straight forward aim, results, conclusion
I: Why do you expose to this type of practicals?

I: What are your experiences of having to implement the practical examination? Please elaborate
T9: Not good
I What do you mean?
T9:I have to make my own arrangements to get teachers to invigilation for the pract exams- the office don't see this as an official exam, they say make you own arrangement, have it outside the exam period,

T9: I need help, I was not trained at college for practical work, and the CAPS training did not cover practical work, they only focus on theory

Teacher 10

I: What is your view on practical work?

T10: Pract work helps learners to understand concepts like osmosis… when I teach they don't know what osmosis is – when I demonstrate osmosis and show endosmosis and exosmosis then they link it to their daily live – like cooking

I: What kinds of practical work do you engage in?

T10: Minds on

I: What do you mean by minds on?

T10: Minds on is when they fill in a worksheet after the demonstration… you can't ask hard questions they will fail… the worksheet only has questions on the demonstration

I: Why do you prefer these methods for practical work?

T10: In my classes girls and boys are equal – in fact I encourage girls to answer question. Girls are actively involved in practs, they are taking on roles as investigators and not recording and observing they are not only observing or identifying , they set up, manipulate equipment, do the practs, interpret and write the report – they are more involved that boys nowadays

I: What would make you feel more confident to conduct these practicals kindly explain?

T10. there are cheaper things that I can use that I want some tips from anyone who ever tried something better than what I am using

T10: Aaaah if I can have a class with a minimum of thirty learners even if I don't have tools to use that can be better.

I:What were your experience in 2012 when the first grade 10 practical examination was implemented at the end of the year

T10: IT was negative, I need help, I couldn't cope