CLASSROOM PRACTICES OF SOME NATURAL SCIENCES TEACHERS OF THE VHEMBE DISTRICT, LIMPOPO PROVINCE

by

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DECLARATION

STUDENT NO. 5513-143-3

I, ***Ndivhuwo Prudence Netshivhumbe*** declare that this dissertation **"Classroom practices of some Natural Sciences teachers of the Vhembe District, Limpopo Province"** is my own work and that all the sources I have used or quoted have been indicated or acknowledged by means of complete references.

I further declare that I submitted the dissertation to originality checking software and that it falls within the accepted parameters for originality.

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19 July 2018
DATE

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SUMMARY

The purpose of this study was to explore the classroom practices of Senior Phase Natural Sciences teachers in some of the schools of the Vhembe District. Qualitative case study approach was employed and three teachers participated. The following research questions were explored: What is the level of the teacher's subject-matter knowledge in the teaching of Natural Sciences (NS)? What is the nature of the teacher's instructional strategies in the teaching of NS? How does the teacher's subject-matter knowledge and instructional strategies shape the teachers' classroom interaction and discourse in the teaching of NS? Interviews, observations and a questionnaire have been used for data collection. Teachers used their teaching experiences to teach NS. Results indicated lack of teachers, facilities and resources. It is recommended that the Department of Education as an arm of government should see that schools have the facilities, resources and teachers they need for proper teaching and learning as well as providing sufficient workshops to improve teachers' classroom practices.

***Keywords**: Classroom practice, teacher knowledge, instructional strategies, Natural Sciences, Senior Phase, classroom interaction and discourse*

KAKARETSO

Sepheo sa thuto ena e ne e le ho hlahloba mekhoa ea litlelase tsa matichere a Phahameng ea Setsebi sa Tlhaho ea Setsebi tse ling tsa sekolo sa Vhembe. Ho ne ho sebelisoa mokhoa o nepahetseng oa ho ithuta litsebo le matichere a mararo. Lipotso tse latelang tsa lipatlisiso li ile tsa hlahlojoa: Mokhoa oa mosuoe oa mosuoe ke oa mofuta ofe thutong ea Saense ea tlhaho? Mokhoa oa mekhoa ea koetliso ea tichere ke efe tabeng ea thuto ea saense ea tlhaho? Mosuoe oa mosuoe o tseba joang le mekhoa ea ho ruta e amanang le ho sebelisana ha tichere le ho bua ka thutho ea saense ea tlhaho? Lipuisano, litlhaloso le lipotso. E sebeliselitsoe ho bokella data. Barupeluao ba ile ba sebelisa liphihlelo tsa bona tsa thutho ho ruta saense ea tlhaho. Liphello li bonst'a ho haelloa ke matichere a saense ea tlhaho, mehaho le thepa. Ho khothalletsoa hore Muso le Lefapha la Thuto lo bone hore likolo li na le mehaho, lisebelisoa le matichere bakeng sa thuto le thutho e nepahetseng hammoho le ho fana ka lithupelo tse lekaneng bakeng sa ho ntlafatsa mekhoa ea matichere ea tlelase.

***Mantsoe a sehlooho**: Tloaelo ea tlelase, tsebo ea matichere, mekhoa ea ho ruta, Setsebi sa Tlhaho, Mohato o Moholo, ho sebelisana ka tlelaseng le puo*

OPSOMMING

Die doel van die studie was om die klaskamerpraktyke van senior Fase Natuurwetenskappe-onderwysers in sommige skole van skole in die Vhembe-distrik te ondersoek. Kwantitatiewe gevallestudie-benadering was in diens en drie onderwysers het deelgeneem. Die volgende navorsingsvrae is ondersoek: Wat is die aard van die onderwyser se onderwyser kennis in die onderrig van Natuurwetenskappe? Wat is die aard van onderwyser se onderrigstrategiee in die onderrig van Natuurwetenskappe? Hoe vorm die onderwyser se kennis en onderrigstrategiee die onderwyser se klasinteraksie en-diskoers in die onderrig van Natuurwetenskappe? Onderhoude, waarnemings en vraelys wat gebruik word vir data-insameling. Deelnemers het hul onderrigervarings gebruik om Natuurwetenskappe te onderrig. Resultate dui op gebrek aan Natuurwetenskappe-onderwysers, fasiliteite en-bronne. Dit word aanbeveel dat die regering en die Departement van Onderwys moet sien dat skole fasiliteite, hulpbronne en onderwysers het vir behoorlike onderrig en leer, asook voldoende werkwinkels om onderwysers se klaskamerpraktyke te verbeter.

***Sleutelwoorde**: Klaskamerpraktyke, onderwyserkennis, onderrigstrategiee, Natuurwetenskappe, Senior Fase, klaskamergesprek en diskoers*

ABBREVIATIONS

CAPS	Curriculum and Assessment Policy Statement
CK	Content Knowledge
DBE	Department of Basic Education
DoE	Department of Education
FET	Further Education and Training
IRE	Initiation, Response and evaluation
ISMK	Incorrect Subject Matter Knowledge
LoLT	Language of Learning and Teaching
M	Misconceptions
NCS	National Curriculum Statement
NS	Natural Sciences
PCK	Pedagogical Content Knowledge
PGCE	Post Graduate Certificate in Education
RNCS	Revised National Curriculum Statement
SMK	Subject Matter Knowledge
SP	Senior Phase
SPNS	Senior Phase Natural Sciences

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CHAPTER 1:
INTRODUCTION

1.1 Research background

The key factors that make teaching and learning effective and manageable are availability of teaching aids, teachers, and facilities. One of the major challenges is that most schools, especially more rural schools do not have access to these key factors. Contextual factors such as large class sizes and under-resourced and unconducive learning environments (Onwu and Stoffels, 2005) have significant influence on teaching and the learning of science. Besides, Onwu & Stoffels (2005) indicate that even though democracy dawned in 1994 in South Africa, there are still schools that are under-resourced in townships and rural areas, which also have under-qualified science teachers.

The Vhembe District is one of the districts found in the Limpopo Province that is dominated by rural schools, and most of these rural schools are facing educational challenges such as a lack of qualified science teachers and poor infrastructure, as well as lacking resources to support teaching and learning (Tshiredo, 2013). Moreover, in the past few years the Department of Education (DoE) in the Vhembe District noted that only a few learners choose science subjects in the Further Education and Training (FET) phase. One of the reasons inhibiting learners' interest in science is a lack of a science foundation, which is normally caused by having under-qualified teachers (Mtsi and Maphosa, 2016). According to De Jong et al (2002) there is a strong relationship between what teachers know, and how they teach.

Murphy et al (2007) indicated that teachers at primary schools had to cope with teaching of Natural Sciences (NS) though they lack confidence in the subject matter. Therefore, these teachers fail to lay a good foundation of science to learners by teaching less than expected content. Mudau and Nkopodi (2015) indicated that teachers lack confidence and find it difficult to teach Natural Sciences (NS) due to lack of subject matter knowledge (SMK). Furthermore, McNall, Krall & Lott (2009) indicated that some teachers still use traditional teaching in NS rather than involving learners in practical activities in or outside the classroom i.e. investigations, experiments.

Consequently, this study focused on teacher's classroom practices as the basis from which to understand the teaching of Natural Sciences in some of the rural schools of the Vhembe District.

1.2. Problem Statement

According to the National Curriculum Statement (NCS) (DoE, 2011), Natural Sciences at the senior phase level lays the basis of further studies in more specific science disciplines, such as Life Sciences, Physical Sciences, Earth Sciences or Agricultural Sciences. I observed that in the past few years of teaching in the Vhembe district, not many learners choose science subjects in the FET Phase. This is not isolated to Vhembe District as Braund and Reiss (2006) indicate that the problem exists in some developed countries of the world as well, where fewer learners are choosing to study science at higher levels and pursue as a career. Furthermore, from anecdotal evidence, in rural schools there are teachers who teach Natural Sciences (NS) without the necessary qualifications e.g. Post Graduate Certificate in Education (PGCE) specializing in NS. Mudau and Nkopodi (2015) further indicate that under qualified teachers lack confidence, and consequently find it difficult to teach Natural Sciences (NS). Many studies have been done in Natural Sciences (Mtsi & Maphosa, 2016; Kokonyane, 2015; Anthony, 2015 and Sitsebe, 2012), but they did not focus on classroom practices.

Mtsi & Maphosa (2016) study focused on challenges in the teaching and learning of Natural Sciences and reported lack of required infrastructure and resources for science teaching. Kokonyane (2015) study focused on opportunity to learn Natural Sciences and reported that schools are provided with prescribed NS curriculum but they received no guidance on how and when to teach specific topics. Anthony (2015) study focused on factors related to Natural sciences learner performance and reported that inappropriate teaching strategies, overcrowded classrooms, lack of discipline, inadequate conceptual comprehension, lack of laboratory equipment and resources, non-compliance with Curriculum Assessment Policy Statements, and incomplete or unsatisfactory preparation of teachers' lesson plans as factors affecting learners performance. Sitsebe (2012) study focused on student discourse in a Natural Sciences classroom and reported that the performance of learners in external examination depends on patterns of discourse employed in the classroom. Accordingly, it was the purpose of the study to explore the classroom practices of Senior Phase Natural Sciences teachers in some of the schools of the Vhembe District.

1.3. Research questions

The following questions generated from the problem of the study.

1.3.1. Research Main question

- What are the classroom practices of Senior Phase Natural Sciences teachers in some of the schools of the Vhembe District?

1.3.2 Sub-questions

- What is the nature of the teacher's subject-matter knowledge in the teaching of Natural Sciences?
- What is the nature of the teacher's instructional strategies in the teaching of Natural Sciences?
- How does the teacher's subject-matter knowledge and instructional strategies shape the teacher's classroom interaction and discourse in the teaching of Natural Sciences?

1.4. Aim and objectives

1.4.1 Research main aim:

- To explore the classroom practices of Senior Phase Natural Sciences teachers in some of the schools of the Vhembe District.

1.4.2 The following objectives generated from the main aim of the study:

- To describe the nature of the teacher's subject-matter knowledge in the teaching of Natural Sciences.
- To determine the nature of the teacher's instructional strategies in the teaching of Natural Sciences.
- To understand how teacher's subject-matter knowledge and instructional strategies shape the teacher's classroom interaction and discourse in the teaching of Natural Sciences (NS).

1.5. Rationale of the study

Though the government made enormous efforts in training and recruiting qualified science teachers in the schools of Limpopo Province, South Africa, there are still schools in rural areas of Vhembe District that are lacking teachers who specialise in Natural Sciences (NS). Therefore, such teachers find it difficult to teach science subjects, especially Natural Sciences (NS). The aim of this study is to explore the classroom practices of Senior Phase Natural Sciences teachers in some of the schools of the Vhembe District.

The study is important to the current Natural Sciences (NS) teachers and anyone who wishes to teach Natural Sciences (NS) in the Senior Phase (SP) to gain a better understanding of how to teach NS. Although the study is limited on how teachers teach NS in three schools of Vhembe District, it also highlights some of the challenges that teachers experience when teaching NS in rural schools. This study could assist the government together with teachers to solve the problems associated with the teaching of NS. Furthermore, it will encourage the teachers to form science association programs where they can share ideas on contemporary issues in NS education.

1.6. Limitations and delimitations

1.6.1. Limitations

The focus of the study was on three NS teachers in the Vhembe District, Limpopo Province. Two of the three teachers were teaching grade 7, and the other teacher was teaching grade 8. The fact that the study only focused on 3 teachers in the Vhembe district may be viewed as a limitation of the study, however through the rich description provided during analysis of data the finding may be applicable to other districts with similar contexts.

1.6.2. Delimitations

Although the study was conducted with three Senior Phase Natural Sciences (SPNS) teachers from selected schools, the findings were not generalised to other schools teachers in the district. However, the comprehension of the classroom practices of the cases of this study should also assist other teachers and interested stakeholders in the Vhembe district and other districts as well.

1.7. Research structure

This section highlights the outline and organisation of all the chapters included in this study.

Chapter 1: introduction

In this section the following are presented: research background, problem of the study, research questions, aims and objectives, rationale of the study, limitation, structure of the research and chapter summary.

Chapter 2: Literature review

This section discusses the literature reviewed in order to gain an understanding on the theories of the research including the discussions of the results of other researchers that had an interest on the topic of exploring the teaching of Natural Sciences. The theoretical framework and conceptual framework used in this study are presented in this chapter.

Chapter 3: Methodology and Design

This section presents the methodology and design of the research that were employed in order to explore the classroom practices of senior Natural sciences (NS) teachers in some of schools in the Vhembe District, Limpopo Province.

Chapter 4: Data analysis, discussion and findings

This section presents data obtained from three Senior Phase Natural Sciences (SPNS) teachers. The analysis of the results, discussions and findings are presented in this section.

Chapter 5: Conclusion and recommendations

This chapter presents the answers to the research questions, summaries of the findings, contributions of the research as well as recommendations of the study.

1.8. Summary of the chapter

This section first provides data of the research background followed by the problem of the study. The research questions, aims, rationale and limitations of this research are also provided. This section also indicates what the next four chapters comprise of. In conclusion, the next chapter presents the literature review including the theoretical and conceptual framework of the research.

CHAPTER 2:
LITERATURE REVIEW

2.1. Introduction

McMillan (2004) define research as a discipline inquiry of gathering, interpreting and reporting data by means of using principles that are acceptable in order to verify that a knowledge claim is reasonable. Research is a process of gathering data and analysing the data collected logically for a specific purpose (McMillan & Schumacher (2014). This section presented the discussion of the literature associated to Natural sciences (NS) teaching, which results from a review of mostly related research.

This literature review was done in order to gain an understanding on the theories of the research and the results discovered by other researchers who had an interest on the subject of exploring the teaching of NS. The discussion focuses on the teaching and learning of NS by highlighting the findings as well as identifying the gaps in the teaching practice of the subject matter.

The results of the reviewed literature are discussed in sequence. Firstly, a discussion which highlights the subject NS in CAPS is presented. Secondly, the views of several researchers associated to factors influencing the teaching of NS come next. Thirdly, the discussion on NS teaching and learning approach succeeds the factors discussions. Although the discussion of NS teaching is presented third, its impact should not be taken lightly because it is the basis on which the vital aspect of this study is rooted. Fourthly, discussions on teaching strategies of NS are presented. Lastly, classroom interaction and discourse in Natural sciences (NS) classroom are presented, followed by the theoretical framework and conceptual framework underpinning this study.

2.2. Natural Sciences in CAPS

According to Curriculum Assessment Policy Statements (CAPS) Grades 7 – 9 Natural Sciences (DBE, 2011a, 2011b and 2011c), science is a systematic way of looking for the explanations of the ideas and connect such ideas. This means that the knowledge that learners attain in the NS classroom enable them to exercise discovery skills by means of searching for various explanation of a particular idea and look for the connectivity. NS curriculum consists of four knowledge strands, namely Life and Living, Matter and Materials, Energy and Change, Planet Earth and Beyond and they are used to organise the content of the subject NS (DBE, 2011a, 2011b and 2011c).

DBE (2011a, 2011b and 2011c) it is important for teachers to connect the ideas of related topics in NS to assist learners to achieve a thorough understanding of the nature of and the connectedness in NS. This means that the teachers must use prior knowledge in the NS teaching to connect to new information of related topics for learners to gain knowledge of science and able to see the connectivity of Senior Phase Natural Sciences. NS provide learners the opportunities to make sense about the environment based on the ideas they learnt during NS lessons as well as encouraging them to ask questions that could lead to further research and investigation (DBE, 2011a, 2011b and 2011c). This means that NS subject enable learners to relate what they learn in the classroom with the environment around them.

According to CAPS Natural Sciences Grades 7 – 9 DBE (2011a, 2011b and 2011c), NS consists of the following three specific aims namely, the doing of science, knowing the content and make connections, and understanding of the uses of sciences. According to the NS first specific aim of doing science (DBE, 2011a, 2011b and 2011c), learners have an opportunities to learn through doing, e.g. perform experiments, doing investigation. Moreover NS require learners to know the content and make connections on the ideas learnt (DBE, 2011a, 2011b and 2011c), therefore it is the task for a teacher to teach the learners in such way that they will be able to learn and understand the ideas of NS subject. Furthermore, NS learners need to be assisted to see that what they are learning in science at school can be relevant to everyday life.

Senior Phase NS develop and improve learners' thinking and reasoning skills. DBE (2002c), process skills refers to the learner's cognitive activity of creating meaning and structure from new information and experiences. DBE (2011a, 2011b and 2011c) indicated that learners can develop and improve cognitive and practical skills such as experimenting, investigating, recording information, analysing and interpreting information as well as asking questions during NS lessons. This means the NS encourages learners to think on their own and come up with relevant information on specific ideas. The NS assessment should be based on NS content and its specific aims (DBE, 2011a, 2011b and 2011c). This means NS activities, both formal and informal must be focused on NS specific aims for the purpose of developing and improving learners thinking and reasoning skills.

2.3. Factors influencing the teaching of Natural Sciences (NS)

2.3.1. Language of teaching Natural Sciences (NS)

The teaching and learning of NS subject can be influenced by means of several issues and one of these issues is the language used during NS lesson. Language is important in our lives and it plays a very important role in and out of the classroom. NS is taught in English and teachers are required to use such language when teaching NS to their learners. Some of the learners the language used in the teaching and learning of NS, which is English, is not their home language. According to Sethusha (2015), the language in Education Policy (DoE, 2010) advocates teaching in English, which is not a home language in Limpopo Province. Language is essential for identifying the concepts and relating the concepts with one another and for building up a completely new domain in cognitive and communicative terms (Anthony, 2015).

Rural schools face different problems compared to urban schools when it comes to developing and improving their instruction strategies in science. In some rural schools, one of the major issues is the Language of Learning and Teaching (LoLT) Natural Sciences (NS). Sethusha (2015) states that rural schools face a multitude of challenges and the most important is the language used in the classroom when teaching. The learners must learn several vocabularies in the NS. Learners are expected to use English when communicating and writing class activities in the NS classroom, the result being that learners find it difficult to understand the concepts taught if they are not good at English. Ong and May (2004), observed that the problem is worsened if the science teachers are not proficient in English. Sethusha (2015) indicates that some teachers use Tshivenda to explain certain abstract concepts when they teach, which is referred to as code switching; and teachers felt compelled to do this because learners are not proficient in English as Language of Learning and Teaching (LoLT).

Furthermore, Msila (2013) indicates that language has a strong effect on educational quality, especially so in rural and historically black schools in South Africa, which have the problem of giving instructions in English and it, affects greatly the quality of education. This means that a science language can be used in a variety of ways in a NS classroom and it can influence learner's science career. The NS teacher has to help NS learners to learn the science language, e.g. terminology. It is therefore imperative for NS teachers to be assisted to teach NS that matters. By so doing, NS will be meaningful to the teachers and teachers will be able to come up with some strategies to assist their learners to understand science vocabulary and relate scientific concepts to learners' experiences.

2.3.2. Natural Sciences (NS) teachers

NS teaching can be effective if specialised teachers are available in schools to offer the subject. Tshiredo (2013) says that a shortage of science teachers and scientific expertise is a reality that exists in many schools in Vhembe District. There is a lack of teachers to offer science subject in some African countries and in some instances teachers available to teach science may not be qualified to teach the subject (Muwanga-Zake, 2001). Some schools do not have enough science teachers and the teachers available at schools are offering a subject they are not qualified to teach. Tshiredo (2013), some teachers who teach science did not major in it, but they do so because of the shortage of science educators. Therefore, some teachers choose what they could teach and disregard what they could not due to lack of science background (Tshiredo, 2013).

Mudau (2013) indicated that teaching difficulty is a situation where the classroom practice of the teacher fails to create meaningful learning, resolve misconceptions, developing of inquiry as well as problem solving skills and these influences the performance of the learners. The teacher who does not have adequate knowledge on a subject will find it difficult to use various instruction and resources to assist the learners to learn particular concepts. Additionally, this might cause the teacher to become uncomfortable because it is not easy to teach what you do not understand.

Some teachers hesitate to teach science subject because of the limited knowledge they have on the subject. According to Ramnarain and Fortus (2013), if teachers have problems in understanding some of the topics in the subjects that they teach, it raises concerns around their content knowledge (CK). Some studies (Kola, 2013; Ogunniyi and Rollnick, 2015), noted the problem of the existence of unqualified science teachers in schools in Africa and how this negatively affects quality science teaching and learning. Dudu (2013); Makgato and Mji (2006) show concern on the problem of lack of qualified science teachers in South African schools.

The teachers who have knowledge on the subject and instruction can make NS teaching and learning to be effective in schools. De Jong, Veal and Van Driel (2002), indicated that there is connectivity between what the teachers knows and the way they deliver their lessons. According to Yilmaz-Tuzun (2008), teachers who have the subject content find it easier to use different instruction and appropriate activities. Hence, it is very important for the Department of Education to hire a qualified teacher for particular subjects because the knowledge that the teachers have on a subject influences the aspects of teaching such as preparation, planning and the decisions made regarding the content to be taught.

For the learners to receive proper education the teacher with knowledge of the subject matter must be available in schools. RNCS (DoE, 2002c), teachers in schools must be qualified and dedicated in order to accomplish their roles as indicated in the Norms and Standard for education. Some teachers at schools knew learners by names and that assists them to maintain order, grabs learner attention and identifies areas of content where learners still need interventions. Therefore, it is imperative for teachers to identify learners in their classroom.

2.3.3. Resources

Tobin (1992), states that a teachers' purpose is to provide the best materials and learning situations to make learning individually meaningful for each student. The resources needed for teaching NS are listed against each topic in order to assist teachers with planning and preparation (DBE, 2011). According to Taylor (2008), a good textbook lays the curriculum out systematically providing expositions of the concepts, definitions of the terms and symbols of the subject in question, worked examples of problems, lots of graded exercises, and answers.

Lack of resources to support teaching and learning is a reality in some rural schools. In very rural areas, there are shortages of resources such as textbooks, laboratory equipment, projectors and charts in the teaching and learning of NS, which are compounded by a lack of facilities resulting in the hindering of proper teaching and learning of NS. Sethusha (2015) states that teachers lack supporting materials such as textbooks and other teaching aids. Sethusha (2015) further reports a lack of facilities such as libraries and laboratories in some schools. According to Tshiredo (2013), it is difficult to teach science in a school where there are limited science resources and particularly no laboratories.

In South Africa, during a national review of the Implementation of the NCS involving hearings and submissions from teachers, it was stated that learners had not been provided with sufficient textbooks and that some textbooks were of dubious quality (DBE, 2009). This, points to serious problems in effective science curriculum implementation. Limited resources, however, encourage teachers to modify the curriculum by utilising hands-on experiences (Stern & Marcella, 2008). Vicente (2013), although teachers have limited resources, they will need to exercise creativity to source alternative resources in order to implement Scientific inquiry if they wish to develop the problem solving skills of their Grade 9 NS learners.

Availability of classrooms, laboratories, libraries as well as adequate textbooks are important aspects for proper teaching and learning at schools as they can assist in meeting the goals of the curriculum. Textbooks also offer a crucial resource for teachers in their planning and in gaining access to the appropriate knowledge and skills to teach at an appropriate level (DBE, 2009). McKinney (2013), found that textbooks offer teachers the comfort and convenience of having lessons planned out and worksheets easily available on demand. In a study conducted by Ogunmade (2005) in Lagos, Nigeria, involving the status of secondary school Science teaching, teachers indicated that one of the most important factors inhibiting teaching and learning of Science was insufficient resources. According to Mudulia (2012), for effective science teaching, textbooks, revision books, laboratory chemicals and equipment must be readily available.

2.3.4. Pedagogical Content Knowledge (PCK) in Natural science teaching

The teachers require subject knowledge, pedagogical knowledge and knowledge of learners' preconception. Subject matter knowledge (SMK) pertains to disciplinary knowledge, which is usually acquired through formal education in universities and colleges (Ijeh, 2012; Ozden, 2008; Shulman, 1986). Miller (2007), describe PCK as knowledge, which allows teachers to assist learners to access specific CK in a meaningful way. Teachers having pedagogical knowledge can make NS teaching effective. With pedagogical knowledge, teachers can be able to fulfil their daily tasks in school including instruction and classroom management without any difficulties.

Pedagogical knowledge is normally obtained through formal education training and classroom teaching experience (De Jong, 2010, Schneider and Plasman, 2011).

Knowledge of learners' preconceptions entails the knowledge teachers have about the ideas, views or beliefs learners bring along to the classroom from their own background experience, before they learn about a particular topics or concept to be taught (Juttner & Neuhaus, 2012; Morrison & Lederman, 2003; Treagust & Duit, 2008). An outstanding science teacher with sufficient PCK may develop superb teaching and learning strategies, organise and control the class, also compose interesting additional activities and methods to use in class that might enhance learner achievement (Lombaard, 2015).

In South Africa, policy documents such as the RNCS and CAPS consist of knowledge of the curriculum that can be used to improve PCK in the learning environment. An Integrated Quality Management System (IQMS) can assess the teacher personal and professional development. Consequently, Head of Department (HOD) should be appointed on the strength of their subject expertise, and they should provide opportunities for teachers to improve their subject and pedagogic knowledge through individual and small group mentoring, establishing peer support groups, and commissioning in-service training for teachers within the school, from external service providers or from District level subject advisors (Vicente, 2013).

2.4. Natural Sciences (NS) teaching and learning approach

In South Africa, NS teachers have a three-hour weekly teaching time allocation (DBE, 2011a, 2011b and 2011c). Even though a slightly limited number of hours have been allocated for NS teaching, it has been shown that some teachers are not using their time effectively (Vicente, 2013). Hattingh, Aldous and Rogan (2007), report that a small percentage of teachers were on track, but that many teachers still failed to interpret the learning area policy and plan relevantly, which could make the ideal goals set by the Education Department futile. Teachers should be prepared to actively teach for the minimum number of hours a day, every day as specified by policy (Vicente, 2013).

Taylor (2008), further reports that with the curriculum overload, teaching in most South African schools is moving too slowly to cover anywhere near the demands of the curriculum. National Curriculum Statement (NCS) suggests that teachers should be given guidance and support in the curriculum documents on how to teach specific content, concepts and skills (DBE, 2009). The NS subject deals with the promotion of scientific literacy by developing and using science process skills in a variety of setting, application of scientific knowledge and understanding and appreciation of the relationship and responsibilities between science, society and the environment (DoE, 2002c).

CAPS Natural Sciences Grades 7 - 9 DBE (2011a, 2011b and 2011c), state that one needs to be careful when making selection of content, and make use of a variety of approaches to teaching and learning science. Furthermore, teaching of NS should promote understanding of the following (DBE, 2011a, 2011b and 2011c):

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

2.5. Teaching strategies

A NS classroom involves many activities that demand certain process skills from the learners and it is the task of the teachers to develop and improve some of these skills in their learners. Some teachers used traditional teaching methods and that can disadvantage learners as they might not develop and improve some of process skills required in NS. The traditional lecturing methods are used because of teachers being used to these methods due to their teaching experiences (Lombaard, 2015). Lombaard (2015) further reports that learners deal with vast amounts of information in class due to teachers' traditional teaching strategies. Therefore, learners fail to connect new knowledge with their prior knowledge because they are likely to memorise concepts without understanding. According to Tekkaya and Yenilmez (2006), this might result in a lack of enthusiasm, boredom, irritation and memorisation among learners without contributing to understanding.

Some teachers view teaching as telling and other learners think learning is all about memorisation. Friedriechsen et al. (2009) found that science teachers hold on to their deductive teaching strategies and find it difficult to deviate from these strategies. Teachers must use different methods for teaching science like inquiry, diagrams, models, hands-on activities, assessment, etc. It is imperative for science teachers to make use of teaching through inquiry to challenge learners and themselves to expand their teaching method and learners' thinking skills.

NS teaching should be learner centred in order for learners to develop knowledge and skills such as demonstrating, investigating, interpreting data as well as communication skills. Therefore, the methods and resources the teachers decide on must be relevant to the content to be taught for learners to achieve the desire knowledge and skills. Some schools might be running short of resources but teachers can still improvise to make teaching and learning more interesting. Science lessons require both theoretical and practical sessions. NS promote learning that is active both in the classrooms and in laboratories, where learners can engage in authentic learning processes, such as cooperative learning, group work, practical work, etc.

Practical work in science is acknowledged and widely accepted as an important component in the teaching and learning of scientific concepts (Toplis and Allen 2012; Kibirige et al. 2014). Researchers like Haslam and Hamilton (2010), Abrahams (2010), Gyllenpalm et al. (2010), agree that practical work in schools can effectively and strongly support exploration, manipulation and development of concepts and can make the concepts manifest, comprehensible and useful. The activities that require the use of laboratory in NS can encourage learners to be actively involved and find learning more interesting and enjoyable as well as develop and improve learners' skills such as observing, problem solving and analysis. According Tshiredo (2013), some of the materials in schools that have a little equipment look like they have never been touched. Tshiredo (2013), further reports that it might be the teachers' inadequate knowledge on how to use the laboratory chemicals that makes them feel reluctant to visit their laboratories for experimental activities.

Although researchers agree that practical work in science is important, teachers face challenges in doing practical work (Heeralal, 2014). Teachers may also lack both the practical skills and practical knowledge of how to use certain equipment and therefore choose to avoid practical work completely (Muzah, 2011:193). Motlhabane (2014) revealed that conditions in secondary schools are not satisfactory for doing practical work. According to Tshiredo (2013), most of the activities that need the laboratory are done inside the classroom by using chalk and board.

2.6. Classroom interaction and discourse in Natural Sciences classroom

Classroom discourse refers to the language that students and teachers use to communicate in the classroom (Foy, 2013). In a NS classroom, the students consider the teacher as a more capable peer with whom meaning is constructed through shared discourse (Rollnick, 2000). Learner achievement is highly dependent on a knowledgeable and capable teacher; high quality instructional materials, equipment, and resources; pedagogical content knowledge; and a safe rich environment for learning (DBE, 2011). Teachers should fulfil various roles that include being mediators of learning, interpreters and designers of learning programmes and materials, researchers, lifelong learners and learning area specialists (DoE, 2002c).

According to Mortimer & Scott (2003), interactions and discourse in the science classroom between the teacher and students is fundamental to learning because it is central to the meaning making process. Teachers also draw from multiple discourses to frame, explain and describe concepts and phenomena (Gomez, 2007). The teaching of science can be difficult or effective; stemming from the kind of discourse the teacher uses (Mudau, 2013).

The classroom interaction and discourse emphasise on the types and patterns of discourse, communicative approach and teacher questioning (Mudau, 2013). The authoritative, dialogic and reflective discourses are types of science classroom discourse (Mudau, 2013). According to Chin (2006), authoritative is a discourse that a teacher conveys information and the utterances are often made up of instructional questions and factual statements, while dialogic discourse encourages debates and challenges. In reflective discourse Chin (2006), revealed such discourse as a condition where teachers use a process of negotiation of alternative ideas rather than transmission or confrontation to assist students in understanding the concepts. Communication is part of NS classroom interaction and discourse as it built a relationship among learners, and between learners and teachers, and as well as their environment.

2.7. Theoretical and conceptual framework

Science education has been strongly influenced by constructivist thinking (Taber, 2009). Constructivism theory is a theory of knowledge and learning, which emphasizes the teaching context, student prior knowledge and interaction between the student and the content (Mudau, 2013). The learning of Natural Sciences (NS) is in its own way an investigative, constructive process (Hohenstein & Manning, 2010). Therefore, it is essential for teachers to translate data that need to be learned in an appropriate manner. For example, knowing the learners' current state of understanding, a teacher can encourage learners to discover principles on their own.

Teaching based on a constructivist view of learning considers learners' thinking, where teachers first create the opportunities to enter into a meaningful dialogue with the learners and then make use of the opportunities to interact with the learners' thinking according to Vicente (2013). According to Garbett (2011), in order to use a constructivist approach in science teaching, the teacher must have confidence and be ready to answer any type of question that will arise when learners combine their prior knowledge with the new. According to Hausfather (2001), teachers' content knowledge within constructivism theory is important for the development of understanding in students. Hausfather (2001), further indicated that the teacher supports the use of the new knowledge by creating situations wherein students interact with information, using it to solve problems, discussing interpretations and answering questions as it becomes their own.

Maxwell (2005) defines conceptual framework as the systems of concepts, assumptions, expectations, beliefs and theories that support and inform your research. Maxwell (2005) further indicates that it is something that one builds from pieces borrowed elsewhere and so it is not something that is ready-made. This study uses both theoretical and conceptual framework in order to explore teachers' classroom practices with a focus on teacher knowledge, instructional strategies, interactions, and discourse inside the classroom. Classroom practice diagnostic framework (CPDF), which is underpinned on the constructivism theory, is an alternative diagnostic tool for science classroom analysis that can be used to diagnose teaching difficulties and provide aid with information to assist in professional training of in-service teachers (Mudau, 2013). Classroom Practice Diagnostic framework (CPDF) has been adopted to guide the study because the study involves teacher practices in the classroom. CPDF has assisted the researcher in exploring Natural Sciences teachers' knowledge, instructional strategies as well as classroom interaction and discourse towards their teaching and the connectivity among teachers' knowledge, instructional strategies as well as classroom interaction and discourse.

2.7.1. Classroom practice diagnostic framework (CPDF)

This section indicates what CPDF consists of as well as how it has been used in the study. A study by Mudau (2013), shows that CPDF consists of four main domains, namely teacher knowledge (frame A), instructional strategies (frame B), interaction and discourse (frame C), and diagnosed classroom practices (frame D). **Error! Reference source not found.** Figure 1 displayed that frame A is a source where teacher's practice can be understood. Furthermore, it supports and affects every action of the teacher as it holds the fundamental knowledge in respect of teaching. In this study, teachers' knowledge comprised of content, context, and learners' understanding knowledge. Thus, CPDF hierarchy emphasises that teachers' knowledge is essential for an effective Natural sciences teaching.

By using CPDF, the researcher was able to examine whether the teachers do have appropriate knowledge for supporting the teaching of the learning area of concern, i.e. Natural Sciences. Hence, teachers with appropriate knowledge supporting Natural sciences teaching have a content knowledge that leads to good understanding of curriculum and learner preconceptions. Limited knowledge on a subject influences teachers' classroom practices.

An instructional strategy (Frame B) is the outcome of teachers' knowledge. Teachers use their knowledge when determining the instructional strategies to be used. Therefore, teachers' knowledge influences the way the teacher teaches. Teacher instruction may consist of methods, explanatory framework and activities. The instructional strategies that the teacher decides on can result in additional interaction and discourse in the classroom (Frame C).

In this study frame, C entails types of discourse, pattern of discourse, teacher questioning as well as communicative approach. The classroom discourse emphasises on the types of discourse, these being authoritative, dialogic and reflective discourse. It is vital for teachers to re-examine the ways they are using discourse in the classroom. It is not uncommon for science classrooms to consist of primarily teacher talk and not enough learner interaction. For example, if a teacher speaks 90% of the time in a classroom, and uses complex scientific terms that learners are not familiar with, some of the learners can develop a view that science is difficult which might result in learners losing interest in science and not enjoying the subject. This kind of situation would not only limit learner participation but also complicate the meaning of scientific vocabulary. Therefore, frame A and frame B result and shape frame C. Frame D (classroom practice diagnosed) is influenced by what happens in frame A-C. Furthermore, there is a relationship among all the frames and small letters a, b, c, d, e and f as shown in figure 1.

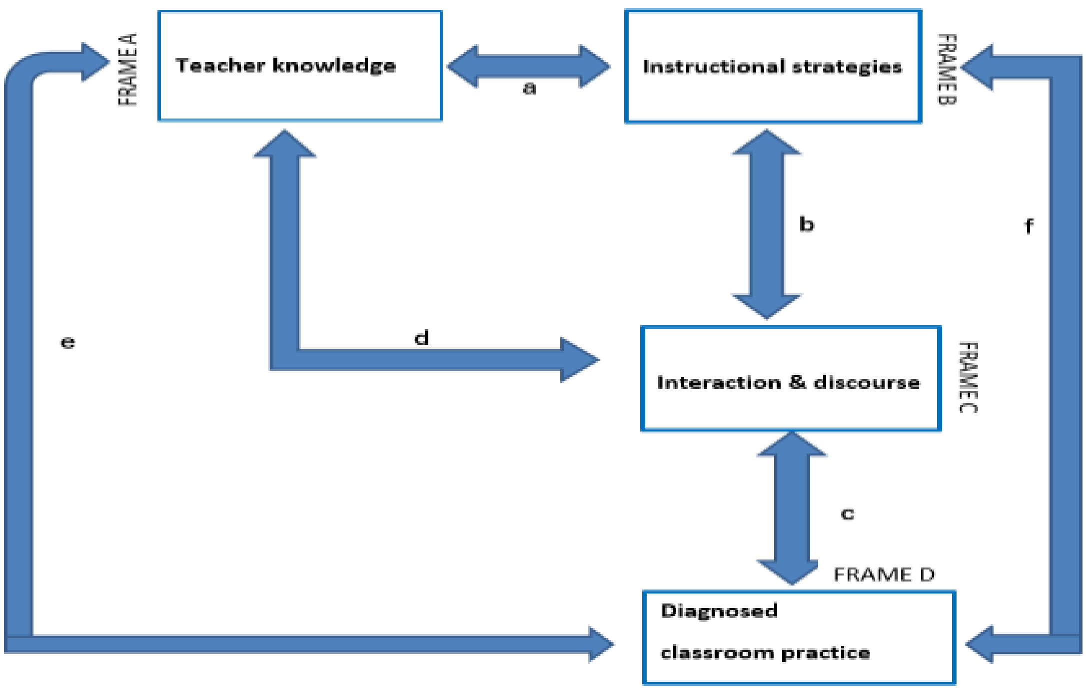

Figure 1: Classroom practice diagnostic framework (CPDF) (Mudau, 2013)

2.7.2. The application of CPDF in the study

Mudau (2013) used CPDF to diagnose teaching difficulties of projectile motion on teacher classroom practices. However, in this study CPDF was used in diagnosing the classroom practices of Senior Phase Natural Sciences teachers. The CPDF enables the researcher to examined teacher knowledge, instructional strategies and interaction and discourse employed during teacher classroom practice.

Eryilmaz et al (2002) indicates that a teacher is expected to know the common misconceptions and experiences of students and their prior knowledge so that they can introduce the new subject matter from those constructs for students to learn the new subject matter. The study focuses on teachers; therefore, the study expected teachers to have Natural Sciences teaching knowledge. The framework was used as a frame of reference to evaluate teacher knowledge on Natural Sciences teaching and how the teacher employed instructional strategies as well as the interaction and discourse. Moreover, the subject matter knowledge (SMK) the teacher used during the lesson was noted. Therefore, it was not only about diagnosing the teacher knowledge but also finding out whether the teacher used prior knowledge to connect with new information.

The framework was further used to diagnose how the teacher supported the meaning making process (Leach & Scott, 2003 and Mortimer & Scott, 2003). In this study communicative approach and discourse, the teacher used during the lesson when introducing the subject content was noted. Furthermore, CPDF was used to diagnose how the teacher knowledge and instruction used facilitate interactions and discourse within the classroom. How the teacher used prior knowledge also had an impact on subject matter. Hausfather (2001) stated that learning involves continuous connection between prior knowledge and the new subject matter.

The final frame of the framework was used as a reference point to diagnose the instructional strategies, interactions and discourse the teacher used in assisting learners to respond the questions initiated in the classroom. The framework also diagnoses instructional strategies and the interactions and discourse the teacher used for the development of cognitive and improvement of thinking skills.

2.8. Chapter summary

In conclusion, chapter two begins by giving an introduction of the literature reviewed. The review of literature is given under five subheadings. The literature reviewed in this study discloses the reality of a lack of qualified science teachers and a shortage of sufficient resources for teaching and learning science. The literature review suggests that teachers must make use of variety of resources, which addresses the content to be taught as indicated in the CAPS document. The literature reveals very little about how teachers deal with the challenges that the curriculum brings and there is no full understanding of how teachers make their decisions when faced with a different teaching approach. The impact of these factors on the teaching of science is applicable to teachers, especially those teaching in rural areas, irrespective of whether the area is classified as developed or underdeveloped. After discussing, some of the relevant literature linked to this study, theoretical framework and conceptual framework is suggested to guide the study. Theoretical framework and conceptual framework enables the researcher to identify the key concepts and approaches to use for data collection and analysis. The research methodology and design are discussed in the next chapter.

CHAPTER 3
METHODOLOGY AND DESIGN

3.1. Introduction

This chapter presents the research methodology and design that has been used to explore the teaching of Natural Sciences (NS) in the rural schools of Vhembe District in the Limpopo Province of South Africa. The following aspects are addressed in this chapter: research approach of the study i.e. qualitative case study approach; the nature of the research; context of the study; rigor; techniques and procedures that were used in the study for data collection; and ethical considerations. The researcher finalized the chapter with a summary.

The main objectives of this study are as follows:

- To explore the classroom practices of Senior Phase Natural Sciences teachers.
- To describe the nature of the teacher's subject-matter knowledge in the teaching of Natural Sciences.
- To determine the nature of the teacher's instructional strategies in the teaching of Natural Sciences.
- To understand how teacher's subject-matter knowledge and instructional strategies shape the teacher's classroom interaction and discourse in the teaching of Natural Sciences (NS).

3.2. The qualitative case study approach

Maree (2007) indicated that researchers have used the case study research method for many years across a variety of disciplines to answer ''how'' and ''why'' questions. Creswell (2007) defines a case study as an in-depth exploration of a bounded system (e.g. activity, event, process, or individuals) based on extensive data collection. According to McMillan and Schumacher (2001), a case is a tool with which a researcher selects to gain an in-depth understanding of participants or documents for study.

For the purpose of this study, a qualitative research design approach was employed to provide possible explanations of phenomena under exploration. Maree (2007) identified six types of qualitative research designs, namely conceptual studies, historical research, action research, case study research, ethnography research and grounded theory. The researcher has used the case study as a research mechanism to serve the patent need to develop a full understanding on the teaching of Natural Sciences (NS) in three schools positioned in the Vhembe District.

According to Sitsebe (2012), a case study allows rigorous data collection, using several methods (triangulation), and allows a situation to speak for itself rather than be largely interpreted by the researchers. This investigation requires interaction with teachers in their schools to elicit data that could assist in answering the research questions. Therefore, the qualitative case study is an appropriate approach for this study. With this approach, the researcher has been able to understand and describe how three teachers in Vhembe District are teaching Natural Sciences (NS) in their classroom.

In this study, a multiple case study design has been used because the research target was three Natural Sciences teachers. Furthermore, the researcher used a multiple case study design for the reason that the teachers have different backgrounds, qualifications and teaching experiences. Consequently, each teacher is considered as a case, and each case comprises of the description of the environment for teaching and learning and teacher description. The data was collected by observations, questionnaires and interviews.

3.3. The nature of the research

The choice of the research design is based on the researchers' assumptions, research skills and research practice, and influences the way in which they collect data (Maree, 2007). For this reason, the researcher has adopted a qualitative approach underpinned by an interpretative paradigm to collect and analyse data in order to be able to answer the research questions. Leedy and Ormrod (2001) report that qualitative approach allows the researcher to focus on the actions performed, as well as to read and listen to the words in all of their complexity as they occur in a natural setting or in a real context.

In this study, three Natural Sciences (NS) teachers were observed in their classrooms during NS lessons and interviewed in their schools. Therefore, with a qualitative approach the researcher had an opportunity to interact with the participants of the study. Moreover, the qualitative approach was suitable for this study because the researcher was able to observe teachers in practice throughout NS lessons. In relation to the interpretive paradigm, qualitative research emphasises the dynamic, holistic and individual aspects of human experiences and endeavours to capture the very same aspects in their entirety, taking into account the environment of the participants (Silverman, 2000). A qualitative approach enabled the researcher to explain the order of what occurred during the teacher classroom practice.

The researcher officially visited the research site twice per school for data collection, whereby different techniques were used to collect data. Finally, inductive reasoning was then applied when working on the data collected. McMillan and Schumacher (2014) pointed out that qualitative researchers do not formulate hypotheses and gather data to prove or disprove them; rather the data is gathered first and then synthesised inductively to generate generalisations. In addition, Inductive reasoning enables qualitative researchers to create a picture from a piece of information obtained (McMillan and Schumacher, 2014).

All of the information gathered by different techniques leads to trustworthiness of the study. Additionally the researcher triangulated the results obtained from multiple techniques to enhance the trustworthiness of the study. The techniques relate to each other because all of the techniques used generated data that focused on Natural Sciences teaching. Consequently, sources pointed in the same direction and instil confidence upon the researcher about the research findings. A clear understanding of words and actions are the fundamental components of the study. These components empower the researcher to provide solid answers for research questions.

3.4. Research context

In this section of the chapter, the researcher presents the research setting, the sampling process and the criteria used when the selection of participants (cases) was made. In addition to sampling process, cases are also discussed.

3.4.1. The setting

The setting of the study is in the Limpopo province. The Limpopo province is one of the nine provinces found in South Africa. As shown in figure 2, the province consists of five districts), namely Mopani, Vhembe, Capricorn, Waterberg and Sekhukhune. The focus of this study was on the Vhembe district Department of Education (DoE) see figure 2 below. The Vhembe district was chosen because the quality of education of some schools found in the district is negatively affected by a shortage of classrooms, teachers and resources. According to Tshiredo (2013), many schools in the Vhembe district are under-resourced. Tshiredo (2013) further indicates that it is difficult to find a school with a well-equipped laboratory, enough classes and learner support materials. There are schools in the Limpopo province where teachers hold their lessons outside of the classroom due to overcrowding and shortages of infrastructure (Nicolson, 2013).

The Vhembe district (see figure 2 below) is positioned in the northern part of Limpopo Province, South Africa. It shares borders with Botswana, Zimbabwe and Mozambique. The seat of the Vhembe district is Thohoyandou, and was the capital of the former Venda Bantustan. The University of Venda is situated in Thohoyandou in the Vhembe district and the researcher resides in the rural area of the Vhembe

District. The Vhembe District consists of clusters and each cluster consists of circuits of schools. There are 7 clusters and 27 circuits of schools in Vhembe District. In this study, the data has been collected in the Vhembe District from three rural schools found in Vhuronga 2 circuit under Vuwani cluster (also shown in in figure 3)

Figure 2: Districts found in Limpopo Province (Capeinfo, 2009)

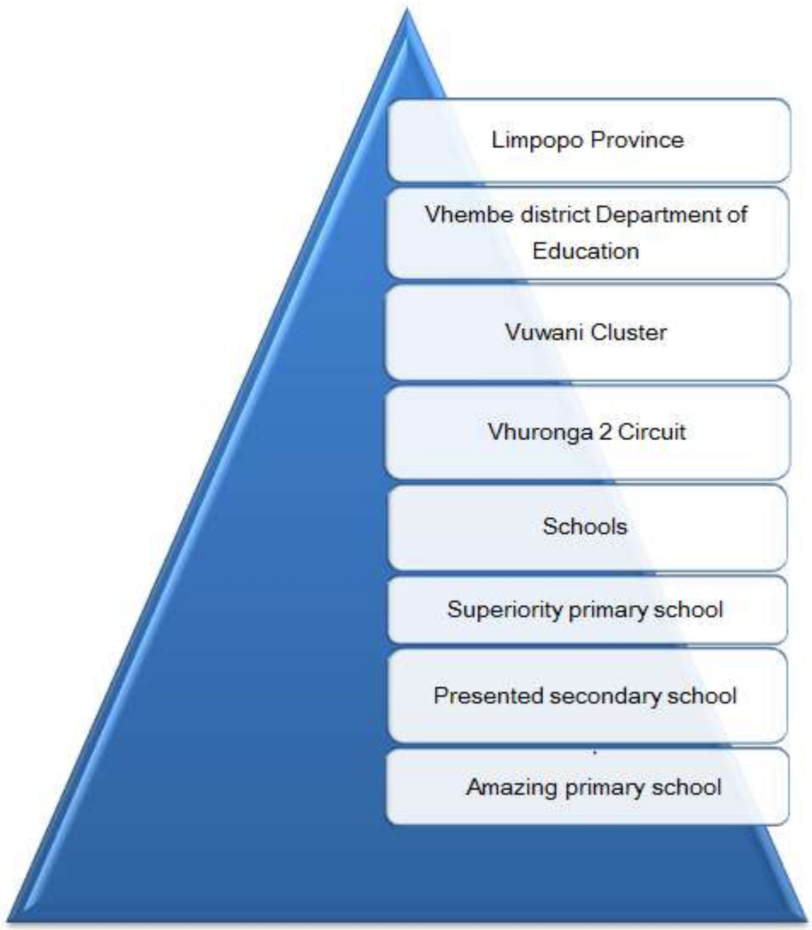

Figure 3: Research setting

3.4.2. Sampling process

Rammala (2009) defines a sample as an element of the population considered for actual inclusion in the study or a subset of measurements drawn from a population we are interested in. In qualitative data collection, purposeful sampling is used so that individuals are selected because they have experienced the central phenomenon (Creswell, 2003). In this study, purposeful sampling was used because it enables the researcher not to spend more time gathering data. In short, the researcher was favoured in terms of time. By using a purposeful sampling, the researcher managed to include three participants (cases) according to relevant criteria that assisted in meeting the objectives of this study. Therefore, it was not necessary to collect data from each rural public school in Vhembe District in order to acquire valid findings.

For the purpose of gaining insight on teachers' classroom practices in the Vhembe District, three rural schools participated in this study. The study engaged in an in-depth study of teachers' classroom practices in the teaching of Natural Sciences. A purposive sampling of three teachers (cases) participated in the study. The participated were currently offering senior phase Natural Sciences and they participated willingly throughout the research process. Consequently, from selected schools, the researcher gained knowledge and understanding from those involved in the teaching of Natural Sciences.

The data was collected from one teacher in each of the three schools that participated in the study. The researcher eluded revealing the names of schools and participants who took part in this study. The names of the participants and schools presented in this study are pseudonyms. The pseudonyms of both participants and schools the researcher proposed for this study was as follows:

- Jane from Superiority primary school
- Charity from Presented secondary school
- Kay from Amazing primary school

3.4.3. The cases

For exploring the classroom practices of Natural Sciences teachers at rural schools, the study focused on three schools. The researcher observed and conducted individual interviews with Natural Sciences teachers from each school. Therefore, the study comprises of cases of three Natural Sciences teachers. The cases of this study are detailed as follows:

A. Jane from superiority primary school

Superiority primary school is an old school situated in an anonymous village. Superiority primary school offers primary school education to people in the village and other neighbourhoods. The school admits Tsonga speaking and Venda speaking learners. The teachers within the school speak Venda whereas others speak Tsonga as their home language. About 95% of the learners in the school live in the village where the school is found.

The school offers grades R-7, and it is not well resourced in terms of teaching aids and facilities. The school has registered approximately 325 learners and does not have a science laboratory. In 2018, the school had one Natural Sciences class, with 50 learners registered for grade 7. Natural Sciences is allocated 3 hours per week, a single period in NS is of 30 minute duration while the double period is of 60 minute duration. NS is taught 4times per week, with 2 days allocated single period of 30 minute duration and 2 days allocated double period of 60 minute duration. The learners are taught in English as the medium of instruction. Jane is a black female teacher and she has been in the teaching field for 16 years. She has been teaching Natural Sciences for 13 years. She teaches Natural Sciences mainly to grade 7's and some other grades. She holds a teaching qualification of Senior Primary Teacher Diploma where she specialised in Mathematics, Biology, English, Afrikaans and Bed Hons.in management.

B. Charity from Presented secondary school

Presented secondary school is situated in the village. Presented secondary school consists of Venda speaking staff and learners. Presented secondary school has enrolled approximately 455 learners and the school is not well resourced. Presented secondary school offers grades 8-12 and does not have a science laboratory. Grade 8 Natural Sciences is allocated 3 hours per week, a single period in NS is of 30 minute duration while the double period is of 60 minute duration. The learners are taught in English as the medium of instruction. In 2018, the school had 115 learners in grade 8. There are two classes allocated for grade 8 learners. Charity is a black male teacher and he has been teaching for 18 years. He has been teaching Natural Sciences for 15 years. He holds a qualification of Higher education diploma majoring in physical sciences and mathematics.

C. Kay from Amazing primary school

Amazing primary school is situated in the village of African people. Amazing primary school offers primary school education to people in the village and other localities. The school has old facilities and it is not well resourced. The majority of learners in the Amazing primary school live in the village where the school is located. Both teachers and learners in Amazing primary school speak Venda and Tsonga as their home language. The learners are taught in English as the medium of instruction. Amazing primary school offers grades R-7. The school enrols approximately 305 learners and does not have a science laboratory. In 2018, the school admitted 44 learners in grade 7. Kay is a black male teacher and holds a qualification of Bachelor of Arts; post graduate certificate (Senior Phase and Further Education and Training) specialised in geography and Tsonga; and Environmental Education. He has 6 years teaching experience and 6 years' experience teaching Natural Sciences.

3.5. Rigour

According to Maree (2007), in qualitative research the researcher is the data-gathering instrument. Maree further indicates that when qualitative researchers speak of ''validity and reliability'' they are usually referring to research that is credible and trustworthy. Lincoln and Guba (1985) state that credibility; dependability, confirmability and transferability are key criteria, which form the framework for determining the rigor of the research. The researcher used the following criteria to ensure that the work of the study is of high quality.

- Credibility(internal validity)
- Dependability
- Confirmability
- Verisimilitude
- Triangulation
- Pilot study

3.5.1. Credibility (internal validity)

Credibility is a way of making sure that the reader believes or is convinced by the findings of the research process (Flanagin and Metzger, 2007). To maintain credibility in this qualitative research, the supervisor has assessed interview protocol, observational tool and questionnaire to ensure that they serve the purpose they were designed for. The researcher also showed five natural sciences teachers who were not part of the main study data collection instruments i.e. interview protocol, observational tool, questionnaire and also requested them to complete questionnaire for that reason, the researcher invited corrections, comments, and additional information from the teachers. Moreover, one of the five teachers was used in a pilot study where all instruments proposed for data collection were tested. The participants of the main study were given an opportunity to see all the instruments consist of the information collected from them. In short, data obtained from each participant was kept safe for allusion and shown to participants before being considered as an ultimate product.

3.5.2. Dependability

According to Lincoln & Guba (1985), and Merriam (2002), dependability or consistency in qualitative research is considered in terms of the findings not changing. In this study, different techniques used to attain data and the findings of the research stayed the same. Furthermore, the techniques used supported each other and resulted in data that displayed connectivity. Maree (2010) defines dependability as the degree to which the reader can be convinced that the findings did indeed occur as the researcher says they did. To achieve this, the researcher employed member checking (Maree, 2007). The identified themes were discussed with participants to ensure that the themes are accurate and dependable (Creswell, 2003). To manage this, the researcher triangulated all of the data that was collected throughout the research process in order to search for common themes to provide reliable findings (Maree, 2007). Maree (2007) further indicates that the researcher must strive to eliminate any bias that might be brought to the study by constantly reflecting on the research process.

3.5.3. Confirmability

Confirmability refers to the neutrality and accuracy of the data (Tobin and Begley, 2004). Moreover, confirmability is concerned with establishing that data and interpretation of the findings are not figments of the inquirers' imagination, but clearly derived from the data (Tobin and Begley, 2004). To accomplish this point, the researcher kept all of the data collected through observation, interviews and questionnaires safe. Consequently, confirmability in qualitative research highlights a crucial element that a study has been properly carried out. This encourages confirmation and support, not only from the researcher, but from other researchers who undertake similar studies (Mothokwa, 2014)

3.5.4. Verisimilitude

In this study, the researcher used direct quotes from cases when analysing and presenting findings where essential in order to reduce data interpretation of the researcher to be questioned. In addition, the participants' voices are presented in italics. This is referred to verisimilitude where the reader will be in the world of the participants. Moreover, in this study where it was necessary the researcher spoke on participants' behalf and their voice in the research report was maintained.

3.5.5. Triangulation

According to McMillan & Schumacher (2010), Merriam (2009), different methods of data collection, including interviews, observation and a questionnaire, were employed to increase the credibility of the findings and consistency of the results with the data. In this study, data was collected through classroom observation, interviews and a questionnaire. Therefore, triangulation techniques were used. According to Cohen et al. (2007), triangulation is the use of two or more methods to collect data. Consequently, the researcher corroborated what the teachers said in the interviews with what was observed in the classroom, which is methodological triangulation (Gall et al., 1996; and Hitchcock & Hughes, 1995). For the purpose of methodological triangulation, all participants were interviewed before the lesson and after the lesson. The participants were given an opportunity to go through the entire instrument that contained the data obtained from them for clarity and to check if the researcher captured exactly what they (the participants) said.

3.5.6. Pilot study

The instruments used in this study were piloted to ensure that they were valid. The instruments were presented to the supervisor for his comments. Thereafter the instrument was refined and tested with one teacher who was not part of the main study but similar to the participants from whom data of this study was collected. The following was learnt during the pilot study:

- After the researcher and two teachers from one school agreed on the dates of piloting, one of two teachers changed her mind about participating on the day of piloting. Therefore, the piloting was carried out with one teacher. This taught the researcher that some of the teachers might pull out or make an excuse on the agreed dates for data collection.
- The data of the pilot study was collected during school hours and it applied with the data of the main study.
- A few questions from the interview and observational tool were not clear and such questions have been changed for clarity purposes.
- The data obtained during piloting was massive and the researcher did not expect so much data, though the studies indicate that even more information can be obtained in this way. However, that assisted the researcher to be aware about the time and effort that would be required in the main study.
- After writing the results and analysing them, the researcher decided on how data would be presented in the final report.

- The research questions have been amended after the pilot study.
- The pilot study alerted the researcher to revisit the literature reviewed and search for other literature related to the study.
- The pilot study aided the researcher to develop and exercise a data analysis scheme (DAS)

In conclusion, the pilot study provided the researcher with an opportunity to be prepared and think of ways to handle the main study.

3.6. Data management

In this section of the chapter, the researcher presents the discussion on data collection techniques, the process of collecting data, how the data was analysed and interpreted as well as how the data was presented and discussed.

3.6.1. Data collection techniques

The aim of this subsection is to present all the different types of techniques that have been used and how they were used for data gathering in this study, namely observations, interviews, and a questionnaire. The above-mentioned techniques are explained in subsections below.

A. Classroom observation

Maree (2007) defines observation as a systematic process of recording the behavioural patterns of participants, objects and occurrences without necessarily questioning or communicating with them. In this study, the researcher went to the teaching and learning facilities where the participants were observed on duty.

A classroom observational tool was developed (

Appendix C) for the purpose of this study. The observational tool is intended to evaluate the environment for teaching and learning, teacher subject knowledge, instructional strategies, classroom interaction and discourse in the Natural Sciences classroom. Mudau (2013) indicates that observation technique is suitable to capture classroom interaction and discourse. Since this study desires to know how teachers are teaching Natural Sciences in the Senior Phase, Mudau’s suggestion on classroom observation has been considered. Hence, interaction and discourse can be discovered through classroom observation.

The researcher gathered data during observation by means of both direct and video recording. The video recording recorded everything that the teacher was doing during the lesson (e.g. presentations, movement and classroom interactions) and such recordings played an important role when the researcher was analysing data at a later stage.

B. Interview

According to Maree (2007), an interview is a two-way conversation in which the interviewer asks the participant questions to collect data and to learn about ideas, beliefs, views, opinions and behaviours of the participant. Maree further indicated that the aim of qualitative interviews is to see the world through the eyes of the participant, and they can be valuable source of information, provided they are used correctly.

The data was collected by making use of a semi-structured interview (Appendix B) that was administered according to an interview timetable. The researcher gathered data during the interviews by means of both direct and audio recording. The individual interviews supplied the researcher with information on aspects like teacher knowledge, instructional strategies as well as resources available to support teaching. Each participant was interviewed before and after the lesson in his or her schools.

The pre-observation semi-structured interview was conducted in order for the researcher to know what the teacher intended to do during the Natural Sciences lesson. The post-observation semi-structured interview was conducted in order for the researcher to know if teaching and learning went according to plan as well as to identify any potential areas for improvement. Therefore the pre-observation and the post-observation semi-structured interview were considered as an essential method for data collection since it provided qualitative data that was useful for researcher to answer the research questions.

C. Questionnaire

According to Maree (2007), a questionnaire is an extremely important part of the research process since this is where the data is generated. Maree further emphasised that the design of a questionnaire requires the researcher to give attention to the appearance of the questionnaire, question sequence, wording of questions and responses categories.

In this study, a questionnaire (Appendix A) was used for data collection. The questionnaire was distributed to three selected schools and the participants completed the questionnaire. The teacher questionnaire was divided into two sections. Section A concentrated on the teacher background. Section B concentrated on the teaching details of the participant. The framework of a questionnaire was in a correct order and clear.

Firstly, the researcher requested five Senior Phase Natural Sciences teachers who were not part of the main study to complete questionnaire. However, such sample teachers were used in order to identify vagueness presented in the questionnaire. Therefore, the questionnaire was refined which enabled the researcher to edit and amend other sections for clarity purpose. Before the participants of main study completed the questionnaire the researcher explained sections of the questionnaire and informed the participant to feel free to ask whenever there is a question that needs to be raised.

3.6.2. Data collection process

In this study, the researcher first seeks for necessary permission from the District Department of Education to conduct the study in order to be able to gain access to both research sites and participants. Moreover, the researcher requested permission from the school principals. Once the permission was obtained, the teachers were then approached. Upon agreement to take part in the research, the researcher worked with them throughout the research process.

In this study, qualitative data was collected by means of observations, interviews and a questionnaire. The researcher visited the schools that were selected. This allowed the researcher to explain to participants how the data gathering procedures will take place. Techniques that will be used for data gathering were also discussed in sequence. Firstly, the researcher presented a discussion of data that would be collected through semi-structured interviews with participants. Secondly, a discussion of data that would be collected through lesson observation with participants was presented. Lastly, the discussion on data that would be collected through the questionnaire was presented. figure 4 display a summary of data collection process.

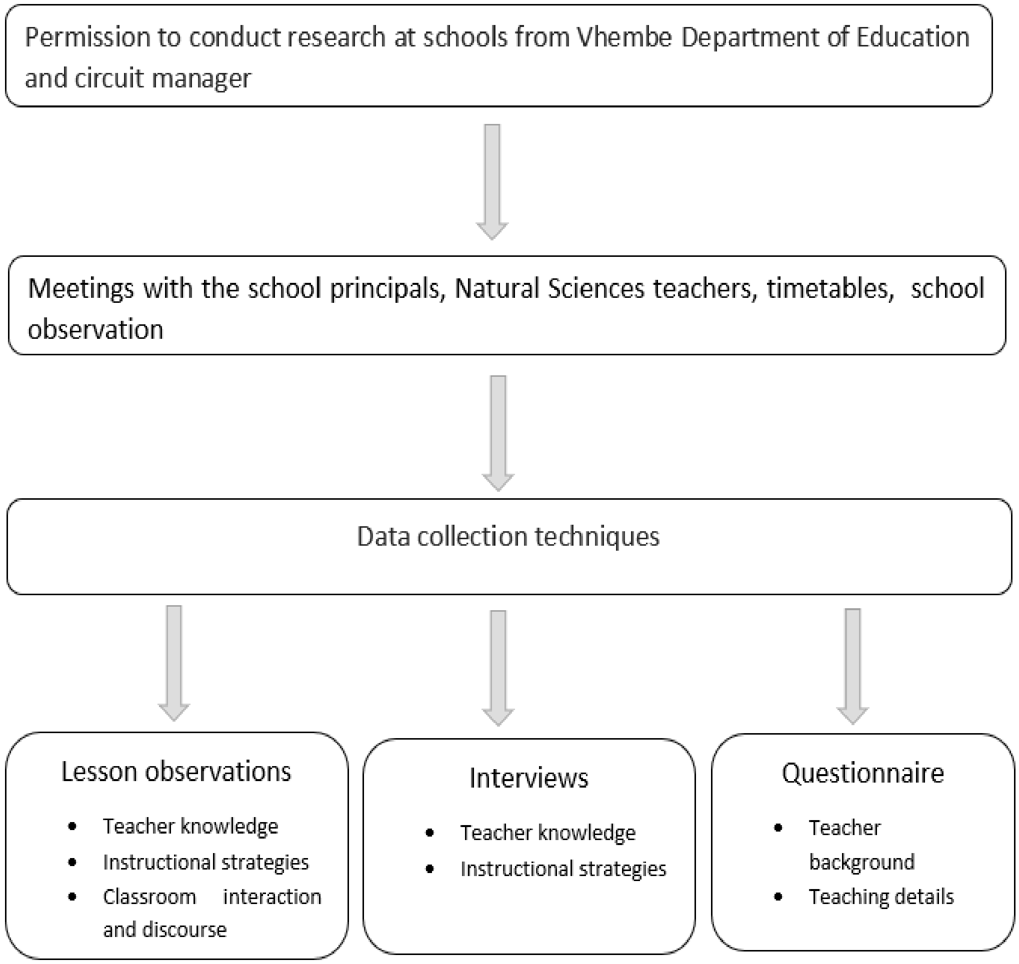

Figure 4: Summary of data collection process

3.6.3. Data coding, analysis and interpretation

This sub-section presents how the findings of this study were analysed. According to McMillan and Schumacher (2010), inductive analysis is a process through which qualitative researchers synthesise and extract meaning from the data by deriving categories and patterns from specific data. In addition, Cohen et al. (2011) indicates that in an inductive process research findings are collected and reduced into certain patterns, categories or themes and then interpreted. In this study the data was analysed using the themes developed throughout the research process. According to Mudau (2013), an alignment amongst themes, categories of research questions, theoretical frameworks, literature reviewed and the researchers' personal experience must be utilised to organise data and enhance identification of patterns in analysis.

Gay and Airasian (2003) explain qualitative research data as an on-going process whereby a researcher analyses data interpretively by synthesising, categorising, and organising data into patterns that produce a descriptive, narrative synthesis. In this study the data collection and analysis was done simultaneously all the way through the entire research process to obtain more perspicuity on the object under exploration.

The researcher analysed and interpreted the data of three cases separately. The researcher analysed the data by means of playing the video recorded during lesson observation and transcribing it into a word document. In the case of audio interviews, the researcher listened to the voices and transcribed data into a word document. After all of the data was transcribed to word documents, the researcher replayed the video in order to check if the words transcribed corresponded with what was on the video. The same process was done for the audio recorded to verify the interview information, and to check if the event did answer the research questions. The researcher did not correct participants' grammatical errors and where the participants used other languages besides English the words were written in the language the participants used with translations placed in brackets.

The researcher read transcripts of each participant word by word while listening to recorded audio to ensure accuracy of the transcripts of interviews. The same method was used for the recorded videos for accuracy of the transcripts of observation. Moreover, participants were shown his or her transcribed data for corrections, comments and additions before being considered as a final product. Shenton (2004) and Harrison, McGibbon and Morton (2001) view this action as member checking. A summary of the data analysis and interpretation process is shown in figure 5

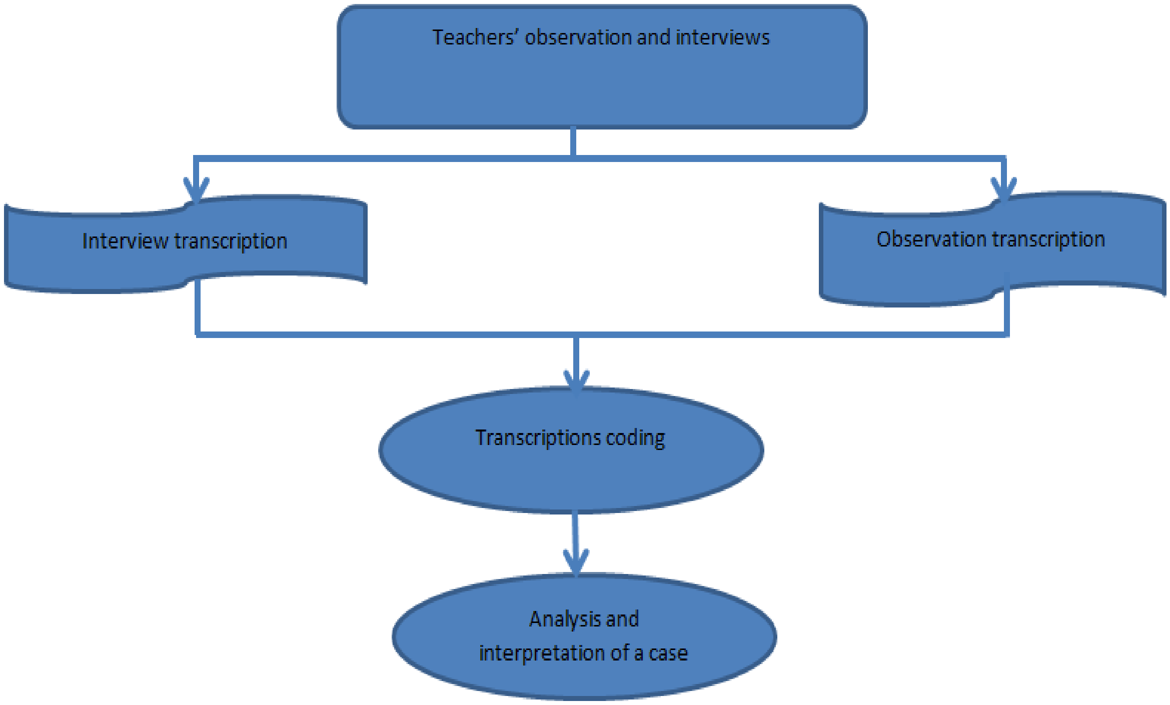

Figure 5: Summary of the analysis and interpretation process (Mudau, 2013)

The lesson observation transcriptions for all teachers in the study included time intervals at the beginning until the end, which helps the researcher when analysing data. Two lessons of each teacher were described completely as the teachers spoke and interacted with the learners in all lessons. The researcher watched the videos of each teacher and everything that each teacher said or did during the lessons was written into the word document. Thereafter the researcher played the videos while reading the transcribed data at the same time. A few pictures were captured from the videos to support lessons transcribed data. The pictures were included in the data presentation. The figure 6 below indicates the coding process.

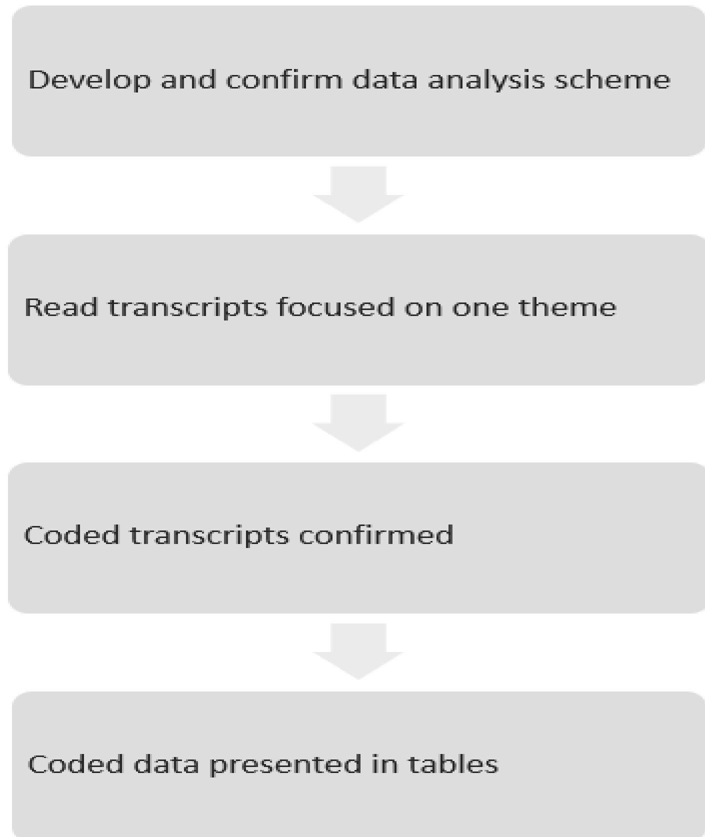

Figure 6: Coding process

The data analysis was developed from the conceptual framework discussed in chapter two of this study figure 1 The data analysis scheme (Appendix Q) used in the main study was applied in the pilot study. Therefore, the DAS was confirmed during piloting. The DAS was applied in the main study as it was confirmed to be useful for data analysis and interpretation purposes in the pilot stage. The researcher first focused on one theme when reading the transcripts of the main study. The text highlight colour tool and track changes were used to codify categories and characteristics of a particular theme (Appendix R). The researcher went through the coded data in order to confirm the transcripts. Thereafter the coded data was presented in tables. The data interpretation of this study mainly focused on all of the themes suggested for this study for the purpose of clarity on teachers' classroom practices. Moreover, the proposed themes link and enable the researcher to answer research questions and meet the objectives of the study.

3.6.4. Data presentation, discussion and findings

The analysis scheme guided and organised the data presentation of the study in the table. In the table, the rows in the table of each theme consist of its categories and characteristics. The pictures that were captured from video that was recorded during teacher classroom practice have been integrated in order to check if they assisted in reaching the findings of the study. Thereafter the contents of the table were discussed in detail. The findings obtained from the data that was analysed and interpreted was presented. Moreover, in the discussion, the researcher uses direct quotes from the case where it was applicable for such use.

3.7. Ethical considerations

Issues of ethical confidentiality, privacy and the personal rights of teachers were protected. Not all of the information was recorded to avoid adverse effects of disclosure. The participation in the study was voluntary. Therefore, all of the participants in this study were willing to participate. A supervisor assessed all letters before being sent to participants. The researcher first asked for permission from the Vhembe district Department of Education before moving into the field and permission was granted (Appendix I). The letters requesting permission to conduct the study and outlining the purpose of the study were sent to the circuit manager, principals and Natural Sciences teachers (Appendix E, Appendix F and Appendix G) and permission was granted. The location of the research sites remained anonymous and all participants were assured that the information obtained would remain confidential.

3.8. Summary

In this chapter, the researcher began by giving an introduction of the research methodology and design applicable to this study. In this regard, the research methodology and design were given under five subheadings, namely the qualitative case study approach; the nature of the research; research context; rigor; and data management. The qualitative approach underpinned by interpretative paradigm was outlined in this chapter. Moreover, the issue of validity to ensure quality and trustworthiness was explored. The data collection techniques, namely observation, interviews and questionnaire were also discussed in this chapter. Finally, ethical issues were discussed. In the next chapter, the researcher presents and discusses data and their findings.

CHAPTER 4

DATA ANALYSIS, FINDINGS AND DISCUSSION

4.1. Introduction

This chapter presents data of three teachers (**Jane, Charity and Kay**) who were selected to participate in the study. The data from each participant has been gathered through teacher questionnaires, classroom observation and interviews. The results of the study are aimed at answering questions concerning the classroom practices of the three teachers. The findings of the study are presented in sequence. First, interviews and observation data will be presented. Second, teacher background and teaching details are presented.

4.2. Teacher profiles

Three teachers participated in the research. The three teachers are referred to by pseudonyms **Jane, Charity and Kay.** The profiles of the three teachers are presented in

Table 1: Teacher profiles

Teacher	Gender	Qualifications	Years of teaching experience	Years of teaching Natural Sciences	Learning areas taught	Grades taught
Jane	Female	Senior Primary Teacher Diploma (SPTD, Mathematics, Biology, English and Afrikaans), Bed honours in management	16	13	Natural Sciences, Mathematics, English	4-7
Charity	Male	Higher Education Diploma(HED-Mathematics, Chemistry, Physics)	18	15	Natural Sciences, Mathematics, Physical Sciences, Technology	8-12
Kay	Male	Bachelor of Art(BA), Post Graduate Certificate in Education (PGCE, Geography+ Tsonga),	6	6	Natural Sciences, Social Sciences, Life Skills, Tshivenda	4-7

		Environmental Education (ENV.Edu)				

The data presented in Table 1 above obtained during interviews with the participants of the study. Table 1 indicate that the participants in the study were three teachers, one female and two males. The teachers who participated in the study hold different teaching qualifications and none of them majored in Natural Sciences. Their teaching experience ranged from 6-18 years whereas their teaching experience in the subject of Natural Sciences ranged from 6-15 years. On paper, they are not qualified to teach Natural Sciences but they are using their experience to teach the subject. According to the DBE (2009), a number of teachers are teaching outside of their specialisation due to a shortage of teachers in certain subjects. One can argue that the schools investigated in this study are facing the similar challenge that was identified by the education policy (DoE, 2009) and Muwanga-Zake (2001) (already covered in section 2.3.2). The study revealed that there are schools in the Vhembe District that have teachers who are using their teaching experiences to teach a particular subject due to a shortage of science teachers.

4.3. Key words table applies for all three cases.

Table 2: key words

Words	Symbol	Explanation
Prior Knowledge	PK	Knowledge required to learn concepts/ ideas.
Sequencing Ideas	SI	order of ideas in the teaching of concepts
Content Knowledge	CK	The information the teacher teaches and expects learners to understand
Subject Matter Knowledge	SMK	Knowledge the teacher uses to assist learners to learn content in a meaningful way
Incorrect Subject Matter Knowledge	ISMK	Inappropriate knowledge of the teachers to assist learners to learn the content
Misconceptions & Difficulty	M & D	Inappropriate ideas used based on faulty thinking
Resources	R	Teaching and learning aids

4.3.1. Data presentation

This section presents the data of the study.

A. Teacher knowledge

Table 3 below presented Jane's knowledge and such knowledge comprised of the following categories, namely content, context and learners' understanding. The three categories consist of several characteristics as shown in the table below.

Table 3: Teacher knowledge (Jane)

Theme	**Category**	**Characteristics**
Teacher knowledge	**Content**	• **Jane:** *the first thing that you need to know is the terminology. What is a mixture? I know that you have done this in grade 6.* [Concept, initiation, authoritative, prior knowledge (PK)] • **Jane:** *can you give me the examples, what is it that you (learners) can mix together?* [Sequencing ideas(SI)] • **Jane**: *a mixture is when two or more substances are put together.* [Content knowledge (CK), prior knowledge (PK)] • **Jane:** *when we say two or more substance is put together, we find these substances are put together in a physical way, the way that you can see, and the way that you can see physically.* (CK) • **Jane:** *we can classify the materials of a substance that we want to put together to form a mixture.* (Authoritative, SI) • **Jane:** *some of the substances are pure and if something is pure it means that it is not mix with anything it is alone.* (CK, SI) • **Jane:** *water itself it is pure. I have water here, can't you see that this water is pure does it have any colour or any colorant?* (Authoritative, Subject Matter Knowledge (SMK) , demonstration)

a) Jane placing water to bottle

b) Jane when explaining water is pure

- **Jane:** *but because of technology we now have impure substances, who can give me the example of impure substance.* (CK, SI, PK)
- **Learner:** *tea* (answer)
- **Jane:** *yes we have tea* (confirmation)
- **Jane:** *in some of the mixtures the substances that are mixed together keep on their own physical properties, like come on class, like when you mix beans and rice, they keep their own physical properties; you are able to identify them, to select what is that, what is that other one. Sometimes we cannot see the different part of mixture like in tea.* (SMK, convey information, SI)
- **Jane:** *what is to separate class?* (initiation, concept)
- **Jane:** *you have put things together* (she put books together to make a mixture-see picture below), *what is to separate? I have made a mixture.* (ISMK,M)

mixture of books on Jane's hands

- **John:** *taking things out and put them in their order* (response).
- **Jane**: *my mother has boys and girls, we were using one rondavel being five at home, then my father build a 12 rooms*

		house (learners whispering) *then my mother try to separate us, how can she do that?* (SMK, SI) • **Mutshidzi:** *my mother will take three boys to their room and two girls will share their room.* (response) • **Jane**: *very good, Mutshidzi shows that three can share a room being boys, two can share a room being girls, or how can she separate us* (she was asking of another way that the mother can separate the children) *don't forget we are five at home* ***(SMK)*** • **Ndivho:** *each one of us get his or her own room* (response). • **Jane:** what are the methods of separations? (Initiation) • **Jane:** *I am having different colours chalks here. I want the two here, may you please separate these mixtures?* (SMK, demonstration) • **Researcher:** Jane used different coloured chalks as visual aid to illustrate method of separation called hands sorting. See pictures below  a) Coloured chalks  b) hand-sorting method **Researcher:** Jane had maize meal, samp, beans and sieve as visual aid to illustrate method of separation called sieving. See picture below  a) Maize meal  b) Samp  c) beans  d) sieve

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- **Jane:** *we want to see someone sieving, who can do that for us?* (SI, demonstration, see picture below)

Learner sieving

- **Jane:** *Another method of separation, we have filtration.* She used example of muddy water for learners to understand filtration method without having difficulty and Jane first cut a 2-litre empty bottle of cool drink with a pair of scissors to make a filter funnel (Concept, SMK, SI, see picture below)

Jane when making own filter funnel

- **Jane:** *you take that muddy water and use this funnel then have a cotton wool and you press it. when you pour the muddy water, pure water will go down and the dirty things will remain on top and that method is called filtration* (SMK, concept, Jane was not having muddy water and cotton wool but she demonstrated filtration method as if she was having muddy water and as if the cotton wool was placed and pressed on a filter funnel see pictures below)

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		 a) Jane's hand was indicating that pure water was at the bottom b) Jane's hand was showing that the dirty things remain on top of a cotton wool. • Jane used content knowledge (CK) to explain a separation method called decanting. When water and oil were on the same object, oil was on top whereas water was at the bottom of the object (see pictures below)  a) Oil added to drops of cool drink b) Jane's hand showing that drink is at the bottom c) Jane's hand indicating that oil is on top
	Context	• **Jane:** *I'm going to teach separation of mixtures* (topic to be taught) • **Jane:** *Most of the parents depend on grants. Then you see that children do not have enough resources. For example, others they come bare-footed at school, others you see that they are coming without eating anything, they are only waiting for the break that they will eat at school. And the other challenge is that most of the learners, they stay with their grandparents at home who are illiterate. They are not being assisted; you gave them a task they come back without doing it. Why? because there is no one behind them at home* (socio-economic background of learners)

		• **Jane:** *We have the textbooks that we are given by department. We also have the computers that the donors had donated to a school* (resources available at school to support teaching). • **Jane:** *I am going to use the grains, like beans, textbooks, chalkboard, salt, cooking oil, bottles of cool drinks, scissors, chalks, sieving and learners themselves* (resources to be used during the lesson) • **Researcher** Beside the resources you used. What other teaching resources can you use to teach the same concepts and how will you use such resource? • **Jane** *I think I can use videos because I see it somewhere being used that it is fruitful. Learners will watch the video while it is being played then learners will be talking or taking notes. We stop the video and then discuss what they have seen then we continue from where we stop and then after that learners will go and work on their own in their activity books* (resource knowledge) • **Researcher** What challenges do you experience with the teaching of Natural Sciences? • **Jane** *You know we are at far, far, far rural areas. The challenges that we are facing is the language barrier and the second one is the resources. We don't have for example as you can see there is no laboratory here. The other thing, there are no laboratories to conduct the experiment, we don't have the apparatus here around us, you have to search for ourselves and some materials that are useful we don't have. For example if I want a litmus paper where will I get it, even the school is failing to buy, the government failing to provide then that is the serious challenge that we are facing* (facilities-no laboratory, resources or apparatus, socio-economic background) • **Jane:** ***The department is giving us workshops and they also providing some reference books and also the textbook it is trying to bring*** **(curriculum, resources).**

	Learners' understanding	• **Jane:** *The best way is to involve learners in the lesson by pausing questions in the beginning of the lesson, allow them to answer, to participate, and put them closer to you by giving them activity to do. For example, let them search for the word, I mean the terminologies. Let them look from key words that are inside the textbooks. Let them write the class work. Then you will grasp their total participation in the class* (learner interest) • **Jane:** *I think to me learner achievement is the best. My first aspect, what is that my learners are going to achieve? Learners should be able to apply this knowledge in their day to day life. They should be able to know what a mixture is. For example, how they are doing it. When they do something at home, how are they going to do it? I have to cook, how they are going to do it. When they have to separate, how are they going to do it? I think what they achieve is the best* (learner interest) • **Jane:** *After teaching I must give them (learners) exercise so that I can see how far or am I not leaving them behind. Then after that exercise and marking it, it will help me to find whether learners are with me or I'm missing them* (learner interest-understanding) • **Jane:** *The ideas that I'm expecting my learners to learn that is the mixture. The meaning of the word mixture. They must know the physical properties of a mixture. They should also be empowered to know the physical properties in their day to day life. When they are doing something at home they must know that I have mixed something and also they have to know how we can put things together to form a mixture* (concept, knowledge, learner interest) • **Jane:** *Today's learners or today's children are failing even to make tea. They don't know that they have to mix things. Then I think that is important because when they learn about mixtures they will also be able to know that this and this must not be put together because they will bring another mixture which is maybe sometimes you find that it is dangerous to them. Then they must know that we have to do things in the correct way* (teacher knowledge-learner interest)

		• **Jane:** *The prior knowledge that they must have it must be from their previous class grade 4, 5, 6 more especially in grade 6, then it is where they have acquired the first knowledge that when we put 1 and 2 together they are now a mixture* (SMK-experience) • **Jane:** *because of technology we now have impure substances, who can give me the examples of impure substances? (*initiation) • **Mukondi :** *tea* (prior knowledge-experience) • **Jane:** *Substances that you used to make tea, what are they?* (SI, PK, authoritative) • **Learner :** *sugar* (PK, experience) • **Learner :** *water* (PK, experience) • **Learner :** *tea bags* (PK, experience) • **Jane:** *I don't want to write tea bags but I write tea leaves because we even use the ones that are not inside the bags* (authoritative, convey information) • **Learner 4:** *milk* (PK, experience) • **Jane:** *when we put these things (substances used to form tea) together, they form a…* (evaluation) • **Learners:** *tea* [response-misconception(M)] • **Jane:** no, they form a … • **Learners:** *others said tea and others said mixture* [Misconception (M)] • **Jane:** *they form a* … (evaluation) • **Learners:** *mixture* (response-learners read from the board) • **Jane:** *Methods of separation, which one do you still, remember.* (Initiation, PK) • **Researcher:** no response [Difficulty(D)]

B. Instructional strategies

Table 4 Presented below are Jane's instructional strategies comprised of the following categories, namely teaching methods, explanatory framework and activities. The three categories consist of several characteristics as shown in the table below.

Table 4: Instructional strategies (Jane)

Theme	Category	Characteristics
instructional strategies	**Teaching methods**	• **Jane**: *I use question and answer in my introduction. I use demonstration that makes my learners to stay focus to my lesson and they were totally participating and that pleased me* (method used during the lesson) • **Jane:** *what is a mixture?* (She uses a questioning technique to arouse interest and engage learners). • **Ndivho:** *Is objects that are mixed together* (answer). • **Jane:** *a mixture is when two or more substances are put together. When we say two or more substance is put together we find these substances are put together in a physical way. The way that you can see, and the way that you can see physically* (lecture method used to make learners understand the concepts). • **Jane:** *you see someone taking an instrument and the books putting inside the school bag that is a mixture* (example-demonstration methods. See pictures below(a-c)    a) Jane taking books and instrument from a learner. b) Jane holding books and instrument. c) Putting books and instrument in a school bag • **Jane:** *when you take Natural Sciences, Mathematics and English books, you put them together they form a mixture. In the class we have a mixture, there are boys and girls. In the class we see a mixture, others are wearing grey, and others are wearing black that is the mixture* (lecturing using examples).
	Explanatory Framework	• **Researcher:** *models, analogies, examples, illustration can be useful when explaining some of Natural sciences concepts, which ones did you use today and why?*

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Jane: I use modelling. Under modelling I was showing the substances that we are going to mix and then after they have been put together which is a mixture and under illustration we use the examples from the textbooks (SMK).
Jane: When you want to build a wall, you take cement, you take sand and also you add water that is a mixture (convey information, example, authoritative).
Researcher: Jane had rice, beans and salt as visual aid to demonstrate a mixture. See pictures below


a) rice

b) beans

c) salt

d) Jane mixing the substances

e) mixture

Jane: I can take salt (she holds the packet of salt and shows it to the learners) you know that is salt (she opens the salt and transfers it on to the cover of a container) I am doing it physically I am using my hands (she mixes the salt, rice and beans) what is this now? (See pictures c-e above
Learners: salt (M)
Jane: no, I put them together, what is this? (see picture e above)
Learners: mixture (response).
Jane: what is this mixture composed of? (SI)
Learners: salt, beans and rice (response)
Researcher: Jane told learners to open page 80 on their platinum grade 7 Natural Sciences textbook. Thereafter she asked learners questions. See pictures below

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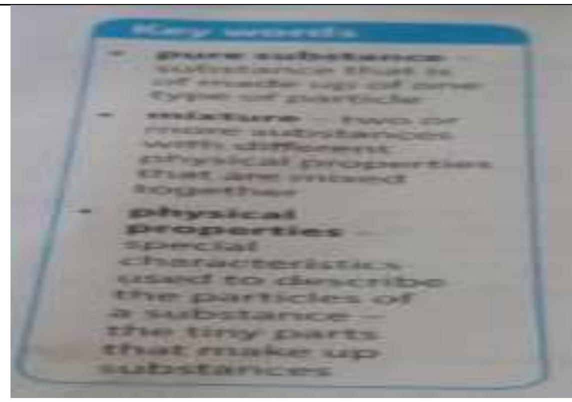
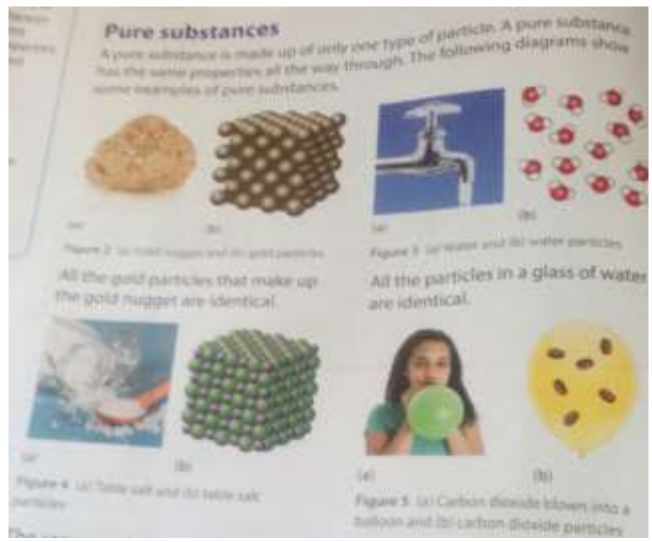
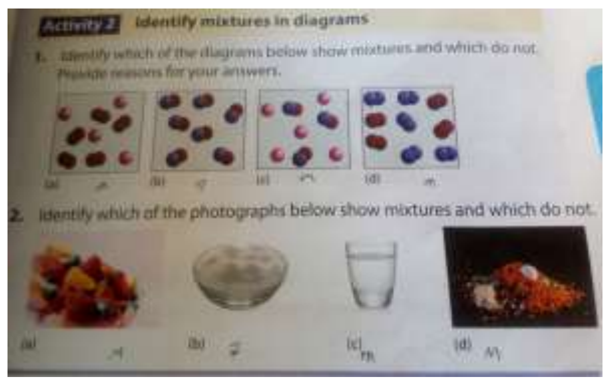
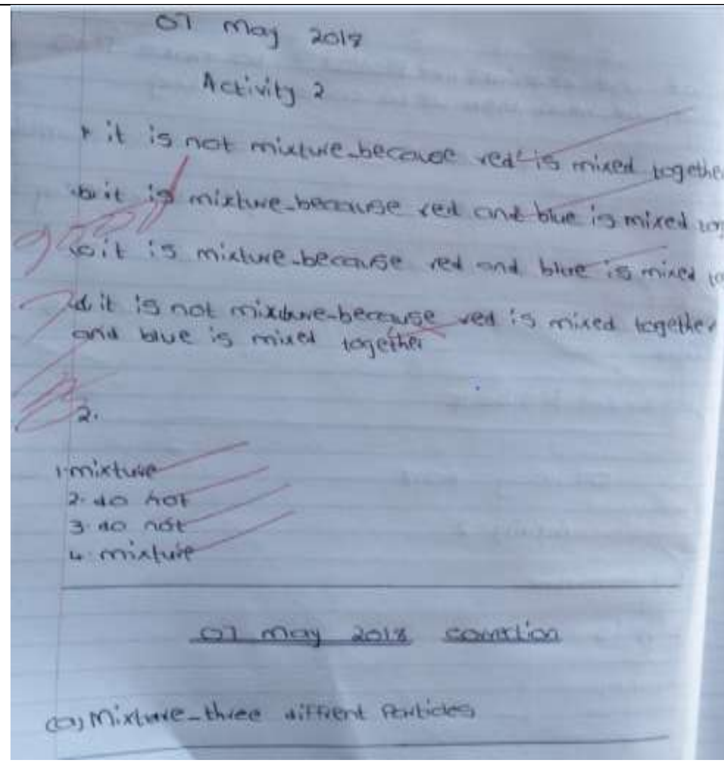




A) Key words **B) Examples of pure substances**

- **Jane:** *there are key words there, number 1 what is written there* (picture A above)? (Initiation, authoritative)
- **Learners:** pure substance(response)
- **Jane:** *what does it mean?*
- **Learners:** *substance that is made up of one type of particle.*
- **Jane:** can you give me the example of a substance that is made of one particle(SI)
- **Learner :** water(response)
- **learner :** milk (PK, not shown on picture B above)
- **learner :** salt (response)
- **Jane:** No, no, salt there are some particles there (Authoritative-convey information)
- **Learner :** gold (response)

		• **Jane:** *can you point where you find it?* (learners pointed at their textbook picture B above) • **Learner :** *gold particles* (response) • **Jane:** *Water particles, where are water particles?* (learners pointed at their textbooks, see picture B above) • **Researcher:** Jane used examples to explain separation of mixtures • **Jane:** *Vho Magogo **(Grannies)** there at home they keep on separating, when it is summer time they separate the mixtures, they separate nduhu **(nuts)** from mavhele **(maize),** they separate phonda from nawa **(beans)** they use their hands and they are busy with hands sorting.*
	Activities	• **Jane**: *take out your exercise book and do activity 2 number one and number two let's write* (learner class work-see picture below)  • **Researcher:** Learner book (answers and correction of class work)



07 May 2017

Activity 2

a it is not mixture because red is mixed together

b it is mixture because red and blue is mixed tog

c it is mixture because red and blue is mixed to

d it is not mixture because red is mixed together and blue is mixed together

2.

1 mixture
2 do not
3 do not
4 mixture

07 May 2018 correction

(a) Mixture three diffrent Particles

- **Teacher:** *It takes learners attention and they give totally participation in the class. And when they are going to write it is easy for them to think or to remember what we have demonstrated in the class* (reason for using demonstration activity).

- **Researcher:** The pictures below demonstrate a mixture and the separation of a mixture

a)mixture

b) learners separating the mixture

- **Jane:** *now I am Mr. Nemukula, rice + salt + beans=* (SMK, evaluation)
- **Learners:** mixture

		• **Jane:** *then I want to put each one of the particles or a substance aside, separately, what can we do* (Jane told Phuluso, Mushe and Mutshidzi to do the separation) • **Jane:** *what are they doing?(*question) • **Class:** *they are separating* (answer). • **Jane:** *what are they are using*?(question-SI) • **Learners:** *hands* (answer) • **Researcher:** Jane conclude the lesson by giving learners a task to go and find the other ways that can be used to separate the mixture(initiation, authoritative)

C. Classroom interactions and discourse

Table 5 below presents Classroom interactions and discourse comprised of the following categories, namely types of discourse, patterns of discourse and teacher questioning. The three categories consist of several characteristics as shown in the table below.

Table 5: Classroom interactions and discourse (Jane)

Theme	**Category**	Characteristics
Classroom interactions and discourse	**Types of discourse and Patterns of discourse**	• **Jane:** *here is the rice, here are the beans* (Jane moves around showing learners beans and rice that she holds in different hands. see picture below) (initiation-authoritative).  • **Jane:** *I am trying to mix them together* (the teacher mixes the rice and beans using her hands and places the mixture on the a learners' book   a) Mixing beans & rice b) mixture on learner book • **Jane:** *Can we name this mixture?* (interact- authoritative) • **Learners:** no (response) • **Jane:** *why do say you can't name this mixture?* (initiation, authoritative) • **Learner:** *I haven't seen it before?* (response) • **Jane:** *But there are things you can see through your naked eyes, Tshililo what do you see here?* (convey information, authoritative) • **Tshililo:** *beans and the rice* (response) • **Jane:** *I have formed a mixture* (interact-authoritative)

	Teacher questioning	• **Jane:** *what is a mixture?* (Drives lesson) • **Jane**: *what is it that you can mix together* (Develop thinking skills) • **Jane**: *can you give me the example of a substance that is made of one particle?* (Develop thinking skills) • **Jane:** *I have water here can't you see that this water is pure?* (demonstrate-Improve learning) • **Jane:** *Substances that you used to make tea, what are they?* (Encourage and motivate) • **Jane:** *what is to separate class?* (drives lesson) • **Jane:** *what are the methods of separations?* (drives lesson) • **Jane:** *what is inside the container?* (Jane holds a container that has a mixture. Demonstrate-Improve learning) • **Jane:** *we didn't do all the methods of separating*. *I'm giving you this task, go and find other method of separation. They are there in your book, using the magnet to separate two different things* (encourage and motivate)
	Communicative approach	• **Jane:** *we have eaten a mixture, what is that you have eaten?* (Initiation- Interact) • **Learners:** *rice, fish, and pumpkin* (response, interact). • **Jane**: *that is a mixture* (interactive-authoritative) • **Jane**: *you can also take each and everything aside, one can say I don't eat fish but I will eat rice alone, one can say no I don't want butternut I can take a fish and rice together and then I bind my meal* (convey information, authoritative).

4.3.2. Discussion

According to CAPS Natural Sciences Grades 7 – 9 DBE (2011a. 2011b and 2011c), the Natural sciences curriculum consists of the knowledge strands that are used as a tool for organising the content of the subject Natural Sciences, namely Life and Living, Matter and Materials, Energy and Change, and Planet Earth and Beyond. In her pre-lesson interview Jane indicated that she would teach about the separation of mixture and such a topic falls under the knowledge strand of matter and material (Appendix K). The study revealed Jane had experiences in the teaching of Natural Sciences (NS) concepts since she had indicated in the pre-lesson interview that she has NS teaching experience (Appendix K). The teacher content knowledge (CK) has been assumed as being developed through teaching experience in the topic and workshops organised by the department (Appendix K).

> **Researcher**: *What are you going to teach today?*
> **Teacher**: *I'm going to teach separation of mixtures.*
> **Researcher**: *What support is provided to you as a Natural Sciences teacher?*
> **Teacher**: *The department is giving us workshops.*

When teaching Natural Sciences, it is important to emphasise the links learners need to make with related topics to help them achieve a thorough understanding of the nature of and the connectedness of things in Natural Sciences (DBE, 2011). The content knowledge (CK) that Jane displayed about the separation of mixtures was appropriate and organised. For example, the teacher first introduced the topic of the lesson and asked learners questions based on prior knowledge (Appendix N).

> **Teacher**: *we are now busy with separation of mixture. The first thing that you need to know is the terminology, what is a mixture? I know that you have done this in grade 6.*
> **Ndivho**: *is objects that are mixed together*.

According to Yilmaz-Tuzun (2008) teachers' content knowledge can influence what they teach as well as how they teach. It was noted at the beginning of the lesson that Jane asked learners to define mixture and also requested learners to give the examples of mixtures (Table 3). She used the questioning technique in order to check if the learners still remember what they have learnt in the previous grade and encouraged learners to use their thinking skills (Table 3).

Then she carefully used content knowledge to explain a mixture and the classification of mixtures (Table 3). During the lesson Jane demonstrated the sequence of ideas (Appendix N).

> **Jane**: *A mixture is when two or more substances are put together. Then when we say two or more substance is put together we find these substances are put together in a physical way, the way that you can see, and the way that you can see physically. You see someone taking an instrument and the books putting inside the school bag that is a mixture.*

Jane used content knowledge (CK) and subject matter knowledge (SMK) that was adequate in the explanation of the concepts to the learners. Jane only refers to the NS textbook when teaching since she did not take either a lesson plan or the NS CAPS document along to assist her to avoid missing crucial aspects to cover in particular concepts. Jane used her SMK when she explained a pure substance (water) by means of demonstration in order to assist learners to learn the concept without difficulties (Table 3)

> **Jane**: *Some substances are pure, if something is pure it means that it is not mix with anything it is alone. Water itself it is pure, I have water here can't you see that this water is pure? Does it have any colour or any colorant? (*Jane had a jug with water inside and she poured water inside an empty for learners to see that the water was pure*).*

Jane also used her CK by describing physical properties of mixtures with some examples (Table 3).Her emphasis here was for her learners to know that sometimes the different components that a mixture is comprised of can be seen and sometimes cannot. This indicates that the teacher has the required CK (Appendix N).

> **Jane**: *In some of the mixtures, the substances that are mixed together keep on their own physical properties. Like when you mix beans and rice, they keep their own physical properties. You are able to identify them, to select what is that and what is that other one. Then sometimes we cannot see the different part of mixture. Like in tea, can you pick what tea leaves is? Can you pick the milk outside? Can you pick that water outside? Can you pick that sugar outside? When they are together we cannot differentiate it, we just give it a new name, now it is a tea.*

However there was also a case where misconception (M) and ISMK displayed (Table 3). Jane also used her CK, SMK to explain different methods of separation by means of demonstration (Table 3). Jane's CK was adequate. She knew what the curriculum required in the teaching of the separation of mixtures and she was aware of the resources available at school to support her teaching (Table 3). For example, Natural Sciences textbook. Textbooks also offer a crucial resource for teachers in their planning and in gaining access to the appropriate knowledge and skills to teach, at an appropriate level (DBE, 2009).

Although researchers agree that practical work in science is important, teachers face challenges in doing practical work (Heeralal, 2014). The school does not have laboratory and equipment (Appendix K).

> **Teacher**: *There are no laboratories to conduct the experiment; we don't have the apparatus here around us.*

Limited resources, however, encourage teachers to modify the curriculum by utilising hands-on experiences (Stern & Marcella, 2008). Even though the school did not have sufficient resources to support her teaching, Jane did not stop doing practical activities for learners to understand the content (Table 3). Tobin (1992), states that a teachers' purpose is to provide the best materials and learning situations to make learning individually meaningful for each student. Therefore, besides the textbook she was provided at school she also prepared other teaching aids to assist her during the lesson (Appendix K).

> **Teacher**: *I have prepared rice grains, salts and beans as my first teaching aids.*

Teachers should fulfil various roles that include being mediators of learning, interpreters and designers of learning programmes and materials, researchers, lifelong learners and learning area specialists (DoE, 2002c). Jane was aware of other resources she can use that can be helpful to the learners to learn the concept she taught (Table 3, Appendix K)

Jane indicated some of the challenges she was experiencing, e.g. language barrier (Table 3, Appendix K). Language is essential for identifying the concepts and relating the concepts with one another and for building up a whole new domain in cognitive and communicative terms (Anthony, 2015). For many learners, the Language of Learning and Teaching (LoLT) is not their home language and this places them at a considerable disadvantage (DoE, 2003). Jane sometimes mixed languages, she used English and Tshivenda (teacher-learner home language) to assist learners to learn and understand what she was trying to explain (Appendix N).

Jane: *Vho Magogo* ***(Grannies)*** *there at home they keep on separating, when it is summer time they separate the mixtures, they separate nduhu* ***(nuts)*** *from mavhele* ***(maize),*** *they separate phonda from nawa* ***(beans****) they use their hands and they are busy with hands sorting.*

Jane: *you see when they are building at your home you see the constructers busy sieving the soil and they want the soft particles and the grains particles to be separated ani athu zwi vhona vha tshi khou sefa mavu ndi zwenezwila* **(*you haven't seen when they are sieving the soil that is sieving).***

Jane knew what to do to keep learners focused and take part in the lesson, there are a few aspects she keeps in mind when she plans for a lesson and she knows how she can check for learner understanding Table 3. The teacher delivers a lesson in such a way that it encourages learners to participate and make use of their prior knowledge (Appendix N). Researchers like Haslam and Hamilton (2010), Abrahams (2010), Gyllenpalm et al. (2010), agree that practical work in schools can effectively and strongly support exploration, manipulation and development of concepts and can also make the concepts manifest, comprehensible and useful. The teacher makes use of demonstration (practical activity) when explaining to the learners and she also gave learners the opportunity to do some demonstration (Table 3).

Jane: *I am having different colours chalks here. I want the two here, may you please separate these mixture.*

According to grade 7-9 NS CAPS (DBE, 2011a, 2011b and 2011c), the teaching and learning of Natural Sciences involves the development of a range of process skills, namely accessing and recalling information, observing, comparing, measuring, sorting and classifying, identifying problems and issues, raising questions, predicting, hypothesising, planning investigations, doing investigations, recording information, interpreting information and communicating. Such skills may be used in everyday life, in the community and in the workplace. Cognitive and process skills that the learners develop and gain during Natural sciences lesson are accessing and recalling information, observing, sorting and classifying (Appendix N). See table 6 for teacher knowledge.

Table 6: Summaries of Jane knowledge on the topic separation of mixtures

Teacher knowledge	**Content**	• Jane explained mixtures and methods of physical separation.
	Context	• Jane attends NS workshops provided by the Department. • Jane uses the textbook, a chalkboard, chalks and other teaching aids she prepared, e.g. Grains. • Learners in schools are from poor family backgrounds with low socio-economic status, e.g. they depend on social grants and some parents cannot provide additional resources that can assist their learners to learn. Some parents are illiterate and cannot help their learners with school work e.g. homework
	Learners' understanding	• Jane uses prior knowledge to connect to new information. • Jane sometimes uses Tshivenda and learners participated. • Jane explains terminology and gives learners opportunities to read the terminologies from the textbook.

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Jane's instructional strategies include teaching methods, namely the question and answer method, lecture and demonstration; explanatory framework that was illustration, modelling, examples and activities like class work and homework; and demonstration (Table 4). Jane made use of the questioning technique at the beginning of the lesson to develop a lesson and evaluate learner understanding of previously learnt ideas about the topic (Appendix N). Learners were asked to explain the mixture (Appendix N). She asked for examples of mixtures (Appendix N). Most learners raise their hands as an indication of being able to recall what they learnt in the previous grade. The learners gave the correct answers (Appendix N).

> **Jane**: *What can you say when you define a mixture?*
> **Ndivho**: *is objects that are mixed together.*
> **Jane**: *can you give me the examples, what is it that you can mix together?*
> **Learners**: *sugar and water, cement and sand.*

The traditional lecturing methods are used because of teachers being used to these methods due to their teaching experiences (Lombaard, 2015). Jane used the lecture method to explain what a mixture is and how the substances are put together to form a mixture in order to make learners understand the concepts (Table 4). Jane also used both the lecture and demonstration methods when explaining how substances are put together to form a mixture (Table 4). In addition, she makes use of the lecturing method using examples for learners to gain a better understanding of the concept (Appendix N).

> **Jane**: *When you take Natural Sciences, Mathematics and English book, you put them together they form a mixture. In the class we have a mixture, there are boys and girls. In the class we see a mixture, others are wearing grey, others are wearing black that is the mixture.*

During the post-lesson interview Jane indicated that she used modelling when showing substances to be mixed to form a mixture and she used illustration with examples from the textbook (Appendix K). She also uses examples when explaining separation of mixtures (Appendix N).

> **Teacher**: *I use modelling, under modelling I was showing the substances that we are going to mix and then after they have been put together which is a mixture and under illustration we use the examples from the textbooks.*

> **Jane**: *our parents; our grannies at home use hand-sorting method when they separate their seeds. During summer time when they want to plough you will find them busy sorting their seed, they want to plough, they first sort them.*

Jane also uses different examples, which are familiar to the learners when teaching separating of mixtures (Appendix N). During the lesson, the teacher did some demonstrations and gave learners chance to demonstrate activities as well (Table 4). By doing such the teacher developed and improved learners' process skills emphasised in grade 7-9 NS CAPS document, e.g. observing skill. Jane gave learners class work and marked it with the learners (Table 4). Therefore, learners had an opportunity to control their work. Jane explained the reason of using demonstration activity more often (Appendix K).

> **Teacher**: *It takes learners attention and they give totally participation in the class. And when they are going to write it is easy for them to think or to remember what we have demonstrated in the class.*

Practical work in science is acknowledged and widely accepted as an important component in the teaching and learning of science concepts (Toplis and Allen 2012; Kibirige et al. 2014). Jane formed a mixture by means of putting rice, salt and beans together and she gave the learners an opportunity to separate the mixture (Table 4). Table 7 below presents Jane instructional strategies used in the lesson.

Table 7: Summary of instructional strategies Jane used in the lesson

Instructional strategies	**Teaching methods**	Question and answer
		Lecture
		Demonstration
	Explanatory framework	Modelling
		Illustrations
		Examples
	Activities	Class work
		Demonstration

Classroom discourse refers to the language that students and teachers use to communicate in the classroom (Foy, 2013). According to Chin (2006), authoritative is a discourse that a teacher uses to convey information and the utterances are often made up of instructional questions and factual statements. Jane's instruction and interaction as well as discourse in the classroom did not encourage much of cognitive activity among the learners. Jane employed an authoritative discourse because she mostly conveys information to the learners by means of the questioning technique (Appendix N). Consequently, the learners were not given an opportunity to add to the lesson ideas or at least to form groups in order to discuss the lesson ideas and present their thoughts. According to Chin (2006), dialogic discourse encourages debates and challenges. Jane did not make use of dialogic discourse because she did a lot of questioning and explanation in the classroom (Appendix N), not considering that learners might have some ideas they might wish to share with the class concerning the content being taught. It could have been a good opportunity for learners to exercise their communicative and thinking skills by debating amongst themselves.

The pattern of discourse used was initiation, response and evaluation (IRE). Jane gave instructions and asked instructional questions to check for learners' understanding and the learners gave responses (Table 5).

> **Jane**: *Here is the rice, here are the beans. I should been having some samp, some pieces of samp. Then*

I am trying to mix them together, let me use your book. I am mixing them together. Can you name this mixture? (Initiation)

Learners: *no (response)*

Jane: *why do say you can't name this mixture? (Initiate, evaluate)*

Learner: *I have not seen it before (response)*

Jane: *You haven't seen it before but there are things you can see through your naked eyes. Tshililo what do you see here? (Authoritative, evaluate)*

Tshililo: *the beans and the rice (response)*

Jane: *the beans and the rice, these are the grains I have formed a mixture (evaluate, authoritative)*

This type of discourse is appropriate for checking if learners understood the content taught. According to Mortimer & Scott (2003), Interactions and discourse in the science classroom between the teacher and students is fundamental to learning because it is central to the meaning making process. This discourse is favoured since it enables the teacher to evaluate the learners in order to check learner understanding and know where the learners still need to be assisted on the content (Appendix N).

Communication is part of Natural science classroom interaction and discourse since it builds a relationship among learners, and between learners and teachers, as well as their environment. The teacher practice did not facilitate much of communicative and thinking skills. The communicative approach that Jane used was interactive-authoritative (Table 5). The interaction was mostly on teachers and learners and only the teacher gave instructions (Appendix N). What Jane said in the lesson was considered as final even though learners were invited to give responses. In the Natural Sciences classroom the students consider the teacher as a more capable peer with whom meaning is constructed through shared discourse (Rollnick, 2000).

The time for learners to interact among themselves was limited (Appendix N). Jane should have given learners the chance to interact among themselves by means of pausing questions or giving learners an idea based on the content. Hence, they should be given the opportunity to discuss among themselves and for her (Jane) to act as a facilitator /mentor so that they can be able to develop process skills like communicating or raising questions. From the learning point of view, process skills are an important and necessary means by which the learner engages with the world and gains intellectual control of it through the formation of concepts (DoE, 2002c). Table 8 below presents interactions and discourse employed in Natural Sciences classroom.

Table 8: Summaries of Jane classroom interactions and discourse

Classroom interactions and discourse	**Types of discourse**	Authoritative discourse
	Patterns of discourse	Initiation-teacher
		Response- learner
		Evaluation-teacher
	Teacher questioning	Drives lesson
		Improve learning
		Develop thinking skills
		Encourage and motivate
	Communicative approach	Interactive-authoritative

4.3.3. Findings

The study discovered that the teacher focused mostly on conveying information to the learners and learners accepted the information the teacher provided for them. It was noted that the teacher attempted to use prior knowledge to connect to new ideas of the lesson. However, Jane did not use her knowledge to teach the topic separating of mixtures in such a way that it enabled the learners to practice much of their cognitive and thinking skills because she did many explanations. During classroom observation the researcher noticed that according to Jane, for her learners to learn the ideas of the lesson was for her to do a lot of explanations and questioning in the classroom. However, the study diagnosed Incorrect Subject Matter Knowledge (ISMK) and Misconceptions (M) that the teacher displayed in the classroom and such ideas learners did not notice or were not aware that the idea was inappropriate (Table 3, Appendix N.). In Table 3 characteristics line 30-33 Jane asked learners what is to separate while putting books together which might result in other learners thinking to separate is when things are being put together. Even though a learner responded correctly (Table 3 line 34) the fact that learners did not question the demonstration used may result in some learners thinking the demonstration used was appropriate.

The researcher found that sometimes Jane used Tshivenda (teacher-learner home language) to explain the concepts to her learners. Hence, the researcher noticed that Jane assisted the learners to learn, participate and understand the concepts better by the use of learners' home language when she explained other ideas of the lesson. Though it was helpful, it may also disadvantage the learners when it comes to writing as the NS subject is written in English. The study discovered that Jane used various methods on the topic of separation of mixtures and such methods seem to be of assistance to the learners as they were actively involved in the lesson. The researcher has noted Jane asked learners' questions that were not challenging; as such, questions did not require learners to exercise much of their communicative and thinking skills. In addition, the demonstrations and examples Jane used to explain the concepts were only ones that were familiar to the learners.

The knowledge and methods Jane used did not create much of the opportunity for learners to interact among themselves and the subject matter. Learners' opportunities to interact with the subject content and among themselves were limited because Jane sometimes used lecturing method to explain other ideas of the lesson. The study found that Jane's classroom practice employed authoritative discourse. The researcher also found no attempted discussion between Jane and the learners concerning the concepts. Besides that, Jane never gave learners an opportunity to raise questions or discuss the concepts among themselves to share some ideas on the topic.

The study revealed that the teacher did not improve the process skill (e.g. learners-raising questions) that was emphasised in the subject NS CAPS document for learners to develop and gain in the NS lesson because she did a lot of explanations which lead to authoritative discourse. As a result, that can hinder learners' interest and understanding of the subject matter content. The researcher noticed Jane's pattern of discourse was successful as she evaluated the learners by means of questioning and class activity. However, the activity given to learners was not challenging. The researcher noted that learners were not given an opportunity to exercise their listening and communication skills by means of summarising lesson taught at the end of the teacher's concepts and presentation. In addition, learners did not have a say about the topic but only did what the teacher instructed. The study discovered that Jane focused on teaching and gave learners a class activity to write and as such resulted in an interaction-authoritative approach.

4.4. Case two: charity

4.4.1. Data presentation

The data is presented as follows.

A. Teacher knowledge

The Table 9 below presented Charity knowledge and such knowledge comprised of the following categories, namely content, context and teacher's learners' understanding. The three categories consist of several characteristics as shown in the table below.

Table 9: Teacher knowledge (Charity)

Theme	Category	Characteristics

Teacher knowledge	**Content**	• **Charity:** *particles model of matter. What is matter?* [concept, initiation, prior knowledge(PK)] • **Charity:** *we have three state of matter* [sequencing ideas(SI), PK] • **Charity**: *we are going to deal with the arrangement of particles of solid, liquid and gas*. [content knowledge (CK), initiation, authoritative, PK] • **Charity:** *movement of particles* (initiation, CK) • **Charity:** *ice vibrate in a fixed position, they vibrate moving up and down at the same time. Water flows easily sliding on top of each other and when some of the water goes underneath, some goes up at the same time. Steam moves to different directions and fills entire container when moving* (CK,SMK, SI, authoritative) • **Charity:** *the space between the particles* (CK, initiation) • **Charity:** *particles of ice are closely paired. The space between water is large and space between steam are very large*(CK, authoritative) • **Charity:** *density and state of matter* (initiation, concept, CK) • **Charity:** *we are going to deal with density, mass and volume* (initiation, CK, PK, SI)
	Context	• **Charity:** *State of matter and arrangement of particles* (topic to be taught). • **Charity:** *Most of the learners depend on social grants* (socio-economic background of learners) • **Charity:** *Textbooks and chalkboard* (resources available to support teaching). • **Researcher:** Okay, besides the resources you used, what other teaching resources can you use to teach the same concepts and how will you use such resources? • **Charity:** *In this concept we should have been having ice, stove and beakers so that when we heat ice, ice will melt and become liquid. When we heat water, water will change to vapour* (resource knowledge). • **Researcher:** What challenges do you experience with the teaching of Natural Sciences? • **Charity:** *Lacking of apparatus and not having laboratory* (facilities-no laboratory, resources or apparatus).

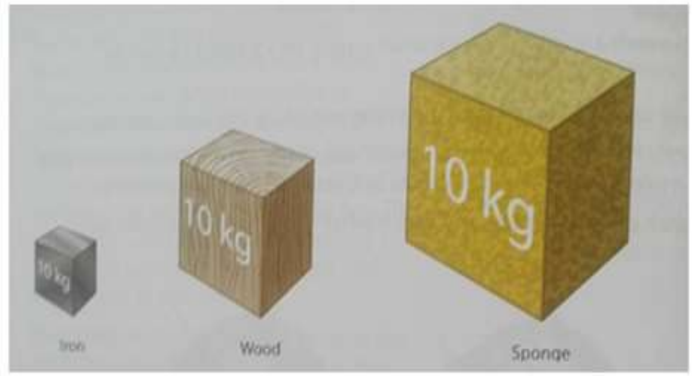
		• **Charity:** *I attend science workshop. It is where I come across new things that I did not know which is a challenge to me. In the workshop we are taught what we don't know* (curriculum).
	Learners' understanding	• **Charity:** *I will be asking them (learners) question so that they can give me answer* (learner interest). • **Charity:** *by giving them class work* (learner interest, evaluation). • **Charity:** *State of matter and the arrangement of particles* (PK, learner interest). • **Charity:** *They should be knowing that matter is anything that occupies space* (PK). • **Charity:** *we have three state of matter*. *Mention three state of matter* (initiation, PK) • **Learner :** *solid* (PK) • **Learner :** *liquid* (PK) • **Learner :** *gas* (PK) • **Charity:** *name of water in the solid state* (initiation, PK) • **Learner :** *ice* (PK, experience) • **Charity:** *name of liquid state of water state* (PK, experience) • **Learner :** *water* (PK, experience) • **Charity:** *name of gaseous state* (PK, experience) • **Learner:** *evaporation* [response, misconception(M)] • **Charity:** *what?* • **Learner:** *evaporation* (M) • **Charity:** *no, evaporation is the process*. *yes Rudzi* (authoritative, interact) • **Learner:** *vapour* (PK, experience)

B. Instructional strategies

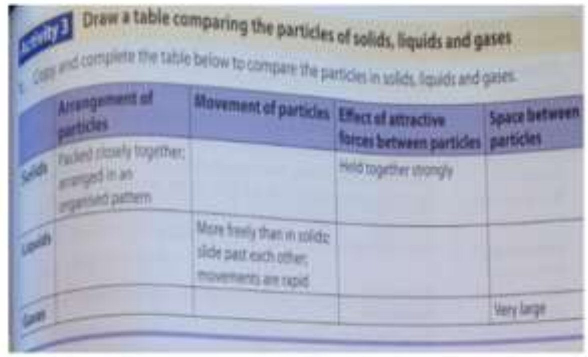
Table 10 below presented Charity instructional strategies comprised of the following categories: Teaching methods, Explanatory Framework and activities. The three categories consist of several characteristics as shown in the table below.

Table 10: Instructional strategies (Charity)

Theme	Category	• Characteristics
instructional strategies	**Teaching methods**	• **Charity**: *Question and answer* (method used during the lesson). • **Charity**: *I asked learners questions and they gave me the answers* (how method was used in the lesson). • **Charity:** *what is matter?* (He used questioning techniques to arouse interest and engage learners). • **Learner:** *model that helps us understand that matter is made from particles and how they affect the behaviour of matter* [response, misconception (M)]. • **Learner:** *matter is that occupies space and has mass* (response). • **Charity:** *the arrangement of particles: solid or ice are arrange in specific pattern, liquid are loosely arranged and are not in a fixed shape*, *and gas or steam they are not arranged in a specific pattern*. *Movement of particles; under ice they vibrate in a fixed position, water they move more freely than in solid and slide pass each other,* and *steam move randomly in all the direction and fill the whole container* (lecturing method used to make learners understand the concepts).
	Explanatory Framework	• **Researcher:** Okay, models, analogies, examples, illustration can be useful when explaining some of Natural sciences concepts, which ones did you use today? • **Charity***: I used illustration.* • **Charity:** *I define matter and gave different examples* (how illustration was used) • **Researcher:** Charity told learners to open page 98 on their grade 8 Natural Sciences textbook and they did. Charity used the three pictures below to explain concepts to learners

		 • **Charity:** *mass is a measure of the amount of matter that an object is made of*. *Mass is measured in grams (g) and or kilograms (kg). The three blocks in the picture above all have a mass of 10kg. The block of iron is the small block; block of wood medium block and block of sponge is a bigger block. The three blocks they are differ in size but have the same mass. Volume is the amount of space an object occupies. Volume is normally measured in units like litres or millilitres. It is also measured in units like centimetres cubed, millimetres cubed or decimetres cubed* (concepts, lecturing-illustration). • **Researcher:** Charity used examples to explain density • **Researcher:** Charity explained to learners that people have a density which is higher than a gas or liquid. He also specified that it was only Jesus who walked on top of the water. But the density of a person is higher than the density of water, that it is why people sink inside the water (SMK). • **Charity:** *The other example that showed us that we have higher density is that when we jump, we will again come down because we are more denser than air. If the density of air was high we could jump and remain in the air***.** *If one of our legs is in the air it will come down because of us being having higher density than air* (SMK, convey information). • **Charity:** *The density of stone is more than the density of water because if we throw the stone inside the water, the stone will sink* (SMK, example).

	Activities	• **Researcher:** Charity told learners to take out their class work book and write activity 3 on page 93. Below is a picture showing activity learners worked on.

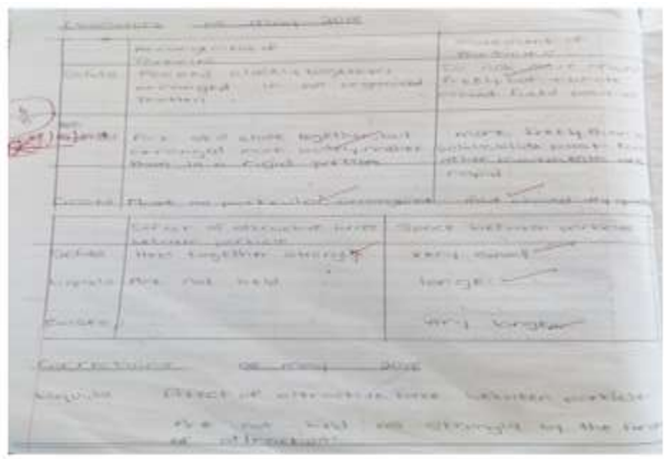


Activity 3 Draw a table comparing the particles of solids, liquids and gases

1. Copy and complete the table below to compare the particles in solids, liquids and gases.

	Arrangement of particles	Movement of particles	Effect of attractive forces between particles	Space between particles
Solids	Packed closely together; arranged in an organised pattern		Held together strongly	
Liquids		More freely than in solids; slide past each other; movements are rapid		
Gases				Very large

- **Researcher:** picture below shows activity written, marked and corrections of activity.



C. Classroom interactions and discourse

Table 11 below presented Classroom interactions and discourse comprised of the following categories: Types of discourse, Patterns of discourse, Teacher questioning the three categories consist of several characteristics as shown in the table below.

Table 11: Classroom interactions and discourse (Charity)

Theme	Category	• Characteristics

Classroom interactions and discourse	Types of discourse and Patterns of discourse	
		Charity: *what happen when we heat ice?* (initiation, interact, authoritative) **Learners:** *it will melt* (interact-response) **Charity:** *ice turn to water. When we heat water it turn to…..(*interact-authoritative) **Learner:** *water vapour* (response) **Charity:** *the process is called what?* (initiation, evaluation) **Learners:** *Others said steam, others said evaporation* [responses, misconception(M)] **Charity:** *evaporation* (feedback, authoritative). **Charity:** *We have a reverse reaction*. *When we cool water vapour it forms water, and when we cool water it forms ice. The process when we cool water vapour to form water is called what?* (initiation, convey information, SI, interact, PK) **Learner:** *condensation* (response) **Charity:** *when we cool water to form ice, process is called (*Interact, authoritative, evaluate) **Learner:** *freezing* (response) **Charity:** *when ice turns to gas which is vapour it is called what?* (authoritative, evaluate) **Learners:** *melting* (response) **Charity:** *when ice turns to gas which is vapour it is called what?* (question was repeated) **Learners:** no response[Difficulty (D)] **Charity:** *sublimation* (Interact, authoritative)

		• **Charity:** mass of iron, wood, sponge is equal to 10kg. Volume of sponge is five cubic centimetres, volume of wood is two comma five cubic centimetres and volume of iron is one cubic centimetre. Density of sponge is equal to ten kg divided by five cubic centimetre is equal to?(initiation) • **Learner: 2 (answer given without unit)** • **Teacher: is equals to** 2kg/dm cubed (he wrote on the board but on the substitution the volume was cubic centimetre but on the answer decimetre cubed was used; ISMK & M) • **Teacher**; density of wood=mass/volume=. volume of wood is 2.5 and then 10/2, 5=(initiation) • Learner: 4 (answer given without unit) • Teacher: 4 kg/dm cubed. density of iron =mass/volume; 10/1(evaluation) • Tshedza (pseudonym): no response • Learner: 10(answer given without unit) • Teacher: 10kg/dm3 (The unit of all the answers was kg/dm3, M)
	Teacher questioning	• **Charity:** *what is matter?* (Drives lesson) • **Charity:** mention *three state of matter* (PK) • **Charity**: *name of water in the solid, liquid and gaseous state* (Develop thinking skills) • **Charity**: *what happen when we heat ice?* (PK) • **Charity:** *when we heat water it turns to…..* (PK) • **Charity:** *the process when we cool water vapour to form water is called what?* (PK)

		• **Charity:** *density of water and oil which one is more denser than the other?* (PK)
	Communicative approach	• **Charity:** *the bottle of cool drink has a volume of 2 litre* (Initiation, authoritative) • **Charity:** *the volume of glass bottle of cool drink* (interact, authoritative) • **Learners:** *1.5 litre* (response, interact). • **Charity**: *is 1.25L.* (evaluate, interactive, authoritative) • **Charity**: *the volume of cool drink can* (interact, authoritative) • **Learners**: *others 350 whereas others said 500* (response) • **Charity**: *is 500mL* (evaluate, authoritative) • **Charity** *now you know that volume is measured in litres and millilitres* (interact, authoritative).

4.4.2. Discussion

According to CAPS Natural Sciences Grades 7 – 9 DBE (2011), the Natural sciences curriculum consists of the knowledge strands that are used as a tool for organising the content of the subject Natural Sciences, namely Life and Living; Matter and Materials; Energy and Change; and Planet Earth and Beyond. During the pre-lesson interview, the teacher indicated what he would teach states of matter and the arrangement of particles. The topic falls under the knowledge strand of matter and materials (Appendix L).

> **Researcher**: *What are you going to teach today?*
> **Teacher**: *State of matter and arrangement of particles*

When teaching Natural Sciences, it is important to emphasise the links learners need to make with related topics to help them achieve a thorough understanding of the nature and connectedness of things in Natural Science (DBE, 2011). The content knowledge (CK) that Charity displayed about states of matter and arrangement of particles was appropriate and organised. Charity introduced the topic and thereafter asked learners questions which required their prior knowledge (Appendix O)

> **Charity**: particles model of matter and then he asked the class what is matter?
> **Learne**r: *model that helps us understand that matter is made from particles and how they affect the behaviour of matter (misconception).*
> **Learne**r: *matter is that occupies space and has mass.*

According to Yilmaz-Tuzun (2008) teachers' content knowledge can influence what they teach as well as how they teach. It was noted at the beginning of the lesson that Charity asked learners to define matter and also requested that learners mention the states of matter (Table 9). He used questioning technique in order to check if the learners still remembered what they had learnt in previous grades about the particular concept. According to CAPS Grades 7 – 9 Natural Sciences (DBE, 2011), science is defined as a systematic way of looking for explanations and connecting ideas. Charity used his CK to explain matter. During the lesson Charity demonstrated the sequence of ideas (Appendix O).

> **Teacher**: *matter is anything that occupies space and has mass. We have three states of matter.*

Charity's content knowledge (CK) and subject matter knowledge (SMK) was used to explain the arrangement of different states of matter (Appendix O).

> **Charity**: *The arrangement of particles of solid, liquid and gas. The arrangement of particles solid or ice are arrange in specific pattern. Liquid are loosely arranged and are not in a fixed shape. Gas or steam they are not arranged in a specific pattern.*

His emphasis here was for learners to know that the arrangement of particles of solid, liquid and gas differ (Table 9). Therefore, it indicates that the teacher had the required content knowledge. However there was also a case where Charity used both English and Tshivenda to explain the sublimation process by means of example so that learners could understand what he was explaining (Appendix O).

> **Charity:** *When ice turns to gas which is vapour it is called sublimation. Naya checkers hangei ho no rengiswa dzi khovhe ni do wana murahurahu hangei khovhe dzedzi dzi nobva madini ni wana dzo vhewa kha inwe ice mara nga ngomu ni tshi sedza a ninga do vhuya na wana huna madi kha hedzila ice, ri khou wanana ne ni do wana hu khou sokou bva vhunwe*

> *vhutsi so hu khou vha na evaporation ri khou wanana ne and learners said yes. heyo dry ice a i turn ubva kha ice ya ita water, I turner ubva kha ice yavha vapour.ndi hafho i no vhudziwa upfi sublimation* ***(at checkers there are fish that are placed in the ice but when you look inside that ice you will not find water but you will see smoke or fog and evaporation will be taking place. Dry ice does not turn from ice to form water, it will turn from ice to vapour and such process is called sublimation).***

Charity was aware of the resources available at the school to support his teaching and other resources he can use that can be helpful to learners to learn the concepts he taught (Appendix L).

> **Researcher**: *What are the resources available to your school to support your teaching?*
> **Teacher:** *Textbooks and chalkboard*.
> **Teacher**: *In this concept we should have been having ice, stove and beakers*

Textbooks are a crucial resource for teachers in their planning and in gaining access to the appropriate knowledge and skills to teach at an appropriate level (DBE, 2009). Although researchers agree that practical work in science is important, teachers face challenges in doing practical work (Heeralal, 2014). Charity indicated that the school does not have a laboratory or adequate apparatus (Appendix L).

> **Researcher:** *What are challenges or problem do you experience with the teaching of Natural Sciences?*

Teacher: *Ndi ngau leka ha zwi apparatus na u savha na laboratory* ***(Lack of apparatus and not having laboratory).***

Limited resources, however, encourage teachers to modify the curriculum by utilising hands-on experiences (Stern & Marcella, 2008). Tobin (1992) states that a teachers' purpose is to provide the best materials and learning situations to make learning individually meaningful for each student. Vicente (2013) says that although teachers have limited resources, they need to exercise creativity to source alternative resources in order to implement scientific inquiry. Teachers should fulfil various roles that include being mediators of learning, interpreters and designers of learning programmes and materials, researchers, lifelong learners and learning area specialists (DoE, 2002c). Besides the textbook provided at school charity did not prepare other teaching aids to assist him during the lesson. Therefore charity was not able to do experiments or demonstrate some ideas of the lesson e.g. heating ice for learners to see it changing to liquid form. According to Mudulia (2012), for effective science teaching, textbooks, revision books, laboratory chemicals and equipment must be readily available.

Charity knows what to do to keep learners focused and involved in the lesson as well as how to check for learner understand (Appendix L).

Researcher: *How will you make sure that all your learners stay focus and participate during lesson?*
Teacher: *Ndi dovha ndi khou vha vhudzisa mbudziso uri vha mphe antsara* ***(I will be asking them question so that they can give me answer).***
Researcher: *How do you know that learners learned or gain a better understanding of what you taught them today?*

Teacher: *Nga u vha nekedza class work* ***(By giving them class work)*****.**

CAPS (DBE, 2011) states that process skills refer to the learner's cognitive activity of creating meaning and structure from new information and experiences. Charity did not develop and improve learners skills such as demonstrating, investigating, interpretation of data because of the resource used, e.g. textbook. Hence, cognitive and process skills that the learners develop and gain during lesson was comparing (Appendix O). Table 12 presents summary of teacher knowledge.

Table 12: Summary of Charity knowledge on topic Particles model of matter

Theme	**Category**	characteristics
Teacher knowledge	**Content**	• He did not explain the concepts of the particle model of matter like atoms and molecules. He explained arrangement of particles in three states of matter. He did not explain the diffusion process in particles of gas and liquid. • He represents particles of three states of matter by means of drawing diagrams and explaining their arrangement, movement, and spacing using the particle model of matter. • Compared particles of states of matter in table.
	Context	• He attended NS workshops • He used the textbook, chalks and a chalkboard to teach. • Learners in schools come from poor family background and depend on social grants for living.
	Learners' understanding	• He connects prior knowledge with new information ideas of the topic. • English, Tshivenda used, and learners participate. • Where learners had difficulty and misconception, he presented appropriate ideas.

Charity's instructional strategies included teaching the method of question and answer and lecture; explanatory framework that was illustration and examples; and activities such as class work (Table 10). Charity makes use of the questioning technique at the beginning of the lesson to develop a lesson and evaluate learner understanding of previously learned concepts. For example, learners were asked to mention states of matter (Appendix O).

> **Charity**: *Mention three state of matter*
> **Learner**: *solid.*
> **Learne**r: *liquid*
> **Learner**: *gas*.

The traditional lecturing methods are used because of teachers being used to these methods due to their teaching experiences (Lombaard, 2015). Charity used the lecture method to explain other concepts (Appendix O).

> **Charity**: *Mass is a measure of the amount of matter that an object is made of. Mass is measured in grams (g) and or kilograms (kg). Volume is the amount of space an object occupies. Volume is normally measured in unit like litres or millilitres. It is also measured in unit like centimetres cubed, millimetres cubed or decimetres cubed. A block, it has a length of 10cm, breath of 10 cm and height of 10cm. The volume of the block is equal to length x breath x height which is equal to 10cm x 10cm x 10cm.*

Charity also used both lecture and illustration method when explaining other ideas of the lesson (Appendix O)

> **Charity**: *Density, the blocks in figure 20 all have different sizes, but their mass is the same. This is because the particles in iron are more closely packed together than the particles of wood.*

> **Charity:** *In figure 21, all the blocks have the same volume but the iron block is much heavier than the sponge foam block even though they are the same size. More iron particles are packed into this volume than in the case of the wood or sponge foam. We say that iron is denser than wood and sponge. Density is equal to mass divided by volume.*

In addition, Charity makes use of lecturing method using example for learners to gain a better understanding of the concept (Appendix O).

> **Charity:** *if you pour oil in water, the oil will go up and not below the water. Therefore, oil will always remain on top of the water not water on top of the oil. There is more space between the oil particles. There are some exceptions to this, for example, wood is a solid but it is less dense than water.*

During post lesson interview, Charity indicated that he used analogy (misconception- Appendix L) and illustration to define matter and gave examples (misconception- Appendix O). Charity did not use modelling in his teaching practice (Appendix O). Charity gave learners class work and marked it with the learners (Table 10). Practical work in science is acknowledged and widely accepted as an important component in the teaching and learning of scientific concepts (Toplis and Allen 2012; Kibirige et al. 2014). Charity marked the class work with the learners and he gave the learners an opportunity to control their class work by means of marking their own book (Appendix O). Table 13 below presents Charity instructional strategies used in the lesson

Table 13: summary of instructional strategies Charity used in the lesson

Instructional strategies	**Teaching methods**	Question and answer
		Lecture
	Explanatory framework	Illustrations
		Examples
	Activities	Class work

Classroom discourse refers to the language that students and teachers use to communicate in the classroom (Foy, 2013). According to Chin (2006), authoritative is a discourse that a teacher uses to convey information and the utterances are often made up of instructional questions and factual statements. Charity employed an authoritative discourse because he mostly conveyed information to the learners by means of the lecture method (Table 10). Consequently, the learners were not given the opportunity to explain some of the ideas or at least given an opportunity to form groups in order to discuss the concepts among themselves. According to Chin (2006), dialogic discourse encourages debates and challenges. Charity did not make use of dialogic discourse because he did a lot of explanations in the classroom (Appendix O), not considering that learners might have some ideas they might wish to share with the class concerning the content being taught. It could have been a good opportunity for learners to exercise their communicative and thinking skills by sharing ideas among themselves.

The pattern of discourse used was initiation, response and evaluation (IRE). Charity explained ideas of the lesson and ask instructional questions where learners responded and evaluated (Appendix O).

> **Charity**: *We have a reverse reaction. When we cool water vapour it forms water. When we cool water it*

forms ice. The process when we cool water vapour to form water is called what? (Initiation)

Learner: *Condensation (response)*

Charity: *when we cool water to form ice process is called (initiation)*

Learner: *freezing (response)*

Charity: *When ice turns to gas which is vapour it is called what? (Initiation)*

Learner: *Melting (response)*

Charity: *Sublimation (evaluate)*

This type of discourse was appropriate for Charity to assess learners' understanding of the content taught. According to Mortimer & Scott (2003), Interactions and discourse in the science classroom between the teacher and students is fundamental to learning because it is central to the meaning making process. This discourse chosen enables the teacher to know where the learners still need to be assisted on the content (Table 11).

Communication is part of Natural science classroom interaction and discourse since it builds a relationship among learners, between learners and teachers, as well as their environment. The communicative approach that Charity used was interactive-authoritative (Table 11). The interaction was mostly on teachers and the learners and the teacher was the one giving instructions (Table 11). What Charity said in the lesson was considered as final even though learners sometimes were invited to give responses.

In the Natural Science classroom, the students consider the teacher as a more capable peer with whom meaning is constructed through shared discourse (Rollnick, 2000). The time for learners to interact among themselves was limited (Appendix O). Charity should have given learners chance to interact among themselves by means of pausing questions or discussing the concepts of the lesson. Charity's' lesson presentation did not enable learners to develop process skills like doing investigation, observation, communication or raising questions. Science process skills are important and necessary as they enable the learner to engage in and gain intellectual control of the world through the formation of concepts (DoE, 2002c).Table 11 & Table 14 presents interactions and discourse employed in Natural Sciences classroom

Table 14: summaries of Classroom interactions and discourse employed

Classroom interactions and discourse	**Types of discourse**	Authoritative discourse
	Patterns of discourse	Initiation-teacher
		Response- learner
		Evaluation-teacher
	Teacher questioning	Drives lesson
		Improve learning
		Develop thinking skills
		Encourage and motivate
	Communicative approach	Interactive-authoritative

4.4.3. Findings

The study discovered that the teacher focused mostly on conveying information to the learners and most of lesson ideas were written on the board. It was noticed that the learners accepted the information the teacher provided for them since they copied notes. Hence, Charity did use his content knowledge to teach the topic particles model of matter in such a way that it enabled the learners to take notes of lesson ideas that can be useful to them while preparing for informal and formal tests as they will be able to reflect on the notes for a particular concepts. However, Charity omits learners' of opportunities to use their thinking skills and reasoning skills on the concepts as he did many explanations.

The study revealed that Charity did his best to assist his learners to learn the concepts through him explaining by using illustration from the textbook. However, there was a situation where Charity displayed Incorrect Subject Matter Knowledge and Misconceptions to the learners (Table 11, Appendix O). Table 11 in characteristics of types and pattern of discourse, the volume of sponge, wood and iron was given in centimeter cubed and the mass was in kilogram. However, during density calculations the teacher in substitution use kg as mass unit and centimeter cubes as volume unit but on the answer the teacher wrote kilogram decimeter cubed. Learners did not question this but learnt inappropriate ideas from the teacher. Additionally, learners also displayed misconception but the teacher was able to assist the learners to know the correct information on a particular concept.

The researcher found that most of the ideas of the lesson were explained using both English and Tshivenda (learners' home language). The researcher noted that Charity using both English and Tshivenda when teaching concepts assisted learners in such a way that encouraged the learners to take part in the lesson. The researcher noticed that Charity made it easier for the learners to learn, participate and understand the concepts without difficulties. The study revealed that Charity used different methods on the topic of particles, model of matter and such methods were able to assist the learners to learn and engage themselves. The researcher has noted that the questioning method was of success since most of questions Charity asked learners. However, some of the questions did not require learners to exercise much of their thinking and communication skills. The study revealed that some of examples used to explain the concepts were familiar to the learners.

The researcher found that the knowledge and methods used during lesson did not give learners enough opportunities to interact among themselves and the subject matter. Therefore, the study found that Charity employed authoritative discourse. Learners' opportunities to interact with the subject content and among themselves were narrow because he employed the lecture method to explain some of ideas of the lesson. The researcher also found that the activities employed in the lesson did not include a discussion. Therefore, there was a lack of discussion activity between teacher and learners, and among learners, themselves during the lesson and no attempted discussion Charity did with the learners concerning the concepts. The study also revealed that the teacher did not develop other process skills (e.g. learners-raising questions) emphasised in the subject NS CAPS document for learners to develop and gain in the NS lesson.

Charity never gave learners an opportunity to raise questions or discuss the concepts among themselves to share some ideas about the topic. Because of Charity doing lot of explanations, authoritative discourse occurs. As a result, this can discourage learners' interest and understanding of the subject matter content. The researcher found Charity's pattern of discourse was of success as he evaluated the learners by means of questioning and class activity; however, the activity given to learners was easy for them. Charity failed to give learners time to discuss and say something based of the concepts taught in order for them to be able to exercise their reasoning skills. In addition, the teacher was the only one giving instruction and learners always did what the teacher expected from them. The study found that Charity focused more on teaching by lecture and gave learners class work to write and such resulted on interaction-authoritative approach.

4.5. Case three: Kay

4.5.1. Data presentation

The data is presented as follows.

A. Teacher knowledge

The Table 15 below presents Kay's knowledge and such knowledge comprised of the following categories, namely content, context and teacher's learners' understanding. The three categories consist of several characteristics as shown in the table below.

Table 15: Teacher knowledge (Kay)

Theme	Category	Characteristics
Teacher knowledge	**Content**	• **Kay:** *the lesson topic is properties of matter and the main purpose is to know all things that are responsible for*

		making any different materials that we have [concept, initiation, authoritative, prior knowledge(PK)] • **Kay**: *the first thing that we need to do, we must start with the word itself matter. What do you understand about this word that we call it matter?* (concept, initiation, PK) • **Kay:** *do you still remember the first thing when we were in the beginning of our Natural science we have dealt with different spheres; do you still remember the spheres? Lithosphere, biosphere, hydrosphere, and mesosphere* (concept, initiation, authoritative, PK) • **Kay:** *then all those spheres we dealt with different state of matter. So there are matters that are found in the water, there are matters that are found on the ground, on the space in different places* (convey information, PK) • **Kay:** *matter is anything that occupies space and has mass. Anything that occupies space has weight* (CK, authoritative) • **Kay:** *in our class we have got different materials. some of the materials they are hard whereas some of the materials they are soft, some of them (materials) they are somewhere between hard and soft* [SMK, sequencing ideas(SI)] • **Kay:** *identify all those materials that we have here in the class and what it is that made those materials* (CK,SMK,SI) • **Kay:** *different materials that can be used to wrap the food* (CK,PK) • **Kay:** *definition for recycling. You have seen old cars that are no longer working at the community and they are people who move around collecting old good* (concepts, Convey information, PK) • **Learner:** *recycling is when you are taking old materials and recycling them and using them again* (response, PK). • **Kay:** *yes, so it means that you are taking the old material, you renew them so that you can use to saw the very same thing that was store there again* (SMK,PK)

		• **Kay**: *between the paper and wood which one can be recyclable?* (SMK, SI) • **Kay:** *impact on the environment* (initiation, concept) • **Kay:** *If you still remember we have learnt about different materials. Now all those materials or objects that are made out of different materials they have got their own uses. We use them to do different things. After using those things sometimes we find that because we are no longer interested on those materials or all those objects that are made out of those materials we turn to put them somewhere. We turn to throw them somewhere. Sometimes we can throw them in the lithosphere. Sometimes we can throw them on the hydrosphere* (PK, Initiation, SI) • **Kay:** *What do you understand by the word lithosphere?* (initiation, concept) • **Kay:** *On the surface area you still remember we have what we called a living and non-living things. The two things they are inter dependent. What are the living things that are on the surface area?* (PK, SI, SMK, interact). • **Learner :** *animals* (response) • **Learner :** *grass* (response) • **Learner :** *trees* (response) • **Learner :** *peoples* (response) • **Kay:** *those materials when we throw them in the lithosphere they are going to cause the problem. We are going to identify the problems in which those items are going to do on the living things* (convey information, CK, SI) • **Kay:** *What is hydrosphere?* (initiation, concept) • **Kay:** *What do you think we can do to avoid loss of lives in the lithosphere and hydrosphere?* (initiation, SI)
	Context	• **Kay:** *Properties of materials* (curriculum-concept). • **Kay:** *It is very poor. The main thing that let it to be poor is that they are not close to things* (socio-economic background of learners)

		• **Kay:** *We have got only books, some charts and we also use objects that are available around here at the school* (resources available to support teaching) • **Kay:** *The objects in the class* (resources to be used) • **Researcher:** Besides the resources you used. What other teaching resources can you use to teach the same concepts and how will you use such resources? • **Kay:** *The related objects, any objects that I found that is related to the lesson that am teaching then I just pointed them and let them feel it, touch it* (resource knowledge). • **Researcher** What challenges do you experience with the teaching of Natural Sciences? • **Kay:** *Lacking of things that I can use to do some experiments* (no laboratory-no apparatus). • **Kay:** *We have some workshops every year* (support provided by the department)
	Teacher's Learners' understanding	• **Kay:** *By involving everyone in the class. By asking them questions and then they respond* (learner interest-understanding) • **Kay:** *I want those people (learners) to take care of the objects around them*(teacher knowledge-learner interest) • **Kay:** *they must know that things come from primary activities into secondary activities therefore until secondary activities, the secondary activities* (PK-experience). • **Kay:** *can you give me some of the uses of the desks* (initiation, PK) • **Learner:** *to seat on it* (PK-experience) • **Kay:** *or what?* (question) • **Learner :** *to write* (knowledge-experience) • **Kay:** *it helps you to write* (interact-authoritative) • **Kay:** *what is it that makes a ruler? think you also have a ruler in your bags, check* (initiation, interact-authoritative) • **Learner :** *plastic*(response) • **Learner :** *wood* (response)

		• **Learner :** *iron* (response) • **Kay:** *it means we have the other one that is made out of wood, the other one out of iron, the other one out of plastics, right* (authoritative-interact) • **Learners:** *yes.* (interact, response) • **Learners:** *instead of using sand to build houses we can use metal* (PK, experience). • **Kay:** *just like here* (the teacher touch the wall of the classroom) *this are not sand, what materials are this once?* (interact-authoritative) • **Learners:** *others said aluminium and others said wood* [(Misconception(M), Difficulty(D)] • **Kay:** is it a plastic? Is it a wood?[difficulty(D), dialogic] • **Learners:** *copper, some again said plastics* [(Misconception(M), difficulty(D)] • **Kay:** *it is a wood, check where there was a scratch as it is painted* [ISMK, misconception(M)] • **Learner:** *stainless steel* (most learners agreed-misconception) • **Kay:** *stainless steel because they are of different in terms of strength* (M, D).

B. Instructional strategies

Table 16 below presents Kay's instructional strategies comprised of the following categories namely, Teaching methods, Explanatory Framework and activities. The three categories consist of several characteristics as shown in the table below.

Table 16: Instructional strategies (Kay)

instructional strategies	**Teaching methods**	• **Kay**: *I use demonstration because I tried by all means to let them to touch the materials or objects that are available in the class* (method used during the lesson).

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- **Kay:** *what is matter?* (He used questioning techniques to arouse interest and engage learners).
- **Learner:** *something that takes up space and has mass.* (answer)
- **Kay:** *matter is anything that occupies space and has mass. Anything that occupies space has weight* (lecture, interact-authoritative).
- **Kay:** *in our class we have got different materials. Some of the materials they are hard whereas some of the materials are soft, some of them (materials) they are somewhere between hard and soft* (SMK, lecture method used to make learners understand the concepts).
- **Kay:** *identify all those materials that we have here in the class* (initiation, question)
- **Learners:** *table; chalkboard; chair; further duster; said desks; papers; brooms; school bags; shelves; buckets; scissors* (responses of different learners)
- **Kay:** *the book that is in front of you there. If we made it out of let say the iron or the steel, what do you think it will happen? The book you see, you can open it properly, easy to bend, smooth (the teacher was opening the book), we can write on it nicely, therefore we take the steel to make a book* (lecture-demonstration methods- see picture below)

Kay hold the book for demonstration

Kay explaining the book is smooth and it bend easily

Kay explaining the book cannot bend like that if made out of steel

- **Kay:** *Do you think it is going to be possible to write on it?* (question)
- **Learners:** *no*(answer)

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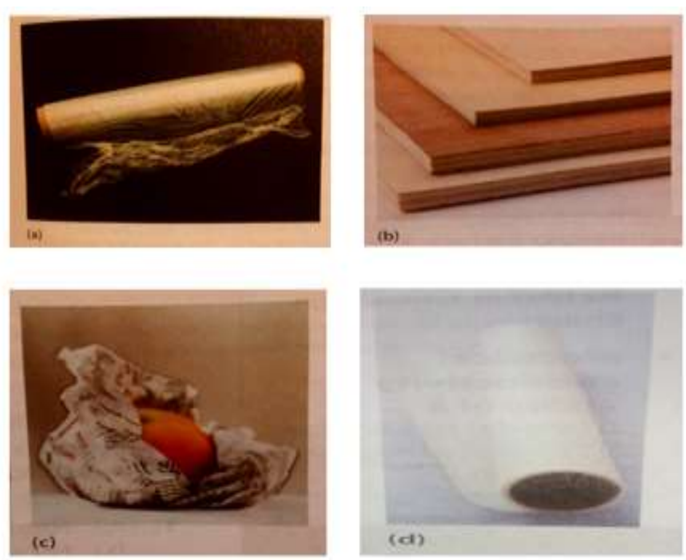
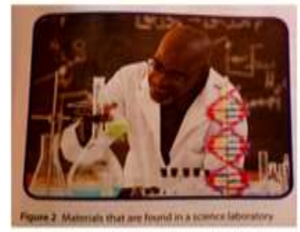
- **Learner:** *harder to write, harder to move easily and harder to bend* (response-PK)
- **Kay:** *yes, harder to move easily. It cannot move easily like this, this one is very smooth. So obviously if you use steel it is going to be tough to bend. If these papers were steel obviously when you bend them like this, it was going to cause some injuries on your fingers. In case of writing it was going to be difficult for you to write on it. I don't know the kind of pen that you are going to use to write* (he laughs) on that kind of book, are you with me (lecture-demonstration method-see pictures above).
- **Learners:** *yes*
- **Kay:** *we have got different materials that can be used to wrap the food. Obviously we're using different types of materials to wrap the food (the learners were told they can go to the shop, restaurant to buy fresh food, any kind of food that they like). But in term of wrapping there are different materials that can be used to wrap the food.* (Lecture method).
- **Researcher:** Kay used figures of different materials to wrap food on page 67 of the platinum grade 7 Natural Sciences learner's book to ask learners questions. See pictures below:



- **Kay:** *let's identify material number a-d* (initiation)

		• **Learners:** *a) clip wrap, b) plywood, c) paper and d) learners said wax wrap* (responses obtained from different learners) • **Kay:** *which one out of the four do you think is more suitable to wrap the food? And you give me the reason* (interact, authoritative) • .**Kay:** *for example there are visitors or you're about to receive visitors from Gauteng is Good Friday. They want to visit or they're visiting your area therefore you are preparing food for them which one do you think we can choose to wrap the food and why?* (example, authoritative) • **Learner:** *A cling wrap* (response) • **Kay:** *what is the main reason for choosing A why not B?* (interact, evaluation) • **Learner:** *because A is easier to wrap than B* (response) • **Learner:** *A because its clean and no dust will get in*(response) • **Learner:** *A, because is more flexible than b* (response) • **Kay:** *What is hydrosphere?* (CK, initiation) • **Learner:** *all of the water found on earth* (response) • **Kay:** *yes and hydro means……..(*question) • **Teacher and learners:** *water* (interact, response) • **Kay:** *it means now we are in a place where we got water and again in water we have living things as well as non-living things. Can we identify a bit of living things in the hydrosphere, thereafter we are going to see how are they going to be affected by those objects you throw in hydrosphere* (convey information, interact, authoritative) • **Learners:** *fish; sharks; star fish; sea tortoise; whales; sea snakes* (responses of different learners) • **Kay:** *they are lots in other words we also have plants and animals in the hydrosphere* (convey information)
	Explanatory Framework	• **Researcher:** models, analogies, examples, illustration can be useful when explaining some of Natural science concepts, which ones did you use today and why?

- **Kay:** *Most cases I illustration because I use some pictures from the books* (SMK)
- **Researcher:** Kay used figures on page 65 of the platinum grade 7 Natural Sciences learner's book for illustration, lecturing and questioning. See pictures below:



- **Kay:** *what do you see at figure 1*(initiation)
- **Learners:** *desks* (response)
- **Kay:** *It means that figure 1 is just like the way our class look like, can you see everything is also there in figure 1. We have already identified those materials that are there* (convey information, interact, authoritative)
- **Kay:** *let's go and have a look at figure no.2 we also have the materials that are in laboratory. Can you identify those materials and try to identify things that made up those materials that are there?* (initiation, SI)
- **Learners:** *glass* (response)
- **Kay:** *what is it that made the glass?* (SI)
- **Learner:** *cell* (response)
- **Kay:** *In figure no 3 we also have different materials. Can you also see those materials (learners said yes)? Let try to identify the material that are there and everyone can see those materials that are there* (initiation, SI, authoritative)
- **Learners:** *school bag; marking pens; watch; books, apple, crayons; a ruler; rubber* (responses of different learners)

		• **Researcher:** *Kay used examples to explain materials that can be used to make the same object.* • **Kay:** *we have some mug at home. Some of them are made out of ceramics, some of them are made out of plastics, and some of them are made out of iron. You see, but all of them they are suitable to use* (example, SMK, authoritative) • **Kay:** *the shoe that you wore there hopeful it is made of leather and a rubber isn't it? Instead of putting a rubber under it, we take a steel or iron we put under there. What do you think will happen?* (SMK, initiation) • **Learner:** *you will not walk properly because the shoe will be heavy* (response) • **Kay:** *yes correct, you cannot walk properly either the shoe will be heavy for you and obviously it will damage your leg* (interact, authoritative) • **Learner:** *instead of using sand to build houses we can use metal* (convey information) • **Kay:** *most of the squatter camps in Johannesburg are made out of elongated iron. That is the house is just that sometimes it can give you more disadvantage than that other one made out of sand because if it hot obviously you are going to feel more hot though there are some windows* (example, convey information)
	Activities	• **Researcher:** Kay used page 65 of the platinum grade 7 Natural Sciences learner's book to do activity 1 with the learners. See pictures below:

Figure 1 Materials that are found in a classroom

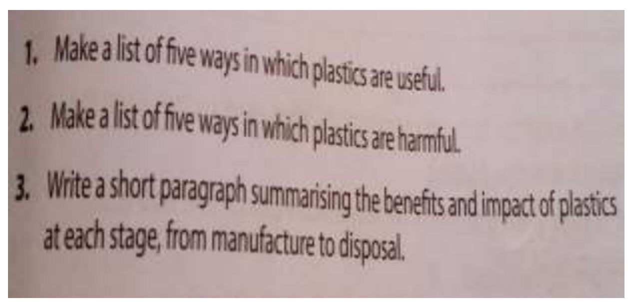
Figure 2 Materials that are found in a science laboratory

Figure 3 Materials that are often used by learners

Activity 1 Investigate the properties of materials around you

1. Look at the objects in Figures 1–3. Write a list of the different items that you can see.
2. a) What material is each object made of?
   b) For each object, give one reason why you think that material was chosen.
3. If you think that another material would have been more suitable for any of the objects, state the material and give a reason why.

- **Kay:** *there are questions there under activity one, can you see those questions that are there?* (initiation)
- **Learners:** *yes* (response)
- **Kay:** *right it means that before we go there we already answered them. The first question says look at the objects in figure 1, 2, number 3; we tried to look at those figures and then we write a list of them as we have identify them already. When you go to question number 2 it has number a) and b) where number a) says what material each object made of? And we identify some of the objects or materials. We tried to see what is it that made those materials. Number b) for each object, give one reason why we think that material was chosen. I gave example like a ruler and I said we cannot make a ruler with a paper because is not going to be possible to use it. I said desk, you cannot make a desk with a sponge because is not going to be possible for you to sit on it, you cannot relax because it will be bending there and there though they can use a rubber, are you with me. Let's go to question no 3 if you think that another material would have been more suitable for any of*

		the objects, state the material and give a reason why(convey information, interact, authoritative) • **Simon:** *we can make a desk with a rubber and iron and we can sit on it and it will not fall apart*(response) • **Kay:** *yes, he said we can take an iron to make a desk and we can sit on it though it cannot be comfortable enough* (interact, authoritative) • **Learners:** *instead of using glass to make bottle for chemical we can use plastic because it can also hold chemicals* (response) • **Kay:** *open page 76 and go through the case study fast. learners were told to go through it(case study) at home since the period was over and answer questions on page 77* (interact, authoritative) • **Kay:** *look at the questions on page 77* (the question that the teacher told them to go and answer on the previous lesson). The teacher read all the questions from the textbook. The activity questions were as follows: see picture below  1. Make a list of five ways in which plastics are useful. 2. Make a list of five ways in which plastics are harmful. 3. Write a short paragraph summarising the benefits and impact of plastics at each stage, from manufacture to disposal. • **Researcher:** The learners did not do the activity on their class work book. They raised their hands and responded to all questions the teacher read for them.

C. Classroom interactions and discourse

Table 17 below presents classroom interactions and discourse comprised of the following categories, namely types of discourse, patterns of discourse and teacher questioning. The three categories consist of several characteristics as shown in the table below.

Table 17: Classroom interactions and discourse (Kay)

Classroom interactions and discourse	**Types of discourse and Patterns of discourse**	
		• **Kay:** *for example you said desks as one of the item found in the class. What is it that you think it made the desk and how it is made or where is it come from?* (initiation-authoritative). • **Sam:** *the tree* (response) • **Kay:** *so it means that we are moving from primary activities to secondary activities. Primary we're talking about the tree the way how it is right. You find that they go and cut down the tree they will take it to the industries to make the fine table that you had*(evaluate, convey information, interact) • **Kay:** *why can't we make a desk with a sponge or a paper? You know the uses for the desk right or before we go there, can you give me some of the uses of the desks* (initiation, interact-authoritative) • **Learners:** *to seat on it* (response) • **Kay:** *or what?* • **Learner:** *to write*(response) • **Kay:** *it helps you to write. So let say we take some of materials like sponge or papers we make a desk, what do you think it will happen?* (initiation, authoritative) • **Learner:** *we will not write properly or seat well* (response) • **Kay:** *yes, we can't seat well because it will be bending and you cannot write properly* (evaluate, interact, convey information, authoritative)

		• **Kay:** *what do you think it will happen if I throw an empty tins or a plastic on top of grass and why?* (initiation, authoritative) • **Paul:** *the grass will turn yellow because it will not get enough sunlight* (response) • **Kay:** *it will first get dry or it will turn yellow then after it will dry then it dies*(evaluate, authoritative)
	Teacher questioning	• **Kay:** *what is matter?* (Drives lesson) • **Kay**: *identify all those materials that we have here in the class* (Encourage and motivate) • **Kay**: *what is it that you think it made the desk and how it is made or where is it come from?* (Develop thinking skills) • **Kay**: *let say we take some of materials like sponge or papers we make a desk, what do you think it will happen?* (Develop thinking skills) • **Kay:** *What is it that makes a ruler?* (Encourage and motivate) • **Kay**: *What is the purpose for the ruler* (Encourage and motivate) • **Kay:** *I have water here can't you see that this water is pure?* (demonstrate-Improve learning) • **Kay:** *what is it that makes a ruler?* (Encourage and motivate) • **Kay:** *between the paper and wood which one can be recyclable?* (develop thinking skills) • **Kay:** *What is recycling?* (encourage and motivate) • **Kay:** *What do you understand by the word lithosphere?* (Encourage and motivate)

		• **Kay:** *What is hydrosphere?* (Encourage and motivate) • **Kay:** *what do you think it will happen if I throw an empty tins or a plastic on top of grass and why?* Encourage and motivate) • **Kay:** *What do you think we can do to avoid loss of lives in the lithosphere and hydrosphere?* (Develop thinking skills, encourage and motivate) • **Kay:** *How can you educate your school colleagues, your community to stay away of disturbing the lives on the environment* (Develop thinking skills, encourage and motivate)
	Communicative approach	• **Kay:** *the big ship is coming from Russia to south Africa thereafter people inside eating different things that were wrap either by containers, by plastics and thereafter they decided to throw away those plastics in the ocean. And there are lives of living and non-living things. What do you think it will happen to the lives of hydrosphere?* (Initiation, Interact) • **Learner:** *the animal in the ocean will die when they eat the plastics* (interact, response) • **Kay:** *yes, the animal sometimes fish they can decide to eat the plastics. Obviously when they eat the plastic sometimes it can be difficult for them to digest those plastics in their stomach. The animal will die as those plastics are made of different things and there are also chemicals added to make the plastics* (evaluate, convey information)

		• **Kay**: *plastics have different colours. Those colours it means there are chemicals. Obviously when they are in the water, the colours will be washed away from the plastic. When they drink that water the animal they are going to be affected* (convey information, authoritative) • **Kay**: *What else apart from the plastics?* (initiation) • **Learner**: *oil* (response) • **Kay**: *Spilling of oil in the ocean, when animal drink water with oil on it they will be affected as a result they will die* (interact, authoritative). • **Kay**: *What do you think we can do to avoid loss of lives in the lithosphere and hydrosphere?* (initiation, dialogic) • **Learner**: *warn people that they must not throw stuffs in the water or anywhere else* (response) • **Kay**: *how can you warn people coming from somewhere else* (authoritative, dialogic) • **Learner**: *we make floating signs* (response) • **Kay:** *What materials do you think we can use to write any information on it as we said we have got some sharks and whales there in the ocean* (authoritative, dialogic) • **Learner:** *make the sign of metals* (response) • **Kay:** *How do we put the signs on the ocean? Something that can float on top of water it is the same, you put something that can float a certain animal may come across as it float that thing and eat* (authoritative, dialogic)

		• **Learner:** *where the ships are staying we should put the sign there* (response) • **Kay:** *so it means that where there're harbours people before they leave with those ships they must get a lesson. They must have at least a workshop inform them that they must not throw anything inside the ocean*(evaluate, authoritative) • **Kay:** *If they are continuing throwing those things in the ocean what is it that we can do? We educate them before they leave with their ship but still there are some certain things thrown there in the ocean*(authoritative, dialogic) • **Learner:** *put the police force that will control the ocean*(response) • **Kay:** *we can put the force that will be monitoring the ocean all the time. In other words impose the harsh law and send them to prison* (evaluate, authoritative) • **Kay:** *How can you educate your school colleagues, your community to stay away of disturbing the lives on the environment* (initiation, authoritative) • **Learner:** *I can advise them to buy dustbins and if the dustbins are full they can take them to the dump yard* (response) • **Kay:** *Do you think the people in the village they can buy dustbins* (initiation, authoritative) • **Learners**: *no* • **Kay**: *they can't buy the dustbins, what do we do?* (authoritative, dialogic) • **Learner:** *we can tell them to use old buckets as their dustbins* (response)

		• **Kay:** *The question is where are you going to take those buckets to?* (authoritative, dialogic) • **Learner :** *no response* (Difficulty(D)) • **Kay:** *we are dealing with the community in the most rural area so what do we do, that is why they decided to dump those pampers on the streams around the village*(convey information, authoritative)

4.5.2. Discussion

In the pre-lesson interview, Kay indicated that he will teach properties of materials (Appendix M). The topic falls under the knowledge strand of matter and materials (Appendix M).

> **Researcher**: *What are you going to teach today?*
> **Teache**r: *Properties of materials.*
> **Teacher:** *We have some workshops every year.*

When teaching Natural Sciences, it is important to emphasise the links learners need to make with related topics to help them achieve a thorough understanding of the nature of and the connectedness in Natural Sciences (DBE, 2011). The content knowledge (CK) that Kay displayed about the Properties of materials was appropriate and organised. Kay first reminded learners about what they had previously learned related to the topic in order to connect previously learnt ideas with new ideas of the topic (Appendix P).

> **Teacher**: *The first thing that we need to do, we must start with the word itself matter, what do you understand about this word that we called it matter. You still remember the first thing when we were in the beginning of our Natural Sciences we have dealt with*

> *different spheres. Do you still remember the spheres? Lithosphere, biosphere, hydrosphere, and mesosphere. All those spheres we dealt with different matter. Therefore, there are matters that are found in the water, there are matters that are found on the ground, on the space in different places.*

The study revealed Kay had experiences in the teaching of Natural Sciences (NS) concepts since he had indicated in the pre-lesson interview that he had experience in Natural Sciences teaching (Appendix M). The teachers' CK had been assumed as being developed through his teaching experience in the topic and workshops attended (Appendix M).

> **Researcher**: *How long have you been teaching Natural Sciences?*
> **Teache**r: *Natural Sciences almost 6 years.*

According to Yilmaz-Tuzun (2008) teachers' content knowledge can influence what they teach as well as how they teach. It was noted at the beginning of the lesson that Kay stated the purpose of the lesson topic. Thereafter he asked learners what matter is and reminded the learners about the different spheres they had learnt (Table 15). He used a questioning technique in order to check if the learners still remembered what they had learnt in the previous lessons related to the topic taught. According to CAPS Grades 7 – 9 Natural Science (DBE, 2011), science is defined as a systematic way of looking for explanations and connecting ideas. Then he used content knowledge and prior knowledge to explain matter and where different types of matter are found (Table 15)

Kay used CK and SMK that was adequate in the explanation of the concepts to the learners and he presented the sequence of ideas during the lesson (Appendix P).

Kay: *matter is anything that occupies space and has mass. Anything that occupies space and has weight. So in our class we have got different materials, some of the materials they are hard whereas some of the materials are soft, some of them they are somewhere between hard and soft right. I want you to identify all those materials that we have here in the class.*

Kay only refers to the NS textbook when teaching since he did not take either a lesson plan or the NS CAPS document along to assist to teach the particular concept. Kay used his SMK when he explained different concepts (Table 15). Kay also used his prior knowledge to enable learners to list the materials that were available in the class in order for learners to know and see the materials available around them (Table 15) His emphasis here was for his learners to know that materials differ as some of them are soft, some are hard and some are in between. Therefore, this indicates that the teacher has the required CK. However, there was also a case where misconception and ISMK displayed (Table 15) Kay also used PK for learners to recognise that different materials can be used to make the same object (Appendix P).

Teacher: *what is it that makes a ruler? The material that makes a ruler. Think you also have a ruler in your bags, check.*

Learner: *plastic.*

Learner*: wood.*

Learner: *iron.*

Teacher: *it means we have the other one that is made out of wood, the other one out of iron, the other one out of plastics.*

Kay's CK was adequate. He knew what the curriculum required in the teaching of the properties of matter and he was aware of the resources available at the school to support his teaching (Appendix M) For example, charts, textbooks and objects available around the school (Appendix M). Textbooks also offer a crucial resource for teachers in their planning and in gaining access to the appropriate knowledge and skills to teach at an appropriate level (DBE, 2009). Although researchers agree that practical work in science is important, teachers face challenges in doing practical work (Heeralal, 2014). The teacher indicated that the school does not have materials to do experiments (Appendix M).

> **Researcher**: *What challenges do you experiences with the teaching of Natural Sciences?*
> **Teacher**: *Lacking of things that I can use to do some experiments*

Limited resources, however, encourage teachers to modify the curriculum by utilising hands-on experiences (Stern & Marcella, 2008). Even though the school does not have sufficient resources to support his teaching Kay did not stop him doing illustration activities for his learners to understand the content (Table 16). Kay tried by all means to let learners touch the materials around them e.g. books.

Tobin (1992) state that teachers' purpose is to provide the best materials and learning situations to make learning individually meaningful for each student. Therefore, besides the textbook he also used objects in the class to assist him to teach during the lesson (Table 16). Teachers should fulfil various roles that include being mediators of learning, interpreters and designers of learning programmes and materials, researchers, lifelong learners and learning area specialists (DoE, 2002c). Kay was aware of other resources he could use that could be helpful to the learners to learn the concept he taught (Table 16). According to Mudulia (2012), for effective science teaching textbooks, revision books, laboratory chemicals and equipment must be readily available.

The teacher delivered the lesson in such a way that it encouraged some learners to engage themselves (Appendix P)

> **Teacher:** *identify all those materials that we have here in the class.*
>
> **Learners**: *table; chalkboard; chair; feather duster; desks; papers; brooms; school bags; shelves; bucket; scissors.*

The teacher used figures from the textbook and gave learners the opportunity to identify materials in the textbook (Appendix P). According to grade 7-9 NS CAPS (DBE, 2011), the teaching and learning of Natural Sciences involves the development of a range of process skills, namely accessing and recalling information; observing; comparing; measuring; sorting and classifying; identifying problems and issues; raising questions; predicting; hypothesising; planning investigations; doing investigations; recording information; interpreting information; communicating and such skills may be used in everyday life, in the community and in the workplace. Hence, cognitive and process skills that the learners develop and gain during Natural science lesson are, accessing and recalling information, observing, sorting and classifying, comparing, communication (Appendix P). See Table 18 for teacher knowledge.

Table 18: Summaries of Kay knowledge

Teacher knowledge	**Content**	• he explained the physical properties of material and their impact on the environment
	Context	• He attend NS workshops • Learners in schools are from poor family backgrounds. • Kay did not use a chalkboard and chalks which can disadvantage the learners as they will not remember everything taught and teachers' notes to refer to when studying at home.

	Learners' understanding	• He used prior knowledge to connect with new information on a particular concept. • Not all misconception displayed in the lesson was attended to and that resulted to learners thinking such ideas are appropriate.

Kay's instructional strategies included using a teaching method, namely question and answer method, lecture and demonstration; explanatory framework that was illustration, modelling and examples; and activities such as class activities and demonstrations (Table 16). Kay made use of a questioning technique at the beginning of the lesson to develop a lesson and evaluate learner understanding of objects around them (Appendix P).

> **Teacher**: *what is matter?*
> **Learner:** *something that takes up space and has mass.*

Thereafter, he asked them to identify all materials available in the class (Appendix P). Most learners raised their hands as an indication of being able to see the objects in the classroom. The learners gave the correct answers, as they know the materials in the class (Appendix P). Some of the questions were challenging and required learners to exercise communicative and thinking skills (Appendix P).

> **Jane**: *What do you think we can do to avoid loss of lives in the lithosphere and hydrosphere?*

The traditional lecturing methods are used because of teachers being used to these methods due to their teaching experiences (Lombard', 2015). Kay used the lecture method to explain matter and different materials and their impact on the environment (Appendix P). Kay also used both the lecture and demonstration methods when explaining the difference between materials that form the same object (Table 16). In addition, he made use of the lecturing method using an example for learners to gain a better understanding of the concept (Table 16)

During the post-lesson interview, Kay indicated that he used demonstration as he tried to let learners touch materials in the class (Appendix M).

> **Teacher**: *I use demonstrations because I tried to let them to touch the materials or objects that are available in the class and illustration*.

Kay also used some examples, which were familiar to the learners when teaching properties of matter (Table 16) During the lesson, the teacher did some demonstrations but he did not give learners a chance to demonstrate the activity as well (Appendix P). By doing demonstration the teacher develops some of the process skills emphasised in grade 7-9 NS CAPS document for learners to gain during the lesson. Kay did a class activity with the learners where he asked the learners questions about the activity and they responded (Table 16). Table 19 below presents Kays' instructional strategies used in the lesson

Table 19: Summary of instructional strategies Kay used in the lesson

Instructional strategies	**Teaching methods**	Question and answer
		Lecture
	Explanatory framework	Demonstration
		Modelling
		Illustrations
	Activities	examples
		Homework
		class activity

Classroom discourse refers to the language that students and teachers use to communicate in the classroom (Foy, 2013). According to Chin (2006), authoritative is a discourse that a teacher uses to convey information and the utterances are often made up of instructional questions and factual statements, while dialogic discourse encourages debates and challenges. Kay's instruction and interaction as well as discourse in the classroom did encourage some cognitive activity between the teacher and learners and among the learners themselves. Kay employed both authoritative and dialogic discourse; through authoritative discourse, Kay conveys information to the learners by means of a questioning technique (Table 17 & Appendix P). Consequently, the learners in this case were not given much of the opportunity to add to the lesson ideas or given an opportunity to form groups in order to discuss the lesson ideas and present their opinions.

Kay did make use of dialogic discourse because other questions he asked did challenge the learners. It was a good opportunity for learners to exercise both thinking and communication skills. The pattern of discourse used was initiation, response and evaluation (IRE) because the teacher gave instruction and thereafter asked learners questions bases on the instruction (Appendix P).

> **Teacher**: *the big ship is coming from Russia to south Africa thereafter people inside eating different things that were wrap either by containers ,by plastics and thereafter they decided to throw away those plastics in the ocean. In addition, there is a life of living and non-living things. What do you think it will happen to the lives of hydrosphere? (Initiation)*
>
> **Learner**: the animal in the ocean will die when they eat the plastics (response)
>
> **Teacher**: *yes, the animal sometimes fish they can decide to eat the plastics. Obviously when they eat the plastic sometimes it can be difficult for them to digest those plastics in their stomach (evaluate).*

This type of discourse was appropriate, as the teacher was able to know what the learners learnt and understood in the lesson. According to Mortimer & Scott (2003), Interactions and discourse in the science classroom between the teacher and students is fundamental to learning because it is central to the meaning making process. This discourse allowed Kay to assess and check learner understanding and correct learners' misconceptions where applicable (Table 17).

Communication is part of the Natural science classroom interaction and discourse since it builds a relationship among learners, and between learners and teachers as well as their environment. The teachers' practice did facilitate communicative and thinking skills. The communicative approach that Kay used was interactive-authoritative and Interactive-dialogic (Table 17). However, most of the interaction was mostly on teachers and the learners as the teacher was the one giving instructions (Table 17). In most cases what Kay said in the lesson was considered as final even though learners were invited to give responses. Kay should have given learners the chance to interact among themselves by means of giving the learners some ideas based on the content and letting them discuss among themselves with him (Kay) acting as a facilitator /mentor so that they can be able to develop process skills like communication amongst themselves.

There was a case where Interactive-dialogic discourse took place (Table 17). In the Natural Science classroom, the students consider the teacher as a more capable peer with whom meaning is constructed through shared discourse (Rollnick, 2000). The time for learners to interact among themselves was limited (Appendix P). There was a case where learners were given an opportunity to raise questions so that they can have a discussion in the class but they did not. See Table 20 for interactions and discourse employed in Natural Sciences classroom

Table 20: Summaries of Classroom interactions and discourse

Classroom interactions and discourse	**Types of discourse**	Authoritative discourse Dialogic discourse
	Patterns of discourse	Initiation-teacher
		Response- learner
		Evaluation-teacher
	Teacher questioning	Drives lesson
		Improve learning
		Develop thinking skills
		Encourage and motivate

	Communicative approach	Interactive-authoritative Interactive-dialogic

4.5.3. Findings

The study discovered that the teacher focused mostly on conveying information to the learners by means of explanation and questioning. However, it was noted that the teacher did not use the chalkboard during the lesson to write any of the lesson information. Hence, the way that Kay taught the properties of materials topic did not enable the learners to take notes during the lesson since nothing was written on the board.

During the lesson, the researcher noticed that Kay tried to assist his learners to learn the ideas of the lesson by means of doing many explanations, using examples and questioning in the classroom. Nevertheless, his lesson could have been more appropriate if the ideas of the lesson were written on the board so that every learner would be able to reflect on the notes the teacher provided for them when studying at home using the textbook provided. Unfortunately, in this case such opportunity for learners to take notes by means of copying from the board seems not to be essential for Kay, as he did not consider writing any of the concepts on the board. However, the study diagnosed Incorrect Subject Matter Knowledge the teacher displayed during the lesson (Appendix P: line 189-197). There was a situation where misconceptions occurred from the teacher and to the learners.

It was also noted that almost all of the learners were participating in the lesson because they were able to give correct responses for the questions asked. Therefore, it was noted that Kay was able to explain the concepts in such a way that learners found it easier to engage with the topic. The study discovered that Kay used various methods on the topic of properties of matter and such methods seemed to be of assistance to the learners as they participated by means of answering questions in the lesson. The researcher has noted that most of the questions Kay asked the learners' were easier for them. For example, Kay asked learners to identify the objects that were available in the classroom and such a question was easy and straightforward to the learners as they can see the objects in the classroom. However other questions Kay asked required learners to use their thinking and communication skills such as deductive reasoning, e.g. what do you think we can do to avoid loss of lives in the lithosphere and hydrosphere?

The knowledge and methods Kay used sometimes created the opportunity for learners to interact among themselves and the subject matter. However, learners' opportunities to interact with the subject content and among themselves were limited because Kay sometimes used the lecture method to explain other ideas of the lesson. The study found that Kay's classroom practice employed both authoritative discourse and dialogic discourse. The researcher also found that the teacher sometimes asked questions that lead to an argument between the teacher and the learners e.g. the teacher asked the learners how they could warn people from somewhere else not to throw the materials in the ocean and such question lead to a debate between the teacher and the learners. Kay gave the learners an opportunity to raise questions or to come up with other ideas if they had any. The study revealed that learners were able to say something about the concepts when asked to do so but they never raised any questions.

The study revealed that Kay assisted the learners to develop and learn process skill like oral communication that was emphasised in the subject NS CAPS document for learners to develop and gain in the NS lesson. Kay gave learners an opportunity to exercise their oral communication skills by means of summarising the benefits and impact of plastics at each stage from manufacture to disposal. As a result, this encourages learners to have interest on the subject matter content. The researcher found Kays' pattern of discourse was appropriate as he assessed the learners by means of questioning. The activity given to learners at the end of the lesson was challenging but motivating e.g. learners were requested to write a paragraph advising the community not to throw pampers in the village stream. There was an opportunity for learners to feel like they were in control of their learning even though it was limited. Consequently, Kay employed both interaction-authoritative and interaction-dialogic communicative approach during his lesson.

4.6. Summary

In this chapter, background and teaching details of each teacher was presented in a table. Thereafter case of each teacher was presented in a table. The detailed teacher classroom practice of each case was analysed according to three themes, namely teacher knowledge, instructional strategies, classroom interactions and discourse. The findings and discussions were presented. Thereafter the teacher background and teaching details were also presented. The next chapter presents answers of research questions and recommendation of the study.

CHAPTER 5:
CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

This chapter presents the answers to the research questions, summaries of the findings, contributions of the research and recommendations.

5.2. Research questions

This study aimed to look at how the three selected Natural Sciences teachers teach in the classroom. The aim of this qualitative research was to explore the classroom practices of Senior Phase Natural Sciences teachers in some of the schools of the Vhembe District, Limpopo Province. The study attempted to answer the following research questions to achieve the aim of the study.

- What is the nature of the teacher's subject-matter knowledge in the teaching of Natural Sciences?
- What is the nature of the teachers' instructional strategies in the teaching of Natural science?
- How does the teacher's subject-matter knowledge and instructional strategies shape the teachers' classroom interaction and discourse in the teaching of Natural science?

5.2.1 What is the nature of the teacher's subject-matter knowledge in the teaching of Natural Sciences?

A. CASE 1 (Jane)

The study revealed that Jane is not a qualified Natural Sciences teacher as she holds a qualification of Senior Primary Teacher Diploma (SPTD) where she specialised in mathematics, biology, English and Afrikaans. This was diagnosed during the interviews. However, Jane used her experience to teach Natural sciences (NS) as well as knowledge gained through Natural Sciences content workshops. This was discussed during the interviews and classroom practice. Jane used content knowledge (CK) and subject matter knowledge (SMK) to explain some of the concepts. However, during the lesson Jane sometimes manifested incorrect subject matter knowledge (ISMK) and misconceptions (M) to the learners and such ideas learners learnt as they did not question such knowledge (Table 3, Appendix N).

Jane's SMK and CK were mostly used to convey information to the learners. Consequently, Jane neglected learner's cognitive and thinking skills in science. Moreover, during teaching, Jane's CK and SMK enabled learners to learn, participate and understand the concepts without difficulties as sometimes learners' home language was used to assist learners to gain a better understanding of the concepts.

B. Case 2 (Charity)

The study discovered that Charity has a lot of teaching experience but he is not a qualified Natural science teacher as he has a qualification of Higher education diploma majoring in mathematics and physical sciences. This was diagnosed during the interviews and classroom observations. Charity gained subject content through workshop attendance. It was noted that the teacher applied knowledge gained as he mostly used CK to explain concepts to the learners.

The study found that the teacher does have the required knowledge to teach NS. The teacher used his experiences in the topic of the particles model of matter to explain the concept and to provide notes for his learners. However, the opportunity for learners to use their thinking and reasoning skills on the lesson ideas were limited. The learners accepted the information the teacher provided to them by means of writing notes that the teacher wrote on the board. Additionally, during teaching Charity's content knowledge, (CK) and SMK enabled learners to learn but not so many learners participated and understood the concepts without difficulties.

C. Case 3 (Kay)

The study found that Kay holds the qualification of a Post Graduate Certificate in Education (PGCE) majoring in geography and Tsonga, not in Natural sciences. Kay's content knowledge (CK) was appropriate and organised, and it was assumed that Kay's knowledge might have been developed through workshops organised by the department and the teaching experience in the topic properties of materials as the qualification he holds is not for Natural Sciences teaching. This was diagnosed during the interviews and classroom practice. The teacher used prior knowledge in his teaching in terms of explaining and asking questions based on previously learnt knowledge in order to remind and evaluate the learners' knowledge and understanding. The teacher did not write concepts on the board and that can hinder the learning of the concepts, as learners cannot recall everything learnt in detail without having the notes to refer to. The SMK and CK used to explain the lesson concepts enabled learners to be able to respond to the questions when the teacher asked.

5.2.2. What is the nature of the teachers' instructional strategies in the teaching of Natural science?

A. Case 1 (Jane)

The study revealed that Jane knew the methods and materials to employ for a particular concept. Jane's instructional strategies on the topic of separating of mixtures were appropriate and organised. The teachers' knowledge of instructional strategies on the topic of separating of mixtures is assumed to have been developed through teaching experiences and workshop attendance as well as through her formal education obtained from the university. This was diagnosed during classroom practice and interviews. In her lesson presentation, Jane employed several methods to engage the learners. However, most of the questions Jane asked the learners were easy as they required learners' prior knowledge and experiences; and the examples used were familiar to the learners. Jane's questioning technique did not challenge the learners since the questions were easy and straightforward. Moreover, the school does not have a laboratory or equipment for experiments but the teacher was able to perform an experiment activity for learners. Jane prepared some teaching aids to assist learners to learn the concepts. This was revealed through interviews and classroom observation.

B. Case 2 (Charity)

Charity presented his lesson on the topic particles model of matter with the use of different methods and such methods enabled the learners to take part in the lesson. The different methods used were adequate. The teachers' knowledge of instructional strategies on the topic particles model of matter was developed through workshop attendance organised by the department and teaching experiences in the subject of Natural Sciences. This was revealed through face to face interviews. However, the learners' opportunity to relate to the concepts was limited as only the teacher gave instruction.

Additionally, methods used did not create challenges to the learners, for example, Charity sometimes used diagrams from the textbooks to explain and asked learners questions. Hence, Charity omits other process skills learners were supposed to develop and learn in the lesson e.g. oral communication. The examples used in the lesson to explain the concepts were familiar to the learners. Moreover, the teacher was not able to perform experiment activity because there were no available resources for the teacher and learners to experiment. This was revealed through interviews.

C. Case 3 (Kay)

Kay has the required instruction knowledge, and such strategies seem to have been developed and obtained through the workshops and teaching experience in the subject of Natural Sciences. In addition, Kays' instruction knowledge was appropriate, as he knew the materials to be used to teach particular concepts. This was revealed through interviews and classroom practice. Kay employed different methods in the lesson in order to involve every learner in the lesson. Hence, the different methods Kay used enabled learners to take part in the lesson by means of answering questions the teacher asked. However, the instruction used creates limited opportunities for learners to exercise their cognitive skills.

5.2.3. How does the teacher's subject-matter knowledge and instructional strategies shape the teacher's classroom interaction and discourse in the teaching of Natural science?

A. Case 1 (Jane)

The knowledge and instructional strategies Jane used did not create many opportunities for learners to interact among themselves and with the subject matter. However, Jane did try to use prior knowledge to assist learners to make connection between previous experiences and new knowledge. Thus, Jane gave learners the opportunity to demonstrate other ideas of the lesson so that they could relate with the concepts and among themselves. Jane used coloured chalks to illustrate one of the methods of separation. Hence, such activity allowed interaction between learners and assisted the learners to develop and learn observing process skill. Furthermore, the knowledge and instruction Jane used created interaction between her and the learners e.g. the teacher interacted with her learners through the questioning technique where she asked questions and learners responded.

B. Case 2 (Charity)

The knowledge and instruction Charity used did not give learners sufficient opportunities to share their thoughts about the ideas of the topic model particles of matter. The lack of discussion in the lesson prevented learners from interacting among themselves and the subject matter. Additionally Charity did not create an opportunity for learners to make connections between previous experiences on the concept and the new information. Charity omits other process skills that learners were supposed to have developed and learn e.g. raising questions; therefore, the learners might feel discouraged by thinking that their ideas are not required when it comes to their learning. However there was a case where Charity allowed learners to take control of their work, e.g. learners mark class workbooks on their own.

C. Case 3 (Kay)

The knowledge and instructional strategies used attempted to instil an opportunity for learners to interact with the ideas of the lesson and among themselves. The teacher did however; such opportunity was limited since a lot of explanation. As a result, Kays' knowledge and instruction mostly employed authoritative discourse. However, dialogic discourse also occurred but it was limited. There was a situation where Kay enabled learners to do some addition to the lesson ideas. Therefore, the interaction was between the teacher and learners, among themselves as well as with the subject matter during the lesson. Kays' knowledge and instruction can assist the learners to develop and learn cognitive and thinking skills. In fact some of process skills emphasised on grade 7-9 NS CAPS document were skills that Kay attempted to instil to the learners e.g. oral communication.

5.3. Summary of findings

The study revealed several factors influencing the teaching of Natural Sciences concepts. Furthermore, a few misconceptions displayed by both teachers and learners on the topics were noted. However, the topic of the research was on the classroom practices. The study focused on outlining the main findings and identifying the gaps in the classroom practices.

A. Case A (Jane)

According to Jane, her classroom practices are being affected by the following factors:

- She indicated that most of the learners depend on social grants and they are not well resourced.
- Some of learners come without shoes and with an empty stomach.
- Most of the parents are illiterate which results in learners not being assisted with their schoolwork.
- Insufficient time for teaching which results in other content not being covered.
- Lack of teachers at school to share the subject with as she pointed out that not all NS strands are easy to carry.
- Language barrier. Learners are not fluent in English and they find it difficult to learn the concepts, which results in the teacher being slower when teaching so that all learners can be accommodated.
- Lack of laboratory facility and apparatus to do hands-on activities.
- Insufficient workshops for Natural Sciences.

Though Jane pointed to the above factors affecting her teaching she is not qualified to teach the NS subject since she did not specialise in NS and she still needs to be assisted with the subject matter. A few of the explanations she presented during her classroom practice were not appropriate and learners failed to notice such explanations. The opportunity for learners to interact with the subject content and among themselves was limited as the teacher transmitted a lot of information to the learners. Therefore, the teacher needs to be assisted with the instruction of NS teaching.

B. Case B (Charity)

During data collection, the following was discovered as being factors that affect Charity's' classroom practices:

- Background of learners as they depend on grants.
- Insufficient resources to support his teaching as the only available resources to support him are the textbook and a chalkboard.
- Time for teaching Natural Sciences as he indicated the time is not enough because there are activities like experiments, investigations and projects that need to be done and such activities require more time. Consequently, not many learners participate fully during the lesson.

Though the above-mentioned factors influence Charitys' classroom practices, he is not a subject specialist since he is not holding a NS teaching qualification. Therefore, a few of the explanations he presented to the learners was not clear enough and that resulted in not as many learners participating fully during his classroom practices. The time of learners to interact among themselves and the subject concepts were also insufficient. Charity depends on textbooks given by the school and he did not improvise other teaching aids to assist learners to learn through seeing and be able to develop other skills like experimenting and observing. However, the fact that the school does not have a laboratory or apparatus to be used to do activities required in the NS subject doesn't mean the activities can be omitted. It is the responsibility of the teacher to find a way to assist learners to learn and understand NS subject. Additionally, the teacher needs to improvise related materials for particular concepts and practice several methods for NS teaching.

C. Case C (Kay)

Kay's classroom practice was affected by several factors that the researcher discovered during the process of data collection. The following are factors that grasp researcher attention:

- Kay did not write anything on the chalkboard though chalks and a chalkboard was available in the classroom.
- He indicated that the school lacks materials to do experiments.
- Kay did a lot of questioning compared to the time he spent explaining the ideas of the lesson.
- The teacher asked learners too many questions and not all learners participated by raising their hands and responding to his questions.
- The teacher did not give learners the opportunity to write a class work so that all learners can feel like they are being accommodated.
- Time for teaching NS, he indicated that the time allocated for NS teaching is not enough because NS consists of lot of things that need to be covered which need more attention.

Though the factors mentioned above affected Kays' classroom practices, he is using knowledge gained through workshop attendance and his experience to teach the NS subject. Kay does not have a teaching qualification that specialised in the NS subject. The time in which Kay enabled the learners to interact with the content taught was limited as he gave instruction until the end of the lesson. Furthermore, the time for learners to interact among themselves was limited. The teacher needs to be assisted on the instruction of NS teaching so that all learners could benefit at the end of the lesson.

5.4. Contributions of the study

The previous studies on Natural Sciences teaching focused on the teachers' knowledge as a source of effective teaching. However, this study focused on teacher classroom practices as the origin where the teacher knowledge, instructional strategies, interaction and discourse can be examined.

The framework of the study indicated that the knowledge of the teacher plays an important role in classroom practices. All of the teachers who participated in the study said that their schools did not have laboratory facilities or even the apparatus to do hands-on activities. Limited resources, however, encourage teachers to modify the curriculum by utilising hands-on experiences (Stern & Marcella, 2008). Moreover, lack of resources for teaching can also hinder learners' understanding of concepts.

The study revealed that the participants have teaching qualifications, but not in the NS subject, though they did attend subject content workshops organised by the Department of Education. All participants used teacher centred methods, which limit learner interaction with the subject matter and amongst themselves. Therefore the teacher classroom practices need to be improved so that they can use instructional strategies that can create classroom interactions and discourse that will produce real learner understanding.

The findings of this study concerning the issues of a shortage of facilities and resources for teaching and learning at some of the rural schools positioned in the Vhembe District, should raise awareness to the Department of Basic Education (DBE). Additionally, the government and the DBE should work together to resolve the issues of materials in order for learners to have quality education. In the field of sciences, the finding of this study should raise concern to subject advisors that more workshops need to be conducted, specifically content instruction workshops as soon as possible so that subject teachers can assist learners to receive proper learning. The findings of this study should also raise awareness to the school Head of Department (HOD) that departmental meetings need to be held or taken into consideration to resolve some of the possible issues at schools and seek further assistance if necessary. The findings of the study should raise concerns for NS teachers that they need to work as a team in order to assist each other to make NS teaching and learning more effective.

5.5. Recommendations

This study aimed to explore the classroom practices of senior phase Natural Sciences teachers. The findings of the research provide evidence that there are areas in the teacher classroom practices that need to be developed and improved. The following are the recommendations based on the results of the study and suggestions for further research. .

- It is recommended that the Department of Basic Education (DBE) should see that facilities and resources are available in schools for the proper teaching and learning of NS.
- It is recommended that subject teachers should try to improvise teaching and learning materials where possible instead of omitting some of the activities that could possibly assist learners to develop real understanding of the subject matter. Additionally, the teacher should try to make connections between prior knowledge and the new information of concepts for the benefit of the learners.
- It is recommended that more time should be allocated to Natural Sciences teaching at schools as there are more activities needed to be covered.
- It is recommended that the departmental meetings at schools should be taken into consideration as it can assist both HOD's and subject teachers to share ideas on the NS subject, resolve NS contemporary issues and seek assistance where necessary.
- It is recommended that the subject teacher, HOD and subject advisors work closely together. Both HOD and the subject advisor should monitor the classroom practices of the teacher so that they can assist the teacher where necessary. I strongly believe that monitoring what is happening in the classroom could benefit all parties involved (teacher, HOD, subject advisors and learners) as they could possibly identify some of the challenges related to teacher classroom practices.
- It is recommended that more workshops on subject content be conducted on how to approach NS content.

- For further exploration, the researcher recommends exploration of how teachers' knowledge and instructional strategies applied is monitored; and exploration of the views of teachers on teaching and learning through classroom interaction and discourse.
- The researcher strongly believes that the findings will add value towards encompassing a real understanding concerning teachers' instructions and what is required for improving the situation in the Senior Phase Natural Sciences (NS) classroom.

5.6. Conclusion

This study presented the classroom practices of Senior Phase Natural Sciences teachers in the Vhembe District, Limpopo Province. There are factors outlined as a source of the teachers not being able to do more during classroom practices that developed instructions that create interaction and discourses. Although the recommendations were made, each member in the education sector should do their part to see that the learners receive a proper and high quality education.

REFERENCES

Abraham, I. and Saglam, M. (2010). A study of teachers' views on practical work in secondary schools in England and Wales. *International Journal of Science Education*, 32(6):753:768.

Anthony, J. S. R., (2015). Exploring factors related to learner performance in Natural Sciences: A Case of a school in the Gauteng province, university of South Africa, Pretoria.

Braund, M. and Reiss, M. (2006). Towards a more authentic science curriculum: The contribution of out-of-school learning. International Journal of Science Education, 28(12): 1373-1388.

Cohen, L., Manion, L. and Morrison, K. (2007). *Research methods in education.* London: Routledge Falmer.

Cohen, L., Manion, L. & Morrison, K. (2011). *Research Methods in Education. Seventh Edition.* New York: Routledge.

Creswell, J.W. (2003). Research design, qualitative, quantitative & mixed methods approaches 2nd edition. London: Sage Publications.

Creswell, W.J. (2007). Educational research: Planning, conducting and evaluating quantitative and qualitative research 3rd Edition. Pearson: Merril Prentice Hall.

Department of Basic Education. (2011a).Curriculum and Assessment Policy Statement Grade 7-9. Natural Sciences. Pretoria: Government Printers.

Department of Basic Education. (2011b).Curriculum and Assessment Policy Statement Grade 7-9. Natural Sciences. Pretoria: Government Printers.

Department of Basic Education. (2011c).*Curriculum and Assessment Policy Statement Grade 7-9. Natural Sciences.* Pretoria: Government Printers.

Department of Education. (2002c). Revised National Curriculum Statement Grades R – 9 (Schools), Natural Sciences. Department of Education. Government Printer, Pretoria.

Department of Education. (2003). Revised National Curriculum Statement Grades R – 9 (Schools), Natural Sciences. Department of Education. Government Printer, Pretoria.

Department of Basic Education. (2009). *Report of the task team for the review of the implementation of the National Curriculum Statement.* Pretoria: Department of Basic Education.

Department of Education. (2010). Language in Education Policy. Pretoria: Department of Education.

Department of Education. (2011). National Curriculum Statement Grades R – 12 (Schools), Natural Sciences. Pretoria. National Department of Education.

De Jong, O. (2010). Exploring science teachers' pedagogical content knowledge. In Psillas, D., Kariotoglou P., Tselfes V., Hatzikraniotis E., Fassoulopoulos G. and Kallery M. (eds.), Science education research in the knowledge-based society (pp.373-381). Dordrecht, Netherlands: Kluwer Academic.

De Jong, 0. , Veal, W.R., and Van Driel, J.H. (2002). Exploring chemistry teachers' knowledge base. In Gilbert, J.K., De Jong O., Justi, R., Treagust, D.F. and Van Driel, J.H. (eds.) Chemical education: towards research-based practice (pp.369-390).Dordrecht, Netherlands: Kluwer Academic.

Dudu, W. (2013). Grade 11 Learners' and Teachers' Conceptions of Scientific Inquiry in Relation to Instructional Practices. PhD Thesis. Johannesburg: University of the Witwatersrand.

Eryilmaz, A. (2002). Effects of conceptual assignments and conceptual change discussion on students' misconceptions and achievement regarding forces and motion. *Journal of Research in Science Teaching*, 39(10), 1001-1015.

Flanagin, A.J. and Metzger, M.J. (2007). The role of site features, and information verification behaviours on the perceived credibility of web-based information. New media & society, (9): 319-342.

Gall, M.D., Borg, W.R. and Gall, J.P. (1996). *Educational research: an introduction.* 6th ed*.* White Plains, NY: Longman.

Garbett, D. (2011). Constructivism deconstructed in teacher education. *Australian Journal of Teacher Education, 36(6):6-49*

Gay, L.R. and Airasian, P. (2003). *Competencies for Analysis and Application. Educational Research.* New Jersey: Merrill Prentice Hall.

Gomez, K. (2007). Negotiating discourses: Sixth-grade students' use of multiple science discourses during a science fair presentation. Linguistics and Education, 18: 41-64.

Gyllenpalm, J., Wickman, P.O., Holmgren, S.O. (2010). Teachers' language on scientific inquiry: Methods of teaching or methods of inquiry? International Journal of Science Education, 32(9): 1151-1172.

Harrison, J., McGibbon, L., and Morton, M. (2001). Regimes of trustworthiness in qualitative research: The rigors of reciprocity. Qualitative Inquiry, 7(3):323:345.

Haslam, C.Y., Hamilton, J. (2010). Investigating the use of integrated instructions to reduce the cognitive load associated with doing practical work in secondary school science. International Journal of Science Education, 32(13): 1715-1737.

Hattingh, A., Aldous, C. and Rogan, J.M. (2007). Some factors influencing the quality of practical work in science classrooms. African Journal of Research in Mathematics, Science and Technology Education, 11(1), 75-90.

Hausfather, S. (2001). Where's the content? The role of content in constructivist teacher education. Educational Horizons, 79(1), 15-19.

Hohenstein, J. and Manning, A. (2010). Thinking about learning: learning in science. (In Osborne, J. & Dillon, J., eds. Good practice in science teaching: what research has to say? 2ND edition. Berkshire, England: Open University Press. (Page 69-81.)

Heeralal, P.J. (2014) .Barriers Experienced by Natural Sciences Teachers in Doing Practical Work in Primary Schools in Gauteng. *International Journal of Science*, 7(3): 795-800 (2014)

Hitchcock, G. and Hughes, D. (1995). Research and the Teacher: A Qualitative Introduction to School- Based Research. (Second Edition) London: Routledge.

https://capeinfo.com/akela/2009/05

Ijeh, B.S. (2012). *How competent mathematics teacher develop pedagogical content knowledge in statistics teaching.* Unpublished doctoral dissertation: University of Pretoria, South Africa.

Kokonyane, M.J. (2015). A comparative study of opportunity to learn in Natural Sciences: Case Studies of two standard 7 classes in Botha-Bothe, Lesotho. University of the Free State

Kola, A.J. (2013). Importance of science education to national development and problems militating against its development. American Journal of Educational Research, 1(7): 225-229.

Leach, J. and Scott, P. (2003). Individual and sociocultural views of learning in science education. Science & Education, 12(1), 91-113.

Leedy, P.D. & Ormrod, J.E. (2001). *Practical research: planning and design.* 7th edition. New Jersey: Columbus, Ohio: Merrill Prentice Hall.

Lincoln, Y.S. & Guba, E.G. (1985). Naturalistic inquiry. Beverly Hills: Sage Publications. Retrieved January, 13, 2011 from http://ksl.cpsc.ucalgary.ca/courzses/679-95/jacobsen/guba.html

Lombaard D, (2015). Natural Sciences teacher attitudes and pedagogical content knowledge for teaching botany, university of South Africa, Pretoria.

Makgato, M. and Mji, A. (2006). Factors associated with high school learners' poor performance: A spotlight on mathematics and physical science. South African Journal of Education, 26(2): 253-266.

Maree, K. (2007). First steps in research. Pretoria: Van Schaik Publishers.

Maree, K. (2010). First steps in research 4th edition. Pretoria: Van Schaik Publishers.

Maxwell, J.A. (2005). *Qualitative research design: an interactive approach.* 2nd ed. Thousand Oaks, CA: Sage Publications.

McKinney, R. (2013). Moving beyond the textbook. In closing the book on textbook dependent classroom. Retrieved October 7, 2013, from http://www.wholechildeducation.org/blog/movingbeyond-the-textbook

McMillan, J. and Schumacher, S. (2001). Research in education: a conceptual introduction. 5th edition. New York: Wesley Longman Inc.

McMillan, J.H. (2004). Educational Research. Fundamentals for the Consumer. 4th edition. New York: Pearson Educational Inc

McMillan, J.H. and Schumacher, S. (2010). Research in Education: Evidence-based inquiry. 7th Edition. Boston: Pearson.

McMillan, J.H. and Schumacher, S. (2014). Research in Education- Evidence-Based Inquiry. 7th Edition. International Edition. Boston: Pearson.

McNall, R. L., Krall, R. M., Lott, K. E. and Wymer, C. l. (2009). In-service elementary and middle school teachers' conceptions of photosynthesis and respiration. Journal of science teacher Education, 20(1):41-55.

Merriam, S. B. (2002). Qualitative research in practice: Examples for discussion and analysis. San Francisco, CA: Jossey-Bass.

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation*. San Francisco: Jossey-Bass.

Miller, M.L. (2007). Pedagogical Content Knowledge. In Bonder, G.M. and Orgill, M. Theoretical Frameworks for research in chemistry/science education. London: Pearson Education.

Morrison, J.A. and Lederman, N.G. (2003). Science teachers' diagnosis and understanding of students' preconceptions. Science Education,87.849-867.DOI:10.1002/sce.10092

Mortimer, E.F. and Scott, P.H. (2003). Meaning making in secondary science classrooms. Maidenhead: Open University Press.

Mothokwa, S.S. (2014). The integration of practical tasks in teaching Natural Sciences in grade seven. University of Pretoria.

Motlhabane A. (2014). The voice of the voiceless: Reflections on science practical work in rural disadvantaged schools. Mediterranean Journal of Social Sciences, 4(14): 166-173.

Mtsi, N. and Maphosa, C. (2016). Challenges Encountered in the Teaching and Learning of Natural Sciences in Rural Schools in South Africa. J Soc Sci, 47(1): 58-67 (2016)

Mudau, A.V. (2013), An evaluation of the teaching of projectile motion in Grade 12 classrooms. Tshwane University of Technology.

Mudau, A.V. (2013). Teaching Difficulties from Interactions and Discourse in a Science Classroom. Journal of Educational and Social Research, Vol. 3(3), 113

Mudau, A.V. and Nkopodi, N. (2015). Teachers' anecdotes on the teaching of periodic tables in the Senior Phase. Journal of Educational studies, vol 14(1), 125-140.

Mudulia, A.M. (2012). The relationship between availability of teaching/learning resources and performance in secondary school science subjects in Eldoret Municipality, Kenya. Journal of Emerging Trends in Educational Research and Policy Studies, 3(4): 530-536.

Murphy, C., Neil, P. and Beggs, J. (2007). Primary science teacher confidence revisited: ten years on. Educational research, Vol 49 (4), 415-430.

Muwanga-Zake, J.W.F. (2001). Is Science Education in a Crisis? Some of the Problems in South Africa. From <http://www.scienceinafrica.co.za/scicrisis.htm> (Retrieved on 20 April 2014).

Muzah, P. (2011). An exploration into the school related factors that causes high matriculation failure rates in physical science in public high schools of Alexandra Township. University of South Africa, Pretoria.

Nicolson, G. (2013). Section 27: Department of Basic Education is still failing miserably in Limpopo. Daily Maverick. From <http://www.dailymaverick.co.za/article/2013-04-18-section-27-department-of-basic-education-is-still-failling-miserably-in-limpopo/#.WW-EVDjRbHw

Ogunmade, T.O. (2005). The status of secondary science teaching and learning in Lagos state, Nigeria. Perth: Edith Crown University. (Thesis - DPhil.)

Ogunniyi, M.B., and Rollnick, M. (2015). Pre-service science teacher education in Africa: Prospects and challenges. Journal of Science Teacher Education, 26(1): 65- 79.

Onwu, G., and Stoffels, N. (2005). Instructional functions in large, Under-resourced science classes: Perspectives of South African Teachers. Perspectives in Education, Volume 23(3).

Ozden, M. (2008). The effect of content knowledge on pedagogical content knowledge: the case teaching phases of matter. Educational Sciences: Theory and Practice, 8(2), 633-645.

Rammala, M.S. (2009). Factors contributing towards poor performance of grade 12 learners at Monotsi and Mokwatedi High Schools. (Unpublished MDev thesis). Polokwane: University of Limpopo. Turfloop Graduate School of Leadership.

Ramnarain, U. and Fortus, D. (2013). South African physical sciences teachers' perceptions of new content in a revised curriculum. South African journal of education, 33(1), 1-15.

Rollnick, M. (2000). Current issues and perspectives on second language learning of science. Studies in science education, 35: 93-121.

Sethusha, M.J. (2015). An exploration of the challenges facing underperforming Schools in the Vhembe District, Limpopo Province, South Africa. University of South Africa. Journal of Education Sciences, (JES), ISSN1680-7456 University of Venda.

Schneider, R.M. and Plasman, K. (2011). Science teacher learning progressions: a review of science teachers' pedagogical content knowledge development. Review of Educational Research, 81(4), 530-565.Doi:10.3102/0034654311423382

Sitsebe, V.F. (2012). Student Discourse in a Natural Science Classroom: A Case Study of High School Teaching in Swaziland. University of South Africa.

Shenton, A.K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information*, 22, 63:75.

Shulman, L.S. (1986). Those who understand: knowledge growth in teaching. *Educational Researcher,* 15(2), 4-14.

Silverman, D. (2000). Are science teachers using experiments as props in lessons? http://www.guardian.co.uk/science/blog/2011/jun/21/science-teaching-experiments-in-lesson

Stern, B.S. and Marcella, L.K. (2008). Contemporary readings in curriculum. Thousand Oaks, Calif.: Sage. 392 p.

Taber, K. S. (2009). Progressing science Education: Constructing the Scientific Research programme into the Contingent Nature of learning Science. Springer. ISBN 978-90-481-2431-2.

Taylor, N. (2008). What's wrong with South African schools? (Paper read at the CSR in Education Conference, TSiBA Education on What's Working in School Development held in Cape Town on 21 November 2008.) JET Education Services.

Tekkaya, C. & Yenilmez, A. (2006). Enhancing students' understanding of photosynthesis and respiration through conceptual change approach *Journal of Science Education and Technology, 15(1): 81-87.*

Tobin, G.A. and Begley, C.M. (2004). Methodological rigour within a qualitative framework. Journal of Advanced Nursing 48 (4), 388-396.

Tobin, K. (1992). Constructivism as a referent for science teaching. *Research matters to the science teacher*. Reston, VA: National Association for Research in Science Teaching.

Treagust, D.F. and Duit, R. (2008). Conceptual change: a discussion of theoretical, methodological and practical changes for science education. Cultural studies of science education, 3,297-328.

Tshiredo, L.L. (2013). The Impact of the Curriculum Changes in the Teaching and Learning of Science: A Case Study in Under-resourced Schools in Vhembe District, university of south Africa ,Pretoria.

Vicente A.E. (2013). Teaching practices for the development of the problem solving skills of gr 9 Natural Sciences learners. North West University.

Yilmaz-Tuzun, O. (2008). Pre-service teachers' beliefs about science. Journal of Science Teacher Education, 19: 183-204.

APPENDICES

Appendix A: Questionnaire

NATURAL SCIENCES TEACHER QUESTIONNAIRE

The purpose of this study is to explore the classroom practices of Senior Phase Natural Sciences teachers in some of the schools of the Vhembe District. Your participation as a Natural Sciences teacher in the senior phase is essential in this study. The data that will be gathered from this questionnaire is for research purposes only and your responses will remain confidential.

A. TEACHER BACKGROUND

Please make a cross (X) to indicate your response

1. Gender:

Male		Female	

2. Age group:

20–24 years	25–29	30–34	35-39	40-44	45-49	50-54	55-59	60+

3. Race

African	Coloured	Indian	White	Chinese	Other

4. Nationality (please cross-appropriate box)

☐ South Africa ☐ Non South African please specify:

____

5. Do you have any disabilities?

YES	NO

6. If ‘Yes’, please specify ______________________________________

B. TEACHING DETAILS

1. Teaching Qualifications (please write name of qualification):

Diploma	ACE	Bachelor’s degree	Honours degree	Masters	Doctorate

2. Which institution did you obtain your qualification?

Qualification	Diploma	ACE	Bachelor’s degree	Honours degree	Masters	Doctorate
Institution						

3. Major subjects (Please use x to indicate your choice):

Mathematics	Natural Sciences	Chemistry	Physics	English	Tshivenda	Other specify
History	Geography	Agric. Science	Life Sciences	Xhosa	Tsonga	Other specify

4. How long have you been teaching? (Please cross(x) appropriate box)

1-4 years	5-9 years	10-14 years	15-19 years	20-24 years	25-29 years	30-34 years	34 **+**

5. How long have you been teaching Natural Sciences? (Please make a cross (x) to indicate your response)

1-4 years	5-9 years	10-14 years	15-19 years	20-24 years	25-29 years	30-34 years	34 **+**

6. Apart from Natural Sciences, what other learning areas do you currently teach?

7. How many years have you been teaching in Vhembe District? (Please make a cross (x) to indicate your response)

1-4 years	5-9 years	10-14 years	15-19 years	20-24 years	25-29 years	30-34 years	34 **+**

8. How many years have you been teaching in this school? (Please make a cross (x) to indicate your response)

1-4 years	5-9 years	10-14 years	15-19 years	20-24 years	25-29 years	30-34 years	34 **+**

9. How would you describe the area of your school? (Please cross the appropriate box):

Rural	**Urban**

10. Which language do you use to teach Natural Sciences? (Please cross the appropriate box):

English	Afrikaans	Other specify

11. What grade/s do you currently reach Natural sciences? (Please cross (x) the appropriate box:

Grade	**7**	**8**	**9**

12. How many learners per class that you teach per grade.

Grade	**No. of learners**				
	class 1	class 2	class 3	class 4	Total
7					
8					
9					

Appendix B:

Natural Science teacher interview protocol

Pre-observation interview

A. Context

1. What are your teaching qualifications?
2. How long have you been teaching Natural Sciences?
3. How many periods are allocated for Natural Sciences per week?
4. What are you going to teach today?
5. How would you describe your school's performance in Natural Sciences? Please explain why your Natural Sciences performance is the way it is (good or bad).
6. What is the socio-economic background of your learners?
7. How long are your periods?
8. What are the resources available to your school to support your teaching?
9. What resources are you going to use during today's lesson?
10. How will you make sure that all of your learners stay focused and participate during the lesson?

Post-observation structured interview

B. Content and prior knowledge

1. How do you know that learners learned or gained a better understanding of what you taught?
2. What ideas did you expect your learners to learn?
3. Why it is important for learners to learn and understand the ideas?
4. What prior knowledge do your learners need to have to learn these ideas?

5. Which factor/factors do you think delays learner understanding?

C. Instructional strategies

1. What teaching methods do you use to teach Natural Sciences? Please explain how you use them.
2. Which method/methods did you use in your lesson and why?
3. How did you explain some of lesson concepts to help learners gain the acquire knowledge?
4. Activities that need to be conducted in Natural Sciences include investigations, experiments, projects, demonstration, etc. Explain how you use these activities.
5. Are these activities helpful? Which ones do you use more often? Please explain.

D. Context

1. What aspects do you keep in mind when you plan a lesson?
2. Besides the resources you used, what other teaching resources can you use to teach the same concepts and how will you use such resources?
3. How will you improve your learners' performance in Natural Sciences?
4. What challenges do you experience with the teaching of Natural Sciences?
5. What support is provided to you as a Natural Sciences teacher? If any please give a specific example.
6. Which strand/strands do you prefer to teach in NS?
7. Do you think the time allocated for Natural Sciences teaching is sufficient to complete or cover the intended curriculum? Explain.
8. Are there any other issues you would like to add? If yes, please give details.

Appendix C

Natural Science teacher observational tool

School: ____

Grade: ____

Number of learners in Natural Sciences classroom: ________________

Teacher: ____

Researcher ____

A. Classroom learning environment

1. Description of learning environment

____
____
____
____

2. Classroom arrangement

____
____
____
____

3. Physical appearance of the learners

____
____
____
____

4. Does the classroom environment display sufficient material to aid learners while learning Natural Sciences?

____
____
____

5. How does the classroom environment influence teaching and learning?

____

____

____

B. Instructional learning

a) Topic of the lesson

____

b) Introduction of the lesson

____

c) Prior-knowledge

____

d) Presentation of lesson

____

e) Teaching methods

____

f) Learners’ activities

____

g) Misconceptions

____

h) Teachers and learners’ interaction and discourse during the lessons

____

i) Conclusion of lesson

____

j) Reflection

____

Appendix D

Letter to the district senior manager

College of Education

Department of Science and Technology Education

Request for permission to conduct research at schools

Title: "Classroom practices of some Natural Sciences teachers of the Vhembe District, Limpopo Province"

24 October 2017

The District Senior Manager
Vhembe Department of Education

Dear Sir/ Madam

I, Ndivhuwo Prudence Netshivhumbe, am doing research under the supervision of A.V. Mudau, a professor in the Department of Science and Technology Education. I am working towards my Master's Degree in education with a specialisation in Natural Sciences at the University of South Africa. There is no funding involved. I am requesting written permission to use the schools that will participate in a study entitled, "Classroom practices of some Natural Sciences teachers of the Vhembe District, Limpopo Province".

The aim of the study is to explore the classroom practices of Senior Phase Natural Sciences teachers in some of the schools of the Vhembe District. It will also investigate the factors that might be affecting the effectiveness of Natural Sciences teaching in the Vhembe District. Your department has been selected because the main objective of the study is to investigate how teachers are teaching Natural Sciences in schools and such an objective can be achieved within your department. The study will request consent from Natural Sciences teachers of the Vhembe District to participate in this study, a recording device will be used and the participants' permission will be requested prior to interviews and classroom observation. Once the participants (teachers) agree to take part in the study, I will work with them throughout the research process. In this study, one teacher from each school will be observed, interviewed and will need to complete a research questionnaire.

The benefits of this study will be for all schools positioned in the Vhembe District. The study will provide an insight on the nature of teaching, problems encountered in teaching practice and will provide possible solutions to assist teachers in this regard. There are no known potential risks associated with this study. The names of both schools and participants will be kept confidential. All of the data that will be obtained from each participant will remain confidential and will be used for research purposes only. There will be no reimbursement or any incentives for participation in the research. Participants will receive a summary of research findings upon request.

For more information regarding the study, please contact me at: 079 588 1662 or email: ndivhuprudiey@gmail.com and my supervisor professor A.V. Mudau can be reached at: 012 429 6353 or email; mudauav@unisa.ac.za

Yours sincerely

N.P.Netshivhumbe

Netshivhumbe NP (Researcher)

Appendix E

Letter to circuit manager

College of Education

Department of Science and Technology Education

Request for permission to conduct research at schools

Title: "Classroom practices of some Natural Sciences teachers of the Vhembe District, Limpopo Province"

22 October 2017

The Circuit Manager
Department of Education

Dear Sir/ Madam

I, Ndivhuwo Prudence Netshivhumbe, am doing research under supervision of Awelani Victor Mudau, a professor in the Department of Science and Technology Education. I am working towards a Master's Degree in education with a specialisation in Natural Sciences at the University of South Africa. There is no funding involved. I am requesting written permission to use the schools that will participate in a study entitled, "Classroom practices of some Natural Sciences teachers of the Vhembe District, Limpopo Province".

The aim of the study is to explore the classroom practices of Senior Phase Natural Sciences teachers in some of the schools of the Vhembe District. It will also investigate the factors that might be affecting the effectiveness of Natural Sciences teaching in the Vhembe District. Your department has been selected because the main objective of the study is to investigate how teachers are teaching Natural Sciences in schools and such an objective can be achieved within your department. The study will request consent from Natural Sciences teachers of the Vhembe District to participate in this study, a recording device will be used and the participants' permission will be requested prior to interviews and classroom observation. Once the participants (teachers) agree to take part in the study, I will work with them throughout the research process. In this study, one teacher from each school will be observed, interviewed and will need to complete a research questionnaire.

The benefits of this study will be for all schools positioned in the Vhembe District. The study will provide an insight on the nature of teaching, problems encountered in teaching practice and will provide possible solutions to assist teachers in this regard. There are no known potential risks associated with this study. The names of both schools and participants will be kept confidential. All of the data that will be obtained from each participant will remain confidential and will be used for research purposes only. There will be no reimbursement or any incentives for participation in the research. Participants will receive a summary of research findings upon request.

For more information regarding the study, please contact me at: 079 588 1662 or email: ndivhuprudiey@gmail.com and my supervisor professor A.V. Mudau can be reached at: 012 429 6353 or email; mudauav@unisa.ac.za

Yours sincerely

NPNetshivhumbe

Netshivhumbe NP (Researcher)

Appendix F

Letter to principal

College of Education

Department of Science and Technology Education

Request for permission to conduct research at your school

Title: "Classroom practices of some Natural Sciences teachers of the Vhembe District, Limpopo Province".

24 October 2017

The Principal
Department of Education

Dear Sir/ Madam

I, Ndivhuwo Prudence Netshivhumbe, am doing research under supervision of Awelani Victor Mudau, a professor in the Department of Science and Technology Education. I am working towards a Master's Degree in education with a specialisation in Natural Sciences at the University of South Africa. There is no funding involved. I am requesting written permission to use the schools that will participate in a study entitled, "Classroom practices of some Natural Sciences teachers of the Vhembe District, Limpopo Province".

The aim of the study is to explore the classroom practices of Senior Phase Natural Sciences teachers in some of the schools of the Vhembe District. It will also investigate the factors that might be affecting the effectiveness of Natural Sciences teaching in the Vhembe District. Your department has been selected because the main objective of the study is to investigate how teachers are teaching Natural Sciences in schools and such an objective can be achieved within your department. The study will request consent from Natural Sciences teachers of the Vhembe District to participate in this study, a recording device will be used and the participants' permission will be requested prior to interviews and classroom observation. Once the participants (teachers) agree to take part in the study, I will work with them throughout the research process. In this study, one teacher from each school will be observed, interviewed and will need to complete a research questionnaire.

The benefits of this study will be for all schools positioned in the Vhembe District. The study will provide an insight on the nature of teaching, problems encountered in teaching practice and will provide possible solutions to assist teachers in this regard. There are no known potential risks associated with this study. The names of both schools and participants will be kept confidential. All of the data that will be obtained from each participant will remain confidential and will be used for research purposes only. There will be no reimbursement or any incentives for participation in the research. Participants will receive a summary of research findings upon request.

For more information regarding the study, please contact me at: 079 588 1662 or email: ndivhuprudiey@gmail.com and my supervisor professor A.V. Mudau can be reached at: 012 429 6353 or email; mudauav@unisa.ac.za

Yours sincerely

Netshivhumbe NP (Researcher)

Appendix G

Letter to Natural Science teacher

College of Education

Department of Science and Technology Education

Date: 24 October 2017

Title: “Classroom practices of some Natural Sciences teachers of the Vhembe District, Limpopo Province’’.

DEAR PROSPECTIVE PARTICIPANT

My name is Ndivhuwo Prudence Netshivhumbe. I am doing research under the supervision of Awelani Victor Mudau, a professor in the Department of Science and Technology Education. I am working towards a Master’s Degree in education with a specialisation in Natural Sciences at the University of South Africa. We have no funding. I am sending you this request to participate in a study entitled, “Classroom practices of some Natural Sciences teachers of the Vhembe District, Limpopo Province”. This study will collect important information that could fulfil the main objective of the study, which is to explore the classroom practices of Senior Phase Natural Sciences teachers in some of the schools of the Vhembe District. You are requested to take part in the study because you are a suitable candidate as you are teaching Natural Sciences in a school positioned in the Vhembe District where the study will be undertaken. I do not have your contact details.

I hereby request your permission to observe you while teaching in your classroom and to make use of audio recording during interviews. The data will also be collected by making use of a questionnaire which the participant will be requested to complete. The questions to be asked will be regarding teaching practice. The time that will be given to each participant to complete the research questionnaire will be 20 minutes maximum after the researcher has explained each section of questionnaire. The time allocation of every interview will be 30 minutes maximum and research will be conducted for a period of four months.

Participating in this study is voluntary and you are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason. There are no potential benefits of taking part in this study. There are no negative consequences for any participant if they participate in the research project. The information that you convey to the researcher will not be divulged to your seniors or colleagues and your identity will be kept confidential. Hard copies of your answers will be stored by the researcher for a period of five years in a locked cupboard/filing cabinet for future research or academic purposes; electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further research ethics review and approval. The researcher will destroy all information under her control one year after the completion of the study. There will be no receipt of payment or any incentive for participating in this study. Participants will receive a summary of research findings upon request.

If you may require any information regarding the study, please contact me at: 079 588 1662 or email ndivhuprudiey@gmail.com and my supervisor professor A.V. Mudau can be reached at 012 429 6353 or email; mudauav@unisa.ac.za

Thank you for taking the time to read this information sheet.

Kind regards,

NDIVHUWO PRUDENCE NETSHIVHUMBE

Appendix H

Consent form for teacher

College of Education

Department of Science and Technology Education

CONSENT FORM FOR NATURAL SCIENCES TEACHERS

I, ____ (participant name), confirm that the researcher asking for my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconveniences of participation.

I have read (or had explained to me) and understand the study as explained in the information sheet.

I have had sufficient opportunities to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty.

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to be recorded.

____

I have received a signed copy of the informed consent agreement.

Participant Name & Surname (please print)

____

___________________________ _________________________

Participant Signature Date

Ndivhuwo Prudence Netshivhumbe

Researcher's Name & Surname (please print

N.P.Netshivhumbe 30 January 2018

Researcher's signature Date

Appendix I

Department of Education Vhembe District approval letter

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

VHEMBE DISTRICT

CONFIDENTIAL

DEPARTMENT OF EDUCATION
VHURONGA TWO CIRCUIT
OFFICE
26 MAR 2018
ADMIN
PRIVATE BAG
LIMPOPO PROVINCE

REF: 14/7/R
ENG: MATIBE M.S
TEL: 015 962 1029

Ms NETSHIVHUMBE N.P
P O BOX 392
UNISA
0003

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT SCHOOLS

1. The above matter refers.
2. This serves to inform you that your request for permission to conduct research on the topic: ***"Exploring the teaching of Natural Sciences in the rural schools of Vhembe District, Limpopo Province"*** has been granted.
3. You are expected to observe ethical considerations particularly those relating to confidentiality, anonymity and voluntary participation by research subjects.
4. Kindly inform Circuit Manager(s) and the Principals of selected Schools prior to your interactions with your research subjects.
5. Wishing you the best in your study.

DISTRICT DIRECTOR

2018-03-23
DATE

Thohoyandou Government Building, Old Parliament, Block D, Private Bag X2250, SIBASA, 0970
Tel: (015) 962 1313 or (015) 962 1331, Fax: (015) 962 6039 or (015) 962 2288

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Appendix J

Ethics approval letter

UNISA university of south africa

UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2018/02/14

Dear Ms Netshivhumbe

Decision: Ethics Approval from 2018/21/14 to 2021/02/14

Ref: 2018/02/14/55131433/38/MC
Name: Ms NP Netshivhumbe
Student: 55131433

Researcher(s): Name: Ms NP Netshivhumbe
E-mail address: ndivhuprudiey@gmail.com
Telephone: +27 79 588 1662

Supervisor(s): Name: Prof AV Mudau
E-mail address: mudauav@unisa.ac.za
Telephone: +27 12 429 6353

Title of research:

Exploring the teaching of Natural Sciences in the rural schools of Vhembe district, Limpopo Province

Qualification: M Ed in Science and Technology Education

Thank you for the application for research ethics clearance by the UNISA College of Education Ethics Review Committee for the above mentioned research. Ethics approval is granted for the period 2018/02/14 to 2021/02/14.

*The **Low risk** application was reviewed by the Ethics Review Committee on 2018/02/14 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the UNISA College of Education Ethics Review Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
7. No field work activities may continue after the expiry date **2021/02/14**. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

The reference number **2018/02/14/55131433/38/MC** *should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Kind regards,

M Claassens

Dr M Claassens
CHAIRPERSON: CEDU RERC
mcdtc@netactive.co.za

Prof V McKay
EXECUTIVE DEAN
Mckayvi@unisa.ac.za

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Appendix K

Jane interview transcript

Interview transcript of Jane: May 2018 at Superiority Primary School

Description
Researcher
First of all, I would like to thank you for giving me this opportunity to observe
Your lesson and to interview you.
Teacher
You are welcome
Researcher
What are your teaching qualifications?
Teacher
I have Bed honours in management or you also need the….
Researcher
Only your teaching qualifications.
Teacher
Oh my qualifications okay, I qualified to teach High Primary Teacher Diploma or
Senior Primary Teacher Diploma where I specialised in Mathematics, Biology,
English and Afrikaans
Researcher
How long have you been teaching Natural Sciences?
Teacher
This year is my 13 years of teaching Natural Sciences
Researcher
Okay, how many periods allocated for Natural Sciences per week?
Teacher
In grade 7 we have only 6 periods per week
Researcher
What are you going to teach today?

Teacher

I'm going to teach separation of mixtures

Researcher

How would you describe your school's performance in Natural Sciences?

Teacher

On my side I can say it is good

Researcher

Why are you saying it's good?

Teacher

Maybe because I like Natural Sciences. But I see that there is participation of the learners and even other teachers are interested in what we are doing in science

Researcher

What is the socio-economic background of your learners?

Teacher

Oh that one is challenging. Most of the parents depend on grants. Then you see that children do not have enough resources. For example others they come bare-footed at school, others you see that they are coming without eaten anything they are only waiting for the break that they will eat at school. And the other challenge is that most of the learners they stay with their grandparents at home who are illiterate. They are not being assisted; you gave them the task they come back without doing it. Why? Because there is no one who is behind them at home

Researcher

Ok. How long is your period?

Teacher

My period is 1 hour

Researcher

What are the resources available to your school to support your teaching?

Teacher Okay, we have the textbooks that we are given by department. We also have the computers that the donors had donated to school.

Researcher

Okay, what resources are you going to use during today's lesson?

Teacher

I have prepared rice grains, salts and beans as my first teaching aids

Researcher

Okay, how will you make sure that all your learners stay focus and participate during lesson?

Teacher

The best way is to involve learners in the lesson by pausing questions in the beginning of the lesson, allow them to answer, to participate, and put them closer to you by giving them activities to do. For example, let them search for the words, I mean the terminologies. Let them look from key words that are inside the textbooks. Let them write the class work. Then you will grasp their total participation in the class.

Researcher

How do you know that learners learned or gain a better understanding of what you taught them?

Teacher

By giving them exercise. After teaching I must give them exercise to do, so that I can see how far or am I not leaving them behind. Then after that exercise and marking it, it will help me to find whether learners are with me or I'm missing them

Researcher

What ideas did you expect your learners to learn?

Teacher

The ideas that I'm expecting my learners to learn that is the mixture. The meaning of the word mixture. They must know the physical properties of a mixture. They should also be empowered to know the physical properties in their day to day life. When they are doing something at home they must know that I have mixed something and also they have to know how we can put things together to form a mixture

Researcher

Why it is important for learners to learn and understand the ideas?

Teacher

It is important, why? Today’s learners or today’s children are failing even to make tea.

They don’t know that they have to mix things. Then I think that is important because when they learn about mixture they will also be able to know that this and this must not be put together because they will bring another mixture which is maybe sometimes you find it is dangerous to them. Then they must know that we have to do things in the correct way, we have to use things in a correct way. That is why we are taking the mixture.

Researcher

What prior knowledge do your learners need to have to learn such ideas?

Teacher

The prior knowledge that they must have it must be from their previous class grade 4, 5, 6 more especially in grade 6, then is where they have acquired the first knowledge that when we put 1 and 2 together they are now a mixture

Researcher

Which factor/factors do you think delays learner understanding?

Teacher

The delaying the idea is…. I think here something that delays is the learners’ knowledge, the background. I think is the one that will delay my lesson, the knowledge that they have, the prior knowledge that they have because you find that these learners when it is during holidays they forget everything then you have to start and also the language barrier English as our language of communication you find that other learners are not well in English. Then zwiita uri nwana a sa kone u tavhanya u fara zwi ari lengisa **(a learner will take more time to under the ideas of the lesson if he/she is not well in English and it will also cause the teacher to teach slowly).**

Researcher

What teaching methods do you use to teach Natural Sciences?

Teacher

The teaching methods?

Researcher

That you use to teach Natural Sciences.

Teacher

I use different methods. When we teach Natural Sciences we use demonstrations, we use a…it might be interview, we also use this one that we are doing now, we interview to check learners, question and answer method, identifying, illustration, discussion, group work these are the methods that we use.

Researcher

So can you please explain how you use such methods that you mentioned.

Teacher

Let me take question and answers as an example. I have to introduce the topic by pausing some questions only to find what the learners know, and learners answer, that the question and answer method. when we demonstrate it makes learners stay focused because each and every learner want to see what is that, that I brought in the class then they participate in full

Researcher

What about discussion, how do you use discussion?

Teacher

When we go for a discussion I put learners in groups. Then we have a topic like this one mixture. Then, they have to discuss how they are going to do it by having a scriber, what they will do and after discussion we come as a class and they present what they found

Researcher

Okay, you also mention illustration, how do you use illustration?

Teacher

Under illustration we use the examples, some examples from the textbooks. Then, the learners follow and then they know what is more needed to them from the textbook.

Researcher

Which method/methods did you use in your lesson and why?

Teacher

I use question and answer in my introduction. I use demonstration that makes my learners to stay focus to my lesson and they were totally participating and that pleased me.

Researcher

How did you explain some of lesson concepts to help learners gain the acquire knowledge?

Teacher

Okay, I use modelling. Under modelling I was showing the substances that we are going to mix and then after they have been put together which is a mixture and under illustration we use the examples from the textbooks.

Researcher

Activities that need to be conducted in Natural Sciences include investigations, experiments, projects, demonstration, etc. Explain how you use these activities.

Teacher

Thank you. Under investigation my learners get only the questionnaire to go and make their own research. Then, they write the findings and bring them to school. Then, under experiment is where we conduct that experiment with the learners in the classroom. The reason is that some of the experiments are dangerous, learners can go and apply it outside then it damage or it destroys the properties or learners themselves. Like when they have to test things we are afraid, we don’t allow them to go and test, we do it in the class so that it would be monitored on how they are going to do it. And again under experiment is where we find that they are dependent, learners have to know dependent and independent variable that is why we have to do it together. Thank you

Researcher

What about the project, how do you use the project?

Teacher

We use a project, when we use a projects, I also work with the learners. Why do I do that? I give the learners instructions then they conduct it. We do it at school. Why? Because most of the learners are lazy. If they can take it at home someone will do it for them and then, they don't gain any knowledge. Then we do it at school then I give them instruction they go and conduct it and bring the findings of the project.

Researcher

What about demonstration, how do you use demonstration?

Teacher

We use demonstration to show learners different substances and how to mix

Researcher

Okay, are these activities helpful to learners?

Teacher

I think it is fruitful, very good

Researcher

Okay. Which one do you use more often?

Teacher

I use demonstration more often.

Researcher

Why are you using demonstration?

Teacher

It takes learners attention and they give totally participation in the class. And when they are going to write it is easy for them to think or to remember what we have demonstrated in the class.

Researcher

Okay, what aspects did you keep in mind when you plan a lesson?

Teacher

I think to me learner achievement is the best. My first aspect, what is that that my learners are going to achieve. Learners should be able to apply this knowledge in their day to day life. They should be able to know what is a mixture for example, how are they doing it. When they do something at home, how are they going to do it? When I have to cook, how they are going to do it. When they have to separate, how are they going to do it? I think what they achieve is the best.

Researcher

Okay, besides the resources you used. What other teaching resources can you use to teach?

the same concepts and how will you use such resource?

Teacher

I think I can use video because I see it somewhere being used that it was fruitful. Learners will watch the video while it is being played then learners will be talking or taking notes. We stop the video and then discuss what they have seen then we continue from where we stopped and then after that learners will go and work on their own in their activity books.

Researcher

Okay, how will you improve your learners' performance in Natural Sciences?

Teacher

By giving learners extra work during and after the lessons. Keeping learners busy with informal tasks. To add more informal tasks even if we have for example, if we can say we have plan for 10 exercises then I have to add on that one. Why? Because am preparing them for a formal task that will take them to another level.

Researcher

Okay, What challenges do you experience with the teaching of Natural Sciences?

Teacher

You know we are at far, far, far rural areas. The challenges that we are facing is the language barrier and the second one is the resources. We don't have for example as you can see there is no laboratory here. The other thing is there are no laboratories to conduct the experiment, we don't have the apparatus here around us, and you have to search for ourselves and some materials that are useful we don't have. For example if I want a litmus paper where will I get it, even the school is failing to buy, the government failing to provide then that is the serious challenge that we are facing.

Researcher

Okay, what support is provided to you as a Natural Sciences teacher?

Teacher

The department is giving us workshops and also it is providing some reference books and also the textbook it is trying to bring.

Researcher

Which strand/strands do you prefer to teach in NS?

Teacher

You know I like life and living; and energy and change. These are the content that I like most and I enjoy them while teaching.

Researcher

Do you think the time allocated for Natural Sciences teaching is sufficient to cover or complete the intended curriculum?

Teacher

Totally not sufficient.

Researcher

Why are you saying not sufficient?

Teacher

Most of the concepts need more time to can cover. For example, the terminologies it need time because learners have to use dictionary. Can you see now we are going for a language, they have to use to check the word from the dictionary. They have to go for the key words, it takes time. Again we need to conduct experiment, it also need time. When you have a 30 minutes period you squeeze your lesson to be short, you shorten learners mind, because you can’t give them everything at 30 minutes. Can you see, we cannot conduct a proper experiment with the proper result using little six hours per week.

Researcher

Okay, are there any other issues you would like to add? If yes please detail.

Teacher

Yes let me give. You know NS subject is too demanding, where it needs more workshops that can be conducted before, before the term. The problem that we are facing is that you find that the department is bringing the workshops at the middle of the term or at the end of the term. Now they have introduced the pace setters oh no not the pace setters I am referring to trackers, the planner and tracker they are bringing it very late when you have already pushed the content. Then I think we need more workshops. It also need team work, Natural Sciences need team work. Why? Because not all the strands are easily for the teacher to carry. If we can share the subject, then the problem is that we don’t have enough teachers or enough educators at school, you find that such a person have to carry the whole of the subject alone. Then I see that it must be looked at by the department.

Researcher

Ok, thank you very much for your participation ma’am.

Teacher

Thank you.

Appendix L

Charity interview transcript

Interview transcript of Charity: May 2018 at Presented Secondary School

Description
Researcher
First of all, I would like to thank you for giving me this opportunity to observe your lesson and to interview you.
Teacher
Okay you are welcome.
Researcher
What are your teaching qualifications?
Teacher
Higher education diploma.
Researcher
How long have you been teaching Natural Sciences?
Teacher
15 years.
Researcher
How many periods allocated for Natural Sciences per week?
Teacher
6 periods.
Researcher
What are you going to teach today?
Teacher
State of matter and arrangement of particles.
Researcher
How would you describe your school's performance in Natural Sciences?
Teacher
Good.

Researcher

Why are you saying it's good?

Teacher

Ndi ngauri ndo gudela physical science, u funza physical science **(I qualified for physical science and to teach physical science).**

Researcher

What is the socio-economic background of your learners?

Teacher

Poor.

Researcher

Why are you saying is poor?

Teacher

Ndi ngauri vhana vhanzhi vha hola mundende **(Most of the learners receive social grants).**

Researcher

How long is your period?

Teacher

30 minutes.

Researcher

What are the resources available to your school to support your teaching?

Teacher

Textbooks and chalkboard.

Researcher

So it is only textbooks and the chalkboard you don't have other resources?

Yes.

Researcher

So it means on today's lesson you are going to use only the chalkboard and textbook?

Teacher

Yes.

Researcher

How will you make sure that all your learners stay focus and participate during lesson?

Teacher

Ndi dovha ndi khou vha vhudzisa mbudziso uri vha mphe antsara **(I will be asking them question so that they can give me answer).**

Researcher

How do you know that learners learned or gain a better understanding of what you taught them today?

Teacher

Nga u vha nekedza class work **(By giving them class work).**

Researcher

What ideas did you expect your learners to learn today?

Teacher

State of matter and the arrangement of particles.

Researcher

Why it is important for learners to learn and understand the ideas?

Teacher

To know the different states of matter.

Researcher

What prior knowledge do your learners need to have to learn such ideas?

Teacher

Matter is anything that occupies space vha fanela u vha vha tshi zwidivha **(They should be knowing that matter is anything that occupies space**).

Researcher

Which factor/factors do you think delays learner understanding?

Teacher

Ndi ngauri a hu na zwi experiment zwa u demonstrator lesson heyi **(There are no experiments to demonstrate the lesson).**

Researcher

What teaching methods do you use to teach Natural Sciences?

Teacher

Demonstration, narrative, question and answer.

Researcher

Which method/methods did you use in your lesson and why?

Teacher

Ndi khou vhudzisa vhana mbudziso uri vha kone u mpha dzi phindulo **(I ask learners questions so that they can give me answers).**

Researcher

How do you use narrative?

Teacher

Ndi u explainer dzi definition dza matter **(To explain the definitions of matter).**

Researcher

How do you use demonstration?

Teacher

Ndivha ndi khou perfomer experiment vhana vha tshi khou vhona uri hezwi zwithu zwi shumiswa hani **(I perform experiment and learners observe in order to see how these things works)**. Ndi ngani ice i tshi kona u tshentsha ya vha madi, ndi musi ri khoi fhisa **(Why ice changes to water, is when we are heating it).** Ndi ngani madi a tshi tshentsha a vha vapour musi ri khou a fhisa (**Why water changes to vapour when we are heating it**).

Researcher

Which method/methods did you use in your lesson and why?

Teacher

Question and answer.

Researcher

Why did you use question and answer, how did you use it?

Teacher

Ndo vha ndi khou vhudzisa vhana mbudziso nwana a kona u phindula **(I asked learners questions and a learner answered).**

Researcher

Can you give me the example of the question that you asked learners and the answer the learner responded?

Teacher

What is matter? (Teacher-question). Matter is anything that occupies space and has mass(learner-answer).

Researcher

How did you explain some of lesson concepts to help learners gain the acquire knowledge?

Teacher

Analogy.

Researcher

The one that you use today, which one did you use?

Teacher

I used illustration.

Researcher

How did you use illustration?

Teacher

Nga u difaina matter na u nekedza dzi examples dzo fhambananaho **(I define matter and gave different examples).**

Researcher

Activities that need to be conducted in Natural Sciences include investigations, experiments, projects, demonstration, etc. Explain how you use these activities.

Teacher

In the investigation we give learners experiment that they must perform without the learner knowing the result of the experiment and come up with new solution. In the experiment they perform it knowing the conclusion of the experiment. On the project learners are given time to experiment, they do research and it take more time. Demonstration is when a teacher stand in front of the learners and showing learners how the experiment is done.

Researcher

Okay, so those activities are they helpful to learners?

Teacher

ee zwi a vha thusa nga maanda vhana ngauri vha vha vha khou ita zwithu hand-on **(Yes, they do assist learners a lot as they are doing things hands-on).** Zwi no tshithu tshine tsha itiwa muthu a tshi vhona nga mato a si kanzhi a tshi tshi hangwa **(Thing that is done when seeing with naked eyes is not easy to forget).**

Researcher

Okay, Which one do you prefer to use more often?

Teacher

I prefer using investigation.

Researcher

Why investigation?

Teacher

Ndi ngauri I thusa vhana uri vha wanuluse zwithu zwiswa ngauri vha vha vha sa khou divha uri vha fanela u wana mini, munwe wa kona u disikhavara zwinwe zwithu a khou ita heyi investigation **(It assists learners to find new things because they don't know what they will find out, one can discover new things when doing investigation).**

Researcher

Okay, what aspects did you keep in mind when planning a lesson?

Teacher

The ideas that learners need to learn before the end of the lesson .

Researcher

Okay, beside the resources you used. What other teaching resources can you use to teach the same concepts and how will you use such resources?

Teacher

In this concept we should have been having ice, stove and beakers so that when we heat ice, ice will melt and become liquid. When we heat water, water will change to vapour.

Researcher

Okay, how will you improve your learners' performance in natural sciences?

Teacher

Ndi nga u vha tutuwedza uri Natural Sciences ndi zwithu zwa mupo. Ndi zwithu zwine ra kona u zwi vhona ra zwi demonstrator. Ndi nga vha tutuwedza nga ndila yeneyo **(I will motivate them that Natural Sciences is for the nature. It is what is happening around us, things that we are able to see and demonstrate. That is how I will encourage them).**

Researcher

Okay, What are challenges or problem do you experience with the teaching of Natural Sciences?

Teacher

Ndi ngau leka ha zwi apparatus na u savha na laboratory **(Lack of apparatus and not having laboratory).**

Researcher

Okay, what support is provided to you as a natural sciences teacher?

Teacher

Ndi ya ndi tshi athenda dzi workshop dza science ndi hone hune ndavha ndi khou tangana na zwithu zwiswa zwine nda sa zwi divhe zwine kha nne zwavha zwi challenge. Kha workshop ri vha ri khou ainiwa zwithu zwine ri si zwi divhe **(I attend science workshops, it is where I come across new things that I did not know which is a challenge to me. In the workshop we are taught what we don't know).**

Researcher

Which strand/strands do you prefer to teach in NS?

Teacher

Matter and material, energy and change.

Researcher

Do you think the time allocated for Natural Sciences teaching is sufficient to complete or cover the intended curriculum?

Teacher

No.

Researcher

Why are you saying no?

Teacher

Ndi ngauri science I toda tshifhinga tshilapfu ngauri huvha hu na zwi experiment, investigation na dzi projects lune zwi toda u na tshifhinga tshilapfu. Ri lilela u tavhanya u fhedza syllabus ngeno vhana vha khou salela murahu **(science need more time because it includes experiments, investigations and projects. We always want to finish the syllabus whereas learners are behind).**

Researcher

Okay, are there any other issues you would like to add? If you have please detail

Teacher

No.

Researcher

Okay, thank you very much sir.

Appendix M

Kay Interview Transcript

Interview transcript of Kay: May 2018 at Amazing Primary School

Line	Description
1.	**Researcher**
2.	First of all, I would like to thank you for giving me this opportunity to observe
3.	your lesson and to interview you. What are your teaching qualifications?
4.	**Teacher**
5.	I have got BA Degree, Post Graduate Certificate in Education(PGCE),
6.	Environmental Education Certificate.
7.	**Researcher**
8.	How long have you been teaching Natural Sciences?
9.	**Teacher**
10.	Natural Sciences almost 6 years.
11	**Researcher**
12.	How many periods allocated for Natural Sciences per week?
13.	**Teacher**
14.	They are 6.
15.	**Researcher**
16.	What are you going to teach today?
17	**Teacher**
18.	Properties of materials.
19.	**Researcher**
20.	How would you describe your school's performance in Natural Sciences?
21.	**Teacher**
22.	Is very good.
23	**Researcher**
.24.	Why are you saying is very good?
25.	**Teacher**
26.	Because When I teach I use practical examples.

Researcher

What is the socio-economic background of your learners?

Teacher

It is very poor. The main thing that let it to be poor is that they are not close to things.

Researcher

Okay. How long is your period?

Teacher

30 minutes.

Researcher

What are the resources available to your school to support your teaching?

Teacher

We have got only books, some charts and we also use the objects that are available around here at the school.

Researcher

Okay, what resources are you going to use during today’s lesson?

Teacher

The objects in the class.

Researcher

Okay, how will you make sure that all your learners stay focus and participate during lesson?

Teacher

By involving everyone in the class.

Researcher

Okay, how do you know that learners learned or gain a better understanding of what you taught them?

Teacher

By asking them questions and then they respond, isn’t that I can know that this person(learner) understood what I taught?

Researcher

What ideas did you expect your learners to learn?

Teacher

Sorry?

Researcher

What ideas did you expect your learners to learn?

Teacher

Things that make the materials that…..sorry can you come again

Researcher

What ideas did you expect your learners to learn?

Teacher

In related to this lesson I want them to learn different materials and those things that made those materials, those objects and how those objects are made.

Researcher

Why it is important for learners to learn and understand the ideas?

Teacher

Okay, I want those people(learners)to take care of the objects around them.

Researcher

What prior knowledge do your learners need to have to learn such ideas?

Teacher

They must know that things come from a primary activities into secondary activities therefore until secondary activities, the secondary activities.

Researcher

Which factor/factors do you think delays learner understanding?

Teacher

You see most of the learners they are far away from industries, factories, mines where those things are made.

Researcher

What teaching methods do you use to teach Natural Sciences?

Teacher

Question and answer, teacher centred method, learner centred method.

Researcher

Please explain how you use the method you just mentioned.

Researcher

Alright then I make sure I involve everyone in the class by asking them questions about whatever that I was saying in the class.

Researcher

Which method/methods did you use in your lesson and why?

Teacher

Most cases illustration because I use some pictures from the books.

Researcher

How did you explain some of lesson concepts to help learners gain the acquire knowledge?

Teacher

I use demonstrations because I tried by all means to let them to touch the materials or objects that are available in the class and illustration.

Researcher

Activities that need to be conducted in Natural Sciences include investigations, experiments, projects, demonstration, etc. Explain how you use these activities.

Teacher

Sorry come again?

Researcher

Activities that need to be conducted in Natural Sciences include investigations, experiments, projects, demonstration, etc. Explain how you use these activities.

Teacher

Oh how do I use those activities….

Researcher

Yes.

Teacher

By Investigation obviously I will give them (learners) work to do on their own outside at home or either in the school while am guiding them. Then experiment obviously the main problem is that we don't have the materials that support us to do the experiment right, but if those material are available I can do experiment with kids so that they will see how those results come to and then the other thing the project I can also give them the project that they can do on their own. Demonstration involving them, show them, let them touch and feel the material around them.

Researcher

Okay, are these activities helpful to learners?

Teacher

Yes.

Researcher

Which one do you use more often?

Teacher

Demonstration, reason everyone can involve themselves in the lesson.

Researcher

Okay, what aspects did you keep in mind when you plan a lesson?

Teacher

Teaching aids. I have to make sure that the teaching aids are available.

Researcher

Okay, beside the resources you used. What other teaching resources can you use to teach the same concepts and how will you use such resource?

Teacher

Come again?

Researcher

Beside the resources you used. What other teaching resources can you use to teach the same concepts and how will you use such resource?

Teacher

The related objects, any objects that I found that is related to the lesson that am teaching then I just pointed them and let them feel it, touch it.

Researcher

Okay, how will you improve your learners' performance in Natural Sciences?

Teacher

Encourage them to read, to watch TV or related aspects show in the TV. They can also do some sort of research in the internet if ever there are some questions that they don’t understand so that it should boost their knowledge.

Researcher

Okay, What challenges do you experiences with the teaching of Natural Sciences?

Teacher

Lacking of things that I can use to do some experiments.

Researcher

What support is provided to you as a Natural Sciences teacher?

Teacher

We have some workshops every year.

Researcher

Which strand/strands do you prefer to teach in NS?

Teacher

Biosphere, properties of matter as well as planet.

Researcher

Okay, do you think the time allocated for Natural Sciences teaching is sufficient to complete or cover the intended curriculum?

Teacher

No.

Researcher

Why are you saying no?

Teacher

Natural Sciences have got a lot of things that need to be covered and they need more attention

Researcher

Okay, are there any other issues you would like to add? If yes please detail.

Teacher

No ma’am.

Researcher

Ok, thank you very much for your participation sir.

Teacher

Okay.

Appendix N

Jane observation transcript

Observation of Jane: May 2018 at Superiority Primary School in Grade 7 Natural Sciences Classroom

<u>Day one lesson</u>

Line	Description
	0-4minutes The classroom was not conducive for teaching and learning. The classroom was dirty and old with broken windows. There were also holes in the wall and in the floor. Learners were seated on the desks and they were sharing desks. The desks were arranged in rows and columns with enough space for the teacher and learners to move around. There was no electricity in the classroom. All learners wore school uniform. Jane greeted the learners *good morning class* (Jane greeted the learners while erasing the board using tissue) and learners greeted back *good morning teacher* (all learners were standing on their feet when responding). Jane continued *how are you?* And all learners responded *'I'm fine thank you and how are you?* Jane said *fine thank you, please sit down* and the learners said *thank you (*all learners seated on their desks after being instructed to do so). Jane said *I believe you know that now is a Natural Sciences, isn't so*? And the class responded *yes*. She further said *ok I want us to work together today I'm offering you this subject (Natural Sciences) you know that I like it isn't so?* And the learners responded *yes.* The teacher said *aha **(yes)** don't forget we are in term 2 you participate fully you pass you participate partially you fail you don't participate you totally fail there are no marks from heaven.* The teacher said *we are now busy with separation of mixture (*she wrote the lesson topic on the board). She told learners *the first thing that you need to know is the terminology*, *what is a mixture*? (The teacher wrote on the board). Jane said *who can try, I know that you*

have done this in grade 6, what is a mixture? Come on class (teacher told learners to try and one learner raise up his hand). Jane said *what can you say when you define a mixture? yes there Ndivho (pseudonym)* and Ndivho responded as follows: *is objects that are mixed together. Jane said he says objects mixed together* (teacher repeated what Ndivho said), *can we stand with him a*nd class answered *yes.* Thereafter the teacher said *if you are saying yes can you give me the examples, objects mixed together that is Ndivho's idea*. She asked learners *what is it that you can mix together. I never said open the books* (some learners were opening the textbook*), I never said that* (they kept their textbooks closed) *which are the objects that are put together, the examples* (a few learners raise up their hands). Learner responded *sugar and water* and Jane said *when you mix* sugar *and water, when they are together we say they are a mixture.* Jane said *another example* and a learner responded *cement and sand*. Jane said *cement and sand* (she repeated what a learner had said), *when you want to build a wall you take cement, you take sand and also you add water that is a mixture*. She said *very good you know what a mixture is*. Jane said *a mixture is when two or more substances are put together* (the teacher wrote on the board) *that is what you told me*. The teacher explained the following to the learners: *then when we say two or more substance is put together we find these substances are put together in a physical way* (she wrote physical way on board*), the way that you can see, the way that you can see physically*.

4-8 minutes

She continued *you see someone taking an instrument and the books putting inside the school bag that is a mixture isn't so?* (Jane was demonstrating to the class while talking) and learners said *yes*. She proceeded; *when you take Natural Sciences, Mathematics and English book, you put them together they form a mixture.* She said *in the class we have a mixture, there are boys and girls* (example of a mixture). She then added *in the class we see a mixture, others are wearing grey, others are* *wearing black that is the mixture* (example of a mixture). *Then we are saying we use the physical way for example today what are we eating today, we have eaten a mixture today isn't not so* . Jane said *what is that you have eaten* and learners said *rice, fish, and pumpkin or butternut*. Jane said *that is a mixture.* She said *you can also take each and everything aside, one can say I don't eat fish but I will eat rice alone, one can say no I don't want butternut I can take a fish and rice together and then I bind my meal.* She said *then when these two things oh…we can classify the materials of, uh substances that we want to put together to form a mixture* (the teacher look at the textbook and she wrote on the board). Jane said *number one we find a pure substance, some substances are pure, if something is pure it means that it is not mix with anything it is alone*. Jane said *the examples of pure substances yes that one, what is that* and a learner replied *water.* Then the teacher said *water* (repeated learner answer)*, water itself it is pure, I have water here can't you see that this water is pure? does it have any colour or any colorant?* And learners said *no* (Jane was having a jug with water inside and she demonstrated that water is pure by pouring water inside the bottle that was empty for learners to see). She continued *water itself is one of the examples of pure substance* and she wrote on the board. Jane said *on Wednesday, on Wednesday we take something as our meal here at school, what is that?* And learners said *Milk* .She said *milk* (she wrote on the board) *when it comes from the cow it is totally pure* (she demonstrate with her hands as if she is milking the cow for real), *when you milk it from the cow it is totally pure there is nothing that has been added there but because of technology we now have impure substances* (she wrote on the board), *for example, for example, who can give me the examples of impure substances?* The teacher said *yes Mukondi* (pseudonym) *there* and Mukondi said '*tea'* (she wrote tea on the board). Jane said *yes we have tea, tie (tea), ehee* **(yes)** *we have tea, tie tie mawe tie* ***(tea, tea mother tea),*** *tea* (learners laugh).

8-12 minutes

Jane said *what are the things that have been put together there to make tea, substances that you used to make tea, what are they?* (A few learners raise up their hands) *come on Mulalo* (pseudonym) *why are you seated as if you are in a train* (other learners laugh). Jane pointed to the learner, *yes.* The learner said *sugar*. Another learner said *water*. *At the back*, Jane shouted and a learner responded *tea bags (the* teacher wrote tea leaves not tea bag) and the teacher said *I don't want to write tea bags but I write tea leaves because we even use the ones that are not inside the bags.* Learner replied *milk*. Jane wrote all the substances that are used to make tea on the board. She said *when we put these things together, they form a*…… learners said *tea* and Jane said *hee* ***(no)*** *they form a…….* then Jane again said *they form a…….*other learners were still saying '*tea'* and others said, *'mixture'*. All learners finally responded *mixture (*learners read from the board as Jane was writing while asking them). Then Jane said *very good they form a mixture but they are impure.* The teacher said *now let's come to other examples, a simple examples, I talked about rice, I have some rice grains here* (Jane hold a container having rice and take some with her right hand for demonstration) *can you see them* and the learners said *yes.* The teacher continued *I want to show you the physical way of mixing substances, this is the rice as I told you, now this are the beans* (she also bring beans for demonstration and hold some with her other hand and show them to the learners) *you know them, you eat them*. She said *when do we eat beans* and the learners replied *tomorrow*. Jane said *we are going to eat beans tomorrow, we eat beans with….* and learners said *samp*. Jane said *ehee* ***(yes),*** *then here is the rice, here are the beans* (Jane moves around showing learners beans and rice that she hold with different hands) *I should been having some samp, some pieces of samp.* Jane said *then I am trying to mix them together* (the teacher mix rice with beans using her hands), *let me use your book* (she takes a learner book and places the mixture that she mixed first on her hands).

She said *I am mixing them together can you name this mixture* and learners said *no.* Jane said *why do say you can't name this mixture* and a learner said *I have not seen it before.* The teacher moves around holding the mixture and she said *you haven't seen it before but there are things you can see through your naked eyes*. She stood next to the other learner and said *Tshililo* (pseudonym) *what do you see here* and Tshililo said *the beans and the rice.* Jane said *the beans and the rice, these are the grains I have formed a mixture*. The teacher continued *I can take salt* (she held the packet of salt and showed the learners) *you know that is salt* (she opened the salt and transferred it on to the cover of a container) *I am doing it physically I am using my hands*. Jane then mixed salt, rice and beans (the teacher did the mixture on a cover of a container). She said *what is this now* and a learner said *salt* and Jane said *no I put them together* (she move to other desk with a mixture). She asked again *what is this and* learners replied *mixture*. She said *it is a mixture, what is this mixture composed of* and the learners replied *salt, beans and rice* and Jane said *that is a mixture.*

12-16 minutes

Jane told learners to open page 80 and they did (learners quickly open to page 80 on their Natural Sciences textbook as instructed by the teacher). The teacher said *there are key words there number 1 what is written there* and learners said *pure substance* (Jane repeated what learners said). Jane asked the class *what does it mean* and the class responded as follows: *substance that is made up of one type of particle* (the learners were reading from their textbooks as they were told to do so). Jane then said *can one learner read for us so that we can hear it clearly* (few learners raise up their hands). Jane asked the other learner *don't you know page 80 or you don't know the number, 80 is composed of eight and zero*. One learner then read the definition of the pure substance from the textbook (the learner read exactly what had been said by the class and the teacher then again repeated the same definition). Jane said *can you give me the* *example of a substance that is made of one particle, can you give me the example,* (Jane told the learners they had already discussed that). A learner said *water*. Another said *milk*. A third learner said *salt*. Jane said *no, no, salt there are some particles there* (the teacher disagreed with what learner three responded). Then the teacher said *it is there in your book*, *vula mato wena* **(open your eyes**). Learner said *gold*. Jane said *can you point where you find it* (learners pointed at the textbook while saying yes). Learner said *gold particles*. Jane said *water particles, where are water particles* and learners pointed at their textbooks and Jane said *ehee **(yes)** very good back to the key words*. Jane said *Vhutshilo (pseudonym) the second bullet there* and Vhutshilo said *mixture.* Jane said *class what is a mixture?* (She told learners to read the definition of mixture from the key words written on their textbook). The learners read as follows: *two or more substances with different physical properties that are mixed together*. Jane said *very good Vhuhwavho (pseudonym) can you read alone now, what is a mixture* and Vhuhwavho read from the textbook and repeated what the class said and Jane said, *very good* to her. Jane asked, *can we see the examples of different physical properties that are mixed together,* e*xamples Fhatuwani (pseudonym) example* and Fhatuwani (pseudonym) replied *balloon*.

16-20 minutes

Jane told the class *she says balloon (wrong answer and* Jane was amazed by what Fhatuwani said) and another learner said *water and sugar* (Jane told class they did that already). Jane asked *what about you there and* a learner responded *oil and salt.* Jane moves close to the other learner and said *come on* and a learner said *beans and rice*. Learner said *tea* (Jane laugh while moving). Learner said *milk and pap.* Learner replied *egg and salt.* Learner said *rice and fish* (Jane said as what we ate today). Jane said *check from your book what are the physical properties that are mix together from your book now, tell me what it is indicated there*. Jane said *yes that right* and the learner said *fruits salad*. Learner said *beans* *and rice*. Jane said *good people let quickly rush to bullet number 3*, *John (pseudonym) bullet number 3 from our key word* and John responded, *physical protect* (the learner read properties as protect*).* Jane said *really (class laugh), is that physical protect?* Class said *no (learners laughed)* and then Jane said or *you* (John) *want to correct yourself, what is that? And* John said *physical properties*. Jane told class to read the meaning from the book and learners read as follows: *special characteristics used to describe the particles of a substances and* Jane said, *eeeeh* **(it is an indication that she don't approve the way learners are reading)** *are we reading as if we are frogs in the river heh lets read (*learners read again after being instructed to do so). *Hohohohoho* **(stop, stop, stop, stop, stop)** Jane stop learners and continued with the definition where learners had stopped as follows: *the tiny part that make up substances*. The teacher said to the class *you said we can make tea and when we have already make that tea we call it a mixture.* Jane continued *the tiny part, those tiny part were water particles, sugar particles, tea leaves particles, milk particles then when you put them together physically you take a spoon, my little bit of sugar you add, my milk I add, my water I add, my tea leaves I add and then I put them together then that is physical properties* (Jane act as if she is adding the substances for real), *are we together?* And the class replied *yes*. Jane said *okay now this mixture had different physical properties* (she wrote on the board).

20- 24 minutes

Jane explained to the class the following: *then in some of the mixtures the substances that are mixed together keep on their own physical properties* (the teacher read from the textbook) and Jane proceeds, *like come on class, like when you mix beans and rice, they keep their own physical properties, you are able to identify them, to select what is that and what is that other one, can you see?* (Jane displayed to the learners). The learners said *yes and they have their own physical properties*, Jane added. Jane said *Ehee* ***(yes****) then sometimes we cannot see the different* *part of mixture like in tea, can you pick what tea leaves is*? And the learners said *no* and Jane continued *can you pick the milk outside* and learners said *no.* Jane carries on *can you pick that water outside?* And learners said *no* and Jane proceeds *can you pick that sugar outside*? And learners said *no.* Therefore Jane explained *when they are together we cannot differentiate it we just give it a new name, now it is a tea*. Jane continued mentioning the examples *when they cook porridge at home can you see the different properties there?* And the learners said no. Jane said *the water and the meal or maize meal when they are put together can you differentiate it*? and learners said *no* and she proceeds, *the cement*, she said *when we mix a cement*, *sand and water* and Jane said, *can we again take all the particles aside?* And learners said *no*. Jane said *we cannot, that is the different physical properties of a mixture*. Jane said *then there is activity 2 down there, do you see it*, and learners said *yes.* Jane continued, *it need you work, you know if it is not a rule is a dom.* Jane said *take out your exercise book and do activity 2 number one and number two let's write (*learners then take out their classwork book and other learners were not having their classwork book and they were told to use their notes book). Jane gave learners 3 minutes to write the activity (Jane was moving around while learners were busy with the activity). Jane asked *are you done Khumbudzo (pseudonym)* and Khumbudzo said *no* and Jane said *you said eya* ***(yes)*** *I thought you are calling me. Jane told the other learner to underline with a ruler.* Jane told the learners to not forget to write today's date and she wrote the date on the board.

24-28 minutes

Other learner goes to Jane and told her she doesn't have a classwork book and she was told to use notes book. *That 3 minutes it's over,* said Jane (alarm rang as an indication of the end of first period of natural science). Jane told the other learner she will open the bag until sunset. Jane said are *you done, nobody has started, eh are you not willing to write?* (No reply from learners). The teacher said *I believe you are not* *copying the question but you are answering the question* and she continued *I need only the answers*. Other learner that Jane was next to asked is this the activity and she said *yes*. Jane said *not yet started.* Jane said *nobody is saying am done, nobody, no one.* Jane said *2 minutes left am about to say stop*.

28-32 minutes

Jane told learners to stop and exchange the books. Other learner said *a ri ngo fhedza* **(we did not finish).** Other learner said *u khou di nwala* **(he is still writing)** James (pseudonym). Other learner said *u kha di nwala munwe* **(someone is still writing)**. Jane said *let us not waste time you know that time is money, stop stop let's write, let us correct what you have done*. *It says identify mixtures in diagram, hey wena* **(you**) *hey,* said Jane. Other learner said, *u khou hana u mpha bugu* **(he is refusing to give me his book).** The question wanted learners to identify mixtures and non-mixtures and they should give reason for their choices. Jane said *can I erase somewhere* (Jane erases the other part of the board using tissue). *Ma'am,* another learner shouted and ma'am replied *hello*. Learner said *hango nwala o tou kopa mbudziso* **(he copy the questions only)** and teacher said *no there is no problem you are just controlling what he has done, you control what he has done, whether he finish or not ,where he has ended whether he wrote the correct answer or not do what is needed.* Jane said *does A show a mixture or not?* And learner said *not a mixture* and Jane asked, *why?* Learner said *because the bubbles are the same*. *How many of you got it*, Jane asked (other learners raised their hands). *Is B a mixture or not*, said Jane and learner said *is a mixture*. Jane said, *why? Provide a reason John* and John said *they are not the same* (bubbles are not of the same colour)

32-36 minutes

Jane continued, *we see a red bubbles and purple.* Jane said *C is a mixture or not* and *learner replied, mixture and Jane asked why? (Class didn't respond)* and Jane said *we see 3 different particles.* Jane asked *what* *about D?* Mukondi and Mukondi said *is a mixture.* Jane asked *why* and learner replied *Bubbles are not the same.* Jane added *meaning that particles are not the same or when we say particles are not the same we are saying they are impure, they are not pure.* Jane then asked learners if they are done with marking and the learners said *yes*. Learners return the books to their owners as instructed by the teacher so that they can do corrections. When Jane is about to sign learners' books another learner said *there is also number 2 that need to be marked* and Jane return to her textbook to check number 2. Jane read the question as follows; *identify which of the photographs below mixtures and which one is not. what about A,* Jane asked *and* learners replied *mixture and she wrote on the board* .Jane asked *what is at B there and learners said, it is a salt* and she then asked *is that a mixture or not?* And learners said *it is not a mixture.* Then Jane said *it is mixture* and wrote on the board *(learners start murmuring as an indication of disagreeing with Jane answer).* Jane saw that the learners don't agree with her answer she then asked *why are they saying is not a mixture* and the learners said *it is a salt.*

36-40 minutes

She continued, how do they know that is a salt? (Learners didn't know what to respond). Jane finally write it not a mixture (she erase the mixture) after being convinced by the learners that it is a salt. *What is C* asked Jane and the learners said *not a mixture*. Jane asked *D* and learners reply *mixture*. She then told learners to give the owner a book to do corrections (while learners were busy with corrections Jane was moving around signing learner's books). Jane signed learner's book and she sometimes asked learners about the marks they got.

40-44 minutes

After signing the books Jane said *ok I believe you are done with correction that why you are talking* and all learners said *yes*. Jane then instructed the learners to close their exercise books and they did. Jane then again asked *what a mixture is* (the teacher is now checking learner understanding of what she taught them) and learners reply as follows: *is when two or more substances with different physical properties that are mixed together* (Jane repeated what a learner had said). Jane said *in this mixture we have different physical properties, for examples* (learners did not give the examples)

44-48 minutes

Jane said *we have pure and impure, now when we have mixed two or more particles or substances together we can also be able to separate them* (Jane erased the board with a tissue while talking) *oho someone is still behind now we are moving, you will remain*. Jane continued *the total participation*. Jane asked the class *what is to separate class, vocabulary?* (She asked learners to use their common sense and she then put books together to make a mixture). John said *taking things out and put them in their order* (the teacher repeated the response). Jane said *can you give me the examples* (learners did not give examples of separating). Jane said *my mother has boys and girls we were using one rondavel being 5 at home, we were using the same rondavel being 5 children at home then my father build a 12 rooms house* (learners whispering) *then my mother try to separate us ,how can she do that?* Mutshidzi said, *my mother will take three boys to their room and 2 girls and share their room* (Jane repeated learner response*).* Jane said *very good that is separation or don’t forget is a 12 room house* (Jane again repeated what Mutshidzi (pseudonym) had said about how the mother can separate the five children).

48-52 minutes

Jane said *other ways that the mother can separate the children don’t forget we are five at home* and Ndivho replied *each one of us get his or her own room,* and *that is separation* Jane added. Jane held a container that has a mixture and asked *what is inside the container* and learner replied *rice and salt and beans*. She further said *conjunction language now, what should he say* and learner replied *rice, salt and beans.* Jane asked *which conjunction used* and learners said, *comma and full stop.* Jane then said *now I am Mr Nemukula* (pseudonym)*, rice + salt + beans =?* and learners replied *mixture.* She then asked the other learner and he replied mixture (Jane said very good and told learners to clap hands for him and the class did). Jane said *then I want to put each one of the particles or a substance aside, separately. Jane said what can we* and she asked Phuluso (pseudonym) to separate the mixture and ask Mushe (pseudonym) to help her, then Mushe and Mutshidzi join her in front of the class and Jane asked *what they are doing* and class said *they are separating.* Jane asked *what are they are using? Hands,* said learners*.* She said *the first separation is hands sorting.* Jane said *Vho Magogo* ***(Grannies)*** *there at home they keep on separating, when it is summer time they separate the mixtures, they separate nduhu* ***(nuts)*** *from mavhele* ***(maize),*** *they separate phonda from nawa* ***(beans****) they use their hands and they are busy with hands sorting.* Class applauded for learners who separated the mixture as instructed by Jane. Jane concluded the lesson by giving learners a task to go and find the other ways that can be used to separate the mixtures and she thanked the learners and told them to enjoy the rest of the day (learners clapped the hands) .

Day two lesson

0-5 minutes

Jane started a lesson by reviewing what the learners learnt in the previous lesson (learners were taught about the mixture). The teacher wanted learners to assist someone who was absent in the previous lesson to explain what a mixture is. She further asked *what is a mixture* (Learners were murmuring and the teacher told them to raise up their hands). A learner said *two or more substances that are put together.* Jane said *we have two physical properties of mixtures, which are they?* (Jane waited for learners' response as they have already learned about the physical properties of mixture but no one replied*).* Jane continued *I said we have pure and impure and she wrote on the board* (she looked at the textbook).

Jane said *ok today I want us to move on* under the separation of mixtures (she wrote the topic on the board, it was a continuation of the previous lesson). She then said, *we said that when two or more thing are put together, for examples you have seen, worms, rice and beans are put together* and she proceed *when water and sugar and tea leaves and milk put together, that is a mixture.* She said *then how can we separate them and* the learners did not respond (on the previous lesson Jane gave learners a task to go and find the other ways that the mixture can be separated). Jane said *what are the methods of separations* (she wrote on the board)? She said *I am having different colours chalks here* (she put chalks of different colours on a plate) and she asked *which colours are these?* (she moves towards the learners so that they can see the chalks inside the plate) Learners replied as follows: *blue, pink, green, orange and white.* Jane said, *I want the two here, may you please separate these mixture* (Jane left the plate with chalks on the desk for the two learners seated on that particular desk to do the separation) and the class looked at what they were doing as they were told to do so (learners observe while the two learners were busy separating the mixtures). Jane asked the class what they are using to separate this mixture. And the learners replied, *hands.* Jane said *then that method we call it hand sorting* (she wrote it at the board).

5-10 minutes

Jane said *they are busy sorting it*, (Jane move towards the learners who were busy with the separation) *how are they put it* (Jane stand next to that particular desk to check how they had done the separation), *they have put them according to their colours.* She further said *this method is the one that our grandparents used, thank you we have seen it* (Jane took back the chalks from the learners who were doing the separation) *the method is called hand sorting.* Jane continued *our parents; our grannies at home use hand-sorting method when they separate their seeds.* Jane said *during summer time when they want to plough you will find them busy* *sorting their seed, they want to plough, they first sort them. Jane said, now there are other methods of separation except the one of hand sorting, we also have another methods* (Jane opened the textbook). Jane said *when you have mixed a water and sand or water and rice which method can we use? (*Jane said they have already done that in grade 6). Learner said *sieving*. Jane asked *can we sieve water* and she wrote sieving on the board since it is one of separating methods. Before Jane demonstrated sieving she told learners *here is the maize meal, can you see it*? (Jane holds a plate containing maize meal for learners to see) and learners replied *yes*. Jane placed maize meal on a plate and she asked learners *what is this?* (She held a container with samp inside) and learners said, *samp.* Jane then placed samp on the plate containing maize meal. She holds another container and asked learners what was inside and learners said *beans. She* then placed some beans on the plate containing other substances (Jane held the sieve and the plate containing different substances on it and asked one learner to come and demonstrate sieving for the class). Learner went to the front and Jane placed the mixture on a container so that the learner could sieve without difficulties and then the learner demonstrated sieving to the class. Then Jane asked the class *what is he doing* and learners responded, *sieving*. After the learner had finished sieving, Jane held the things he used and said, *yes now the maize meal is aside and those that are the large grains will remain on top then the process it called sieving.* Jane said *which means here we can combine sieving and hand sorting because this grains are too big, do you see them* and learners said, *yes.* Jane continued ok that is enough (she thanked the learner who demonstrated sieving and told him to sit down). Jane said then another method of separation, which one do you still remember the one that you did in grade 6 come on class, I know that you know (learners fails to give the method). Jane said, you have forgotten and learners said yes. Jane said we have filtration and she wrote it at the board. Jane continued *this is where let just say for example you have* *muddy water, what it mean when we say muddy water* and a learner replied, *dirty water*. Jane said *in this method we use a filter funnel but we can make our own filter funnel using the 2 litre bottle* (Jane cut the bottle using a pair of scissors).

10-15 minutes

Jane said, *you take water, that muddy water and use this funnel then have a cotton wool and you press it when you pour the water pure water will go down and the dirty things will remain on top then that method is called filtration* (Jane did not have any muddy water but she demonstrated the filtering method as if she did). Jane said *then we have another one where we find that at home they wanted to cook something that you like they use cooking oil and pour a lot of cooking oil in the water, how do we see that water has a lot of oil inside* and *a* learner said *the oil will be on top*. Jane said *then I have oil here and I forget to bring water you should have been seeing it*, *then oil and water when they combine, when they are mix, like here you see that the drink is below can you see the oil is on top then this method when we separate it we call it decanting* (she wrote the method on the board) *when you want to remove oil from water*. Jane said *then I want to give you a task now, I want you to go to your dictionaries, find the meaning of these words, and we do it in a form of classwork and wrote it on the board.* Jane wrote the classwork on the board (the classwork wanted learners to explain the meaning of separating methods that they were taught in the lesson*). Jane gave learners five minutes to do the activity and they we control thereafter (*Jane was moving around while learners were busy writing the activity*).* She said*, they are not all but I want know these once first.* Jane said *find the meaning of those words so that we can continue, these are the ones that you have done in grade 6.* Jane asked the learners if they are done and the learners said no. Jane said *come on don't be like tortoise.*

15-20minutes

Jane said *this one for filtration you should know that it will be part of your* *assignment*, *your practical investigation*. Jane said *I believe you are done now* and learners said *no*. Jane said *let us not wait our time*. Jane said *ok stop, stop where you are* (learners were murmuring as an indication that they did not finish and they were told to exchange the books), *exchange the books this is an exercise don't panic there comes a test you will pass.* Jane asked *have you exchanged the books* and learners said *no*. Jane said *let us manage time people* (learners are exchanging the books). Jane said *who can give us the meaning of hand sorting.* She said *yes Mudanabula* (pseudonym) and Mudanabula said *we can sort a mixture that is made up of solid particles with different sizes, colours, textures or shapes by hand* (he read from the book). Jane said this is *the method of separating using your hand* and she wrote on the board. She continued *simple as it is method of separation using my free hands* and she said *you have seen the two separating the chalks using their hands were they looking for something to pick, am talking to you, did they look for something to pick and the* learners said, *no*.

20-25 minutes

They use their own hands, said the teacher and the class. Jane said *now sieving, what do you understand by sieving* and a learner said *methods in which a sieve is used to separate a mixture of solids containing different sized particles* (learner read from the classwork book). Jane said *aha* ***(yes)*** *we use a sieve where a sieve is used to separate substances of different size* and she wrote on the board and she continued *for example* and a learner replied *beans and rice- (the teacher wrote beans and salt not beans and rice on the board)* and Jane said *beans and rice can we sieve beans and rice* and learners said *no*. Jane also mentioned beans and maize as an example of sieving. Jane said *you see when they are building at your home you see the constructers busy sieving the soil and they want the soft particles and the grains particles to be separated ani athu zwi vhona vha tshi khou sefa mavu ndi zwenezwila* **(*you haven't seen when they are sieving the soil that is sieving).*** Jane said *filtering,*

what do you understand by filtering? Where are girl's people, only boys in the class? Yes at the back and learner said, *method in which a filter is used to separate a solid from a liquid* (learner read from the textbook and Jane wrote learner respond on the board). Jane said *now we have decanting, what do you understand by decanting? What are you writing,* learner said *correction,* and the teacher said *whose book is this?* Learner said *mine.* Teacher asked, *why? Didn't you hear me when I say exchange the book* (two learners were marking their own book but exchange after the teacher spoke with one of them). Jane said *who can try that one decanting* (no learner was responding she even told them to participate, learners tried to open their textbooks to check the meaning but still they failed to respond). The teacher said *is it difficult* and learners said nothing. Jane said *that is the method of separation where two liquids, separating liquid from liquid for example water from oil* (she wrote on the board). Jane said *then I believe you have marked and everyone has his or her own book in hands to do corrections.* The teacher then controlled the learner's books, she move around writing marks
that the learner obtained and also sign the books.

25-30 minutes

Learners were told to do correction so that they can read at their homes. The teachers told other learners who obtain less marks that they are playing. Jane said *I want to see correction being done.* Learners were also told that they will write a test on Friday and they were told to go and study. Jane said *ok good people we didn't do all the methods of separating* and she concluded the lesson by giving the learners task to go and find other methods of separation and she said *they are there in your book for example using the magnet separating two different things using magnet, evaporation and so on and so on.* Jane said *thank you for the time we will continue tomorrow, go and find other methods of separation thank you.*

Appendix O

Charity observation transcript

Observation of charity: May 2018 at Presented Secondary School in Grade 8 Natural Sciences Classroom

Day one lesson

Line	Description
	0-10 minutes
	The classroom was conducive for teaching and learning. The classroom was clean. Learners were seated on the desks and they were sharing desks. The desks were arranged in rows and columns with enough space for the teacher and learners to move around. Charity greeted the learners and learners greeted back. All of the learners were in their school uniform. The teacher then introduced the visitor (Ms. Netshivhumbe) to the learners. The teacher told the learners to open page 90. The teacher said *particles model of matter* and then he asked the class *what is matter?* (He wrote on the board). Learner replied *model that helps us understand that matter is made from particles and how they affect the behaviour of matter.* The teacher did not comment on the learner response but pointed to another learner and the learner said *matter is that occupies space and has mass.* And the teacher said *matter is anything that occupies space and has mass* (he wrote the definition on the board and learners take notes). The teacher said *we have three states of matter* and he wrote on the board. Thereafter he said *mention three state of matter* (learners raise up their hands). Learner said *solid*. Learner said *liquid* and learner said *gas.* The teacher wrote the states of matter on the board. The teacher proceeded*; today we are going to deal with the arrangement of particles of solid, liquid and gas* (focus of the lesson). The teacher drew a table of three columns on the board, the first column was for solid, second was for liquid and third was for gas. The teacher said *name of water in the solid state* and the learner said *ice* (he

wrote on the board). The teacher said *name of liquid state of water* and learner said *water* (he wrote on the board). The teacher said *name of gaseous state* and learner said *evaporation*. The teacher said *what?* And the learner again said *evaporation*. The teacher said *no, evaporation is the process*. The teacher said *ya* ***(yes)*** Rudzi (pseudonym) and Rudzi said *vapour* and he wrote on the board. The teacher said *the arrangement of particles solid or ice are arrange in specific pattern* (he read from the textbook and wrote on the board). The teacher said *liquid are loosely arranged and are not in a fixed shape* and he wrote on the board. The teacher said *gas or steam they are not arranged in a specific pattern* and he wrote on the board. The teacher said *movement of particles, under ice they vibrate in a fixed position* and he then explained the same statement using learners' home language as follows *zwi khou tou sumbedza uri naho i ice yo ra la dzi particles dzivha dzi khou vibrater mara dzi khou vibrater kha fixed position.* The teacher said *ri khou wanana ne?* ***(Are we together?)*** And learners said ee **(yes).** The teacher continued *zwiamba uri dzivha dzi khou bammba, zwiamba uri dzothe dzi tshi gonya dzi gonya dzothe, dzi tshi tsa dza tsa dzothe* ***(when ice vibrates,***

they vibrate moving up and down at the same time)*.*

10-20 minutes

The teacher said *ri fhethu huthihi* **(are we together)** and learners said *ee* ***(yes)***.

The teacher said *water they move more freely than in solid and slide pass each other* and he wrote on the board. Thereafter, the teacher said *zwiamba uri that's why liquid itshi fulowa* **,** ndi ngazwo madi a tshi yela, a ya kona u tshimbila o leluwa *a tshi khou slider ntha ha manwe***,** *manwe a vha a khou tsa nga fhasi, manwe a khou gonya nga ntha* ***(that's the reason why water flow easily sliding on top of each other. When some of the water goes underneath, some goes up).*** The teacher said *ri huthihi rothe ne?* ***(We are together right?)*** And learners said *ee*

(yes). The teacher said *steam move randomly in all the direction and fill the whole container* and he wrote on the board. Thereafter he explained using learners' home language as follows *zwino steam tshi tshi khou muva tshi muva hothe, tshi tshi khou muva tshi vha tsho dadza container* ***(the steam moves to different directions and fills entire container when moving).*** The teacher said *ri huthihi ne?* ***(we are together right?)*** And learners said *ee* ***(yes).*** Thereafter he said *zwinga vhananga* gas , nda fafadzela perfume hafha zwa zwino ni dopfa muthu wa hangei a tshi ri i khou nukhelela na ho ula are hangei ari i khou nukhelela na ho ula are hangei ari i khou nukhelela, mara nda nga tevhula madi hafha madi anga yela hangei ,angasi ele hothe ***(if I can spray a perfume learners seated at the different sides in the classroom will be able to smell the perfume but if I can pour water here, water will not flow to all the directions).*** The teacher said *ri huthihi ne* ***(we are together right?)*** and learners said *ee* ***(yes).*** He said *nda vhea ice hafha a i nga muvi* ido dzula i henefha i yeneila ice ngauri dzi particles dzi vibrater kha fixed position ***(if I can put ice here it won't move, it will remain in the same position because ice particles vibrate in a fixed position)***. He proceeded, *they are not free to move*. The teacher said ri huthihi rothe musi **(*we are together right?)*** and learners said *ee* ***(yes).*** The teacher said *the space between the particles* and wrote on the board (he had drawn a table with columns that included ice, water and steam). Then he read what he wrote to the learners as follows *the space between the particles of ice, water and steam.* The teacher wanted to tell the learners about the space between the particles of each state of matter. The teacher said *number 1 the space between the particles of ice they are very small* and he wrote on the board. He then said *zwiamba dzi* ***(it means)*** *particles dza* ***(of)*** *ice they are closely paired zwiamba uri dzi tsini na tsini* ***(it means they are close to each other).*** The teacher said *ri huthihi* ***(we are together?)*** and learners said *ee* ***(yes).*** The teacher said *the space between water is large* and he wrote on the board. The teacher said *the space between steam they are very large.* The teacher said ri huthihi rothe musi ***(we are together right?)*** and learners said *ee* **(yes).** The teacher said *zwiamba uri* ***(it means that)*** *we cannot compress ice and liquid but we can compress gas or steam.* The teacher said *ri huthihi* ***(we are together?)*** and learners said *ee* ***(yes).*** The teacher said *what happen when we heat ice?* A learners said *it will melt* and the teacher said *it will melt this process is called melting* and he wrote on the board. Teacher said *ice turn to water.* The teacher said *when we heat water it turn to…..*and learners said *water vapour.* He asked *the process is called what?* Others said *steam* others said *evaporation* and the teacher said *evaporation* and he wrote on the board. He said *we have a reverse reaction* and then explained the following to the learners *when we cool water vapour it forms water, and when we cool water it forms ice.* He then said *the process when we cool water vapour to form water is called what?* And learner said *condensation* (he wrote on the board). The teacher asked *when we cool water to form ice process is called* and learner said *freezing*. The teacher asked *when ice turns to gas which is vapour it is called what?* Another learner said *melting* and the teacher repeated the question and learners said nothing. Then teacher said *sublimation.* The teacher asked learners if they know gambogo **(snow)** and they said no. The teacher asked learners if they know dry ice and they don't know dry ice. He then said the following *na ya checkers hangei ho no rengiswa dzi khovhe ni do wana murahurahu hangei khovhe dzedzi dzi nobva madini ni wana dzo vhewa kha inwe ice mara nga ngomu ni tshi sedza a ninga do vhuya na wana huna madi kha hedzila ice, ri khou wanana ne ni do wana hu khou sokou bva vhunwe vhutsi so hu khou vha na evaporation ri khou wanana ne and learners said yes. heyo dry ice a i turn ubva kha ice ya ita water, I turner ubva kha ice yavha vapour.ndi hafho i no vhudziwa upfi sublimation* ***(at checkers there are fish that are placed in the ice but when you look inside that ice you will not find water but you will see smoke or fog***

and evaporation will be taking place. Dry ice does not turn from ice to form water, it will turn from ice to vapour and such process is called sublimation).

20-30 minutes

The teacher told the learners to take out their classwork books and do activity 3 on page 93 (learners did the activity as instructed by the teacher). The teacher was moving around while the learners were busy writing the class activity and he then started signing learners' previously marked work.

30-40 minutes

The learners were told to exchange their books and start with the marking. The teacher read the questions of the classwork to the learners as follows, *copy and complete the table below to compare the particles in solids, liquids and gases*. He continued, *solid arrangement of particles they are packed closely together; arranged in an organized pattern*. The teacher said *movement of particles* and learner said *do not move around freely, but vibrates around fixed position.*

40-50 minutes

The teacher said *space between the particles of liquid* and learner said *they are very small.* The teacher said *under liquid the arrangement of particle* and learner said *particles are not arranged in specific pattern.* The teacher said *effect of attractive forces between particles* and learner said *they are not held as strongly by the forces of attraction.* The teacher said *the space between particles* and learner said *they are not arranged in a specific pattern* and the teacher said *space between particles not arrangement of particles.* Other learners said *large.* The teacher said *arrangement of particles in gas* and learner said *there is no particular arrangement.* The teacher said *movement of particles in gases* and learner said *they move around very quickly.* The teacher did not do effect of attractive forces between particles of gases which was the last question of the activity. The learners were told to write the marks they obtained and the activity was out of 8. The learners were also told to write the corrections. In Conclusion of the lesson the teacher moved around signing learners books.

Day two lesson

0-10 minutes

The classroom was clean and learners were in school uniform. Charity greeted the learners and learners greeted back. The teacher told learners to open page 98 and the learners took out their textbooks and opened them to the page the teacher told them. The teacher said *today we are going to deal with density, mass and volume* (learners were making noise while the teacher was telling them what they will be dealing with in the lesson). The teacher said, *mass is a measure of the amount of matter that an object is made of*. The teacher continued, *Mass is measured in grams (g) and or kilograms (kg)* and he wrote on the board. The teacher said *ri fhethu huthihi* ***(are we are together?)*** and learners said *ee* ***(yes).*** The teacher said *number one the three blocks in the picture below all have a mass of 10kg.* The teacher said ri khou dzi vhona edzo dzi block uri ri na block khulwane mbili na kunwe ku block kuthihi kutuku kune kwavha uri ndi kwa metal ***(there are two big blocks and one small block of metal as they can see in the textbook).*** The teacher said *the block of iron is the small block, block* of *wood medium block and block of sponge is a bigger block. They have different chain* he added. The teacher then asked the learners if they can see the blocks that were shown in the textbook and learners said *yes.* He said *tshinwe ndi tshituku tshine tshavha uri ndi iron, tsha wood tshi vhukati ,tshi pontshi ndi tshi ngafhani? ndi tshi hulwane* ***(other block is small which is an iron, wood is a middle or medium block and block of sponge is a biggest block).*** The teacher said *hedzo nthu dzothe vhuraru hadzo dzina mass yino lingana* ***(all those blocks have the same mass).*** The teacher said *those three blocks they are differ in size but have the same* *mass.* The teacher asked the learners if they were still with him and they said they are. The teacher said *volume is the amount of space an object occupies* and such statement was repeated using learners' home language as follows *volume ndi tshikhala tshine* tsha kona u dadziwa zwithu. The teacher said *u fana na kilasi yeneino arali yo hulisa so* ***(like this class when it is bigger like this).*** Another teacher came and asked for a grade 8 NS textbook from a learner who had it and it was given to him. The teacher said *volume is normally measured in unit like litres or millilitres* and such statement was repeated using learners' home language as follows *zwiamba uri volume i mezariwa nga dzi litha kana ngadzi mililitha*. The teacher *said ria tshi vhona tshigumbu tsha cooldrink tshi na volume ya 2 litre* ***(the bottle of cool drink has a volume of 2 litre).*** The teacher then asked the volume of a bottle of cool drink and learners said 1*.5 litres* and the teacher said is *1.25L*. The teacher also asked the class the volume of cool drink can and some learners *said 350 whereas others said 500,* and the teacher said is *500ml.* The teacher asked if the learners were still with him and they said yes. The teacher said *zwiamba hezwo ndi hune rakona u divha uri volume I mezariwa nga dzi litha na nga dzi mililitha* ***(it means we now know that volume is measured in litres and millilitres).*** The teacher said *it is also measured in unit like centimetres cubed, millimetres cubed or decimetres cubed.* The teacher said *a block, it has a length of 10cm, breath of 10 cm and height of 10cm.* He continued *the volume of the block is equal to length x breath x height which is equal to 10cm x 10cm x 10cm.* The teacher said *10cm x 10cm*= and learners said *100* and he continued *by 10cm* and learners said *1000.* The teacher proceed *centimetre x centimetre is and learners said centimetre squared* and he said *centimetre squared multiplied by centimetre* and learners said *centimetre cubed* (the teacher wrote on the board). The teacher said *the volume of block is equal to 1000 centimetre cubed.* The teacher said *this is the same as 1 litre.* The teacher said *1000 cubic centimetre is equal to 1 litre (he wrote on the* *board).* The teacher said *which means the block of 1000cm cubed has a volume of 1 litre.* The teacher asked if the learners were still with him and they said yes.

10-20 minutes

The teacher said *density, the blocks in figure 20 all have different sizes, but their mass is the same.* The teacher said *this is because the particles in iron are more closely packed together than the particles of wood.* The teacher said *zwine zwa khou ambiwa hafhala ndi zwauri iron ri khoi vhona ndi thukhu, wood size yayo ndi khulwane* ***(iron has a small size whereas wood has a big size as shown in a textbook).*** The teacher asked if the learners were still with him and they said yes. He continued *the different kha hezwila zwithu zwivhili ndi the arrangement of particles* ***(the different between the iron and wood is their arrangement of particles****).* The teacher said, *this is because the particles in iron are more closely packed together than the particles in wood.* The statement was repeated using learners’ home language as follows zwine zwiamba uri he dzila dzi particles dza kha iron dzi tsini na tsini nga maanda u fhira dza kha wood. The teacher said *in wood, particles are not closely packed.* He then said *ndi ngazwo khuni ri tshi kona u i fhadza, arali particles dzovha dzi closely packed zwiamba na musi ri khou shumisa mbado ra nga si do i fhadza khuni* ***(the reason we are enabled to click on wood is because their particles are not closely packed but if the particles of wood were closely packed it wouldn’t be possible for us to click on wood).*** The teacher asked if the learners were still with him and they said yes. The teacher said *tsimbi ri ngai fhanza unga khuni* ***(can we click on iron like wood)*** and learners said *hai* ***(no)****.* He said *it is as if the same amount of matter is squeezed into a small volume in iron than in wood.* Thereafter the statement was again explained in learners’ home language as follows *ndi zwauri he dzila dzi particles dza iron dzo vhuisiwa tsini na tsini ufhira dza kha wood, ndi ngazwo iron i na volume thukhu kha volume ya wood.* He continued *ndi ngazwo size dza* *hezwi zwithu zwivhili ri khou lavhelesa adzi lingani* ***(that is why when we look at the size of iron and wood they are not equal).*** The teacher asked if the learners were still with him and they said yes. He explained the following *in sponge foam, the particles are much further apart, so that the same amount of matter take up much more space compared to iron.* The teacher asked zwino hu khou campariwa mini*?* ***(What is compared now?)*** And both teacher and learners said *an iron and a sponge*. The teacher said *zwiamba kha sponge ngauri ndi tshone tshire na volume khulwane dzi particles dzahone they are far apart* ***(because the sponge has biggest volume, it means it has big space between the particles).*** The teacher said *ri khou wanana neh* ***(we are together right),*** *ndingazwo ri khou wana uri volume yahone i khulwane compare to iron mara dzothe dzina mass wau lingana. (****That is why we see that sponge volume is big compare to iron though they have the same mass)****.* and learners said ee ***(yes)*** The teacher asked ri huthihi rothe ***(are we together)*** and they said ee **(yes).** The teacher continued *in figure 21, all the blocks have the same volume but the iron block is much heavier than the sponge foam block even though they are the same size. More iron particles are packed into this volume than in the case of the wood or sponge foam. We say that iron is denser than wood and sponge.* The teacher said *density is equal to mass divided by volume* and he wrote the formula on the board. The teacher also wrote the formula of density in terms of fractions. He said *kha hedzila block tharu dzina mass wo no lingana, volume ya sponge ndi khulwane, ya wood ndi medium, ya iron ndi small* ***(those three blocks had same mass but the volume of sponge is large, wood is medium whereas iron has small volume).*** The teacher asked if the learners were still with him and they said yes. The teacher said *for example mass of iron, wood, sponge is equal to?* And learner said *10kg* and he wrote on the board. The teacher said told the learners they are now going to compare and he gave sponge a volume of five cubic centimetres, wood two comma five cubic centimetres and iron one cubic centimetre and he wrote on the board. Learners were told that the calculations will be done as follows, he will start with density of sponge, wood will follow and iron will be the last. The teacher said *density of sponge is equal to ten kg divided by five cubic centimetre is equal to* and learner said 2kg/dm cubed (he wrote on the board but on the substitution the volume was *cubic centimetre but on the answer decimetre cubed was used)*; *density of wood=mass/volume=.* The teacher said *mass of wood* = and a learner said *10kg.* The teacher said *volume of wood is 2.5 and then 10/2, 5*= and learner said *4* and he wrote on the board. He said *density of iron =mass/volume; mass of iron is equal to* and learners said *10kg*.

20-30 minutes

He continued*, volume of iron is equal to* and learner said *1 decimetre cubed* (he wrote on the board). The teacher said *10/1, yes Tshedza* (pseudonym) and Tshedza said *nothing.* The teacher repeated 10/1= and a learner said 10kg/dm3 and he wrote on the board. The unit of all the answers was kg/dm3. The teacher asked the class *which one has the higher density between the sponge, wood and iron?* And learner said *iron.* Therefore he said *iron is denser than wood and sponge* and he wrote on the board. He continued *between wood and sponge which one has higher density* and learner said *wood*. Then he said *wood is denser than sponge* and he wrote on the board. The teacher said *density and state of matter* thereafter he said to the class *name three state of matter* (some learners raise up their hands). A learner said *gas*, another learner said *liquid* and a third said *solid.* The teacher then said *solids, liquids and gases have different densities*. He continued, *in general, gases are less dense than liquids, and liquids are less dense than solids. Solid has higher density than liquids and liquid has higher density than gases.* The teacher asked if the learners were still with him and they said yes. He said *solid has higher density than liquids and gas*. The teacher asked his learners if they know what density is and they said no. He then said *rine vhathu ri na higher density i no fhira ya gas na liquid, hu tovha muthu muthihi fhedzi we a rivesa zwithu zwa science ndi yesu a yethe o tshimbilaho ntha ha madi. Mara density ya muthu ndi khulwane kha density ya madi that it why ri tshi sinker nga ngomu madini. Ra ima madini ri a nyupela. Tshinwe tsha vhuvhili ndi tsha uri ndi nga zwo rine fhano shangoni ra fhufha ri fhedza ro vhuya fhasi. Ngauri ri more denser than air. A thi afha tshikhalani ndi air and learners said ee. Arali density ya air i khulwane radori ri tshi fhuma ra namba ra ima henefha tshikhalani. Zwiamba uri muya wa do kona uri tenengedza. That is why ra fhufha ri a kona u vhuya ravha ri khou tshimbila fhasi. Ra imisa mulenzhe u a kona u vhuya fhasi ngauri density ya vhorine ndi khulwane kha density ya muya* ***(people have a density which is higher than gas and liquid. it was only Jesus who walked on top of the water. But the density of a person is higher than the density of water, that it is why people sink inside the water. The other thing that shows us that we have higher density is that when we jump we will again come down because we are denser than air. If the density of air was high we were going to jump and remain in the air. If one of our legs is in the air it will come down because of us being having high density than air*).** The teacher asked *if the learners were still with him and they said yes.* The teacher said *zwi di fana na density ya tombo kha madi, ra posa tombo kha madi li ita nyupela. Ndi hezwi zwine ra ri density ya stone is more denser than water* ***(the density of stone is more than the density of water because if we throw the stone inside the water, the stone will sink).*** He asked *so density of water and oil which one is more denser than the other?* And learners said *oil.* The teacher said *oil is more denser than water?* And learners said *no.* And the other learner said *water is more than oil* (he wrote on the board). The teacher explained to learners that if they pour oil in water, the oil will go up and not below the water therefore water will always remain on top of the water not water on top of the water. Hence, there is more space between the oil particles. The teacher said *there are some exceptions to this, for example, wood is a solid but it is less denser than water.* Learners were previously told that solid is denser than liquid, but in this case wood which is solid is less dense than water. The teacher asked learners if they know zwikwekwete **(ship made of wood)** and learners said no.

30-40 minutes

The teacher then explained to learners as follows *Zwihone zwikepe zwino itiwa nga vhathu kanzhi kanzhi ni tshi vhona dzi film he dzi dza ma Nigeria ndi do vhona vhathu vho dzhena nga ngomu vha khou phusha madi ngadzi thonga, madi atshi khou humela murahu. He tshila tshithu tshi khou itiwa nga danda. Vhadivha uri he lia danda vha tshi li posa madini a li nyupeli, lia fulota. Ri khou wanana ne. Lia kona u ima ntha ha madi ngauri density ya wood ndi thukhu kha density ya water. Ndi ngazwo ho itiwa tshikwekwete tshine tsha kona u tshimbiliwa ngatsho madini* ***(there are ships made of wood, likely in some Nigerian movies you can see people travelling using that kind of ship and those people inside the ship they will be pulling water outside the ship using sticks while the ship will be moving forward. Those who created such ships they knew when they throw it on top of the water it will float. So we are enabled to stand on the ship that is on top of the water and not sink).*** The teacher said *however, the order of density from less dense to most dense usually: gas, liquid, solid. The reason why states of matter have different densities is easily explained using the particles model of matter.* The teacher told learners that density of gas, liquid and solid can be explained using the arrangement of particles. The teacher asked if the learners were still with him and they said yes. The teacher said *the arrangement of particles in solid* and learner said *ice* and teacher said *no.* The teacher repeated the question and learner said *they are closely packed in solid* (read from the textbook). He continued *in liquid* and learner said *they are close together, but are arranged more loosely, rather than in a rigid pattern* (read from the textbook). The teacher said *they (liquid) are close together less than solid more than gases.* He continued *particles of gases* and learner said, *have no particular arrangement*. The teacher added they are far apart. The teacher asked if the learners were still with him and they said yes. The teacher continued *particles in gases are spaced far apart whereas particles in a liquid are spaced closer together and particles in a solid are much closer together.* The teacher said *this means that in the same amount of space, gases have much less matter, liquid have more matter in the same space and solids have the most matter in the same space* and such statement was repeated using learners' home language as follows *zwiamba uri gas particles kha same space dzivha dzi thukhu ,kha liquid dzivha dzo dala nyana, kha solid dzivha dzo dalesa.* The teacher asked if the learners were still with him and they said yes. The teacher told the learners to write a classwork activity which was on page 100, activity number 9. They were told to write only number 1 A and B and 2. The teacher gave learners 10 minutes to do the activity (learners took out their classwork books and did the activity as instructed by the teacher).

40-50 minutes

The teacher was moving around when learners were busy writing the classwork activity.

The teacher told learners to stop writing and he started to mark the activity with the learners. The teacher read the question, *1 a) if you placed a solid into a liquid, what would happen? Explain your answer.* And learner replied, *it will sink because liquid less denser than solid.* The teacher told learners to erase the board. The teacher said *it will sink because solid is more denser than water*. b) *Would what you described in part (a) happen for all solids? Explain your answer.* The teacher repeated the question using the learners' home language as follows*, hu khou pfi ezwo zwe vha zwi tautshedza afho ntha zwiitea kha solid inwe na inwe na?* And learner 1 said, *yes*, *because any solid get melt*. The teacher said *wrong*. Learner 2 said *yes because solid particles are packed closely together and arranged in an organised pattern and do not move around freely, but vibrate around fixed position*. The teacher then said *any answer, Patrick* and Patrick said *yes, because solid has a higher density than liquid and gas.* The teacher said *no, because wood is a solid but it float on water.* The teacher told learners not is not all solids that sink. The teacher said, *like a polysterate board, nia vhona aya madithu ane ra a vhidza uri polysterate board. Arali hangei hayani ho rengiwa thundu nga hafha matungo ha thundu heyo huvha ho vheiwa zwinwe zwithu zwitshena zwine zwaita foshofosho zwivha zwo tsireledza thundu uri isongo vhaisale. Naho nanga lidzhia li tshi lingana na classroom heyi li polystarine board na li posa nga ngomu madini a linga do vuwa na duvha na lithihi lo sinker, li dotou floater madini. Mara is a solid, asi liquid, asi gas. Tshine tsha savhe liquid na gas ndi solid* ***(the teacher was telling learners that there is this thing called polystyrene board, he said if at home they bought furniture, the thing that covers the furniture is a polystyrene board which was used to protect the furniture. He indicated that even if the polystyrene board is big like the class if it is thrown on the water it will not sink no matter how big it is. But it is solid not liquid or gas. He then said what is not liquid and gas is solid, but what is not liquid and gas is a solid).*** The teacher asked if the learners were still with him and they said yes. He continued *number 2 draw three particle diagrams to show a gas, a liquid and a solid in three separate boxes.*

50- 60 minutes

He continued, *use these boxes to show the differences between the three states of matter.* The teacher answered the question and thereafter he said, *in gases there is a bigger space between the particles, in liquid there is a small space between the particles, in solid there is no space between the particles.* The classwork activity was out of 5. The learners wrote the corrections and teacher left the classroom after he signed the learners’ classwork books.

Appendix P

Kay observation transcript

Observation of Kay: May 2018 at Amazing Primary School in Grade 7 Natural Sciences classroom

<u>Day one lesson</u>

Line	Description
	0-4 minutes The classroom was conducive for teaching and learning. The classroom was clean. There were some charts pasted on the wall but it was nothing related to Natural Sciences. Learners were sharing desks. The desks were arranged in rows and columns with enough space for the teacher and learners to move around. The teacher borrow a Natural Sciences textbook from a learner. The teacher told the learners to open page 65 and they will also look at page *76 (*learners took out their textbooks and opened page 65). The teacher said, *obviously I have already greeted you right,* and the class said, *yes.* The learners were told not to look at the back but concentrate on what they will be doing in the class. He continued, *if ever you have questions then therefore you are allowed to ask*. The teachers said *our lesson on today that is properties of matter as we as the impact on the environment*. He said *the main purpose for this that is to know all things that are responsible for making any different of materials that we have right* and the learners said *yes*. The teacher said *but the first thing that we need to do we must start with the word itself matter, what do you understand about this word that we called it matter.* The teacher said *if ever you heard about the word called matter you can just raise up your hand you tell me about the meaning of it unless if you don't know anything about it, what is matter?* He said *do you still remember the first thing when we were in the beginning of our Natural Sciences we have dealt with different spheres; do you still remember the spheres?* And learners

said *yes.* Both teacher and learners said *lithosphere, biosphere, hydrosphere, and mesosphere.* The teacher said *then, all those spheres we dealt with different matter.* The teacher said *are you with me* and learners said *yes.* He continued, right *so there are matters that are found in the water, there are matters that are found on the ground, on the space in different places, so what is matter? (*question repeated, a few learners raise up their hands). A learner responded *something that takes up space and has mass.* The teacher said *yes, matter is anything that occupies space and has mass.* He continued *anything that occupies space and has weight.* The teacher said *so in our class we have got different materials, some of the materials they are hard whereas some of the materials are soft, some of them (materials) they are somewhere between hard and soft right.* The teacher said *the first thing that I want you to do that is to identify all those materials that we have here in the class, can you identify them?* (Learners raise up their hands). He then said *or before we identify the items that you see here in the class thereafter we see what isn't that made those materials.* The teacher said *do we have only one person here?* Learner 1 said *table;* learner 2 said *chalkboard*; learner 3 said *chair*; learner 4 said *feather duster*; learner 5 said *desks*; learner 6 said *papers;* learner 7 said *brooms;* learner 8 said *school bags;* learner 9 said *shelves;* learner 10 said *bucket;* learner 11 said *scissors;* (learners were able to state the materials available in the classroom). The teacher said, *let's pick up those materials and see what isn't that have done those materials, for example you said desks as one of the item are found in the class.*

4-8 minutes

The teacher said *now what is it that you think it made the desk and how it is made or where isn't come from?* (Learners raise up their hands). Learner said *the tree*. The teacher said *so it means that we are moving from primary activities to secondary activities.* He said *primary we're talking about the tree the way how it is right* and learners said *yes. He* *continued you find that they go and cut down the tree they will take it to the industries to make the fine table that you had.* The teacher said *so If I may ask why can't we make a desk with a sponge or a paper* (checking for learner thinking skills). The teacher said *you know the uses of the desk right or before we go there, can you give me some of the uses of the desks.* He continued *what is it that we use a desk to do?* (checking for learners' prior knowledge and experience). Learner said *to seat on it* and the teacher *said or what?* Learner said *to write*. The teacher said *it helps you to write*. The teacher said *so let say we take some of materials like sponge or papers we make a desk, what do you think it will happen?(*learners raise up their hands). The teacher said *Thabo come on man, what do you think it will happen?* (Thabo said nothing). Learner said *you will not write properly or seat well*. The teacher said *yes, we can't seat well because it will be bending and you cannot write properly*. He said *apart from the desk, we also have some state we have scissors and books as one of the materials that we have in the class and some bags.* He said *if let's say for example, we make a bag this school bag that you are using to carry the bags everyday by steel, what do you think it will happen.* Learner said *the bag will become heavier*. The teacher *said yes, the bag will become heavier or the body of that person will get damage.* The teacher proceeded; *let us look at those figures that are there at page 65**.*** He said *we have got figure 1, what do you see at figure 1* and learners said *desks*. The teacher *said there are materials there can you see* and learners said *yes.* He said *It means that figure 1 is just like the way our class look like, can you see everything is also there in figure 1, we have already identify those materials that are there.* The teacher *said let's go and have a look at figure no.2 we also have the materials that are in laboratory, can you identify those materials and try to identify things that made up those material that are there?* Learner said *glass* and the teacher said, *what is it that made the glass?* (Some learners raise up their hands). Abe said *cell*. The teacher *said let's go to figure no 3, in figure no 3 we also have different materials can you also see those materials* and learners said *yes*. He said *let try to identify the material that are there and everyone can see those materials that are there.* Learner said *school bag;* learner said *marking pens*; learner said *watch*; learner said *books,* learner said *apple;* learner said *crayons*; learner said *a ruler*; learner said *rubber*. The teacher *said right let try to pick one of the items and try to see what is it that made that material.* The teacher said *a ruler, I prefer to pick up a ruler, so what is it that we can use to make a ruler and why do we have to use those material.* He said *or before we go to why (teacher laugh) because most of the people they don't like it, what is it that make a ruler? the material that makes a ruler.* The teacher said *come on we don't have three people in the class, think you also have a ruler in your bags, check.* Learner 1 said *plastic.* Learner 2 said *wood.* Learner 3 said *iron*. The teacher said it means *we have the other one that is made out of wood, the other one out of iron, the other one out of plastics right* and learners said *yes*.

8-12 minutes

The teacher said *paper we make a ruler do you think it is possible to underline or to use them* and learners said *no.* He then asked *why? What is the purpose for the ruler; let us first identify the purpose of the rule.* A learner said *when we want to make a straight line it will make a bending line*. The teacher said *is there any material that we can talk about there or any questions that we have before we proceed.* The teacher *said there are questions there under activity one, can you see those questions that are there* and learners said *yes*. The teacher said *right it means that before we go there we already answered them, the first question says look at the objects in figure 1, 2, number 3; we tried to look at those figures and then we write a list of them as we have identify them already right.* The teacher said *when you go to question number two it has number a and b where number a says what material* *each object made of and we identify some of the objects or material, we tried to see what is it that made those materials right.* He said *number b for each object give one reason why we think that materials was chosen.*

12-16 minutes

He said *I gave example like a ruler and I said we cannot make a ruler with a paper because is not going to be possible to use it.* The teacher said *do you still remember? Then I said desk, you cannot make a desk with a sponge because is not going to be possible for you to sit on it, you cannot relax because it will be bending there and there though they can use a rubber, are you with me.* The teacher said *lets go to question number 3 if you think that another material would have been more suitable for any of the objects, state the material and give a reason why.* He said *sometimes someone has got another material that you think can make better a certain object identify the object and tell us the material that can use that objects, you give us the reason.* He then said *did you get what I have said* and learners said *yes*. *Apart from this one that are in here right (on the textbook) identify any other material or let me not say apart you can choose one of the object here out of these three figures are you with me* and learners said *yes*. The teacher said *right you say instead of using these materials we can also use these materials because they are suitable because of these and these reasons. Did you get what I have said* and learners *said yes?* Let's identify. *You identify one of the objects here out of these three figures, like you still remember we talked about ruler; and one of the objects there. we said ruler can be made up of plastic, you said it can also be made up of…..iron* (learners respond) *and then wood so it means that these materials they are suitable for making what that we call it a ruler. Right if ever there're other materials that can make the desk you can also tell me that we can use these materials to make a what the desk and you give me the what the reason* (some learners raise up their hands). *Some of you, you are lost here, wake up come on men. Mulalo where are you, you are lost nowhere to be found. Come-on raise up your hands yes Simon* and Simon said *we can make a desk with a rubber and iron and we can sit on it and it will not fall* apart. The teacher said *yes, he said we can take an iron to make a desk and we can sit on it though it cannot be comfortable enough*. The teacher said *right the other item and materials* and the learner said *instead of using glass to make bottle for chemical we can use plastic because it can also hold chemicals*. The teacher said *yes correct. He said instead of using the glass beaker that you see there at figure no 2 we can also use plastic to make those beakers. Are you with me* and class said *yes*. He explained that *we have some mug at home, some of them are made out of ceramics, some of them are made out of plastics, and some of them are made out of iron.* You see, but all of them they are suitable to use. He then said *are you with me* and learners said *yes*. He said okay, *let's take for example for arguments sake the shoe that Makha* (pseudonym) *wears right then we made it with an iron or steel, what will happen?*

16-20 minute

He told learners *the shoe that you wore there hopeful it is made of leather and a rubber isn't it? Instead of putting a rubber under it, we take a steel or iron we put under there. What do you think will happen* and the learner said *you will not walk properly because the shoe will be heavy.* The teacher said *yes correct, you cannot walk properly either the shoe will be heavy for you and obviously it will damage your leg, are you with me?* And learners said *yes*. The teacher said *then okay, let say for example or you want to identify some of the materials*. A learner said *when you make shoe by a steel you find that it can't bend.* The teacher said *yes thank you, correct you see when you wear a shoes somewhere in the middle there it bends isn't it sometime you tear it because if you use it every time, all the time then it will get old* *but the first part that is going to be damage sometimes we see it where it always bend. The thing is if you make a shoe with iron or steel is not going to bend easily, are you with me* and learners *said yes. Okay then is the other thing we can identify* and a learner said, *instead of using sand to build houses we can use metal. Yes instead of using what….sand to build what….houses we can use what ……metal.* The teacher said *just like here* (the teacher touch the wall of the classroom) *these are not sand, what materials are these once?* Other learner said *aluminium* and others said *wood*. The teacher said *is it a plastic? Is it a wood? (*majority of the class disagrees). Other learners said *copper*, some again said *plastics*. The teacher said it is a wood (the teacher told the learners' to check where there was a scratch as it was painted). The other learner said *stainless steel* (most learners agreed). The teacher then said *stainless steel because they are of different in terms of strength*. He said *so It means that we can construct houses with different materials, some they use corrugated iron to construct the houses. Therefore most of the squatter camps in Johannesburg are made out of elongated ion. Are you with me and learners said yes.* The teacher said *that is the house is just that sometimes it can give you more disadvantage than that other one made out of sand, because if it hot obviously you are going to feel more hot though there are some windows.*

20-24 minutes

The teacher said *so it means that we choose material to favour, to suit our needs. We don't just pick up the materials and made things are you with me. Let just say for example the book that is in front of you there. If we made it out of let say the iron or the steel, what do you think it will happen? The book you see you can open it properly easy to bend, smooth (the teacher was opening the book), we can write on it nicely, therefore we take the steel to make a book. Do you think it is going to be possible to write on it?* And learners said *no.* Another learner said *harder to write, harder to move easily and harder to bend.* The teacher said *yes, harder to move easily, it cannot move easily like this, this one is very smooth isn't it?* And learners said *yes*. The teacher said so *obviously if you use steel it is going to be tough to bend, if these papers were steel obviously when you bend them like this it was going to cause some injuries on your fingers are you with me* and learners said *yes. He said in case of writing it was going to be difficult for you to write on it. I don't know the kind of pen that you are going to use to write (he laughs) on that kind of book, are you with me* and learners said *yes.* The teacher asked if learners had any questions and no questions were raised by the learners*. Let's move to page 67 wherein we have got different materials that can be used to wrap the food. Obviously we're using different types of materials to wrap the food.* The learners were told they can go to the shop, restaurant to buy fresh food, any kind of food that they like. *But in terms of wrapping there are different materials that can be used to wrap the food. Example if you buy the fresh loaf from the bakery, they are using some materials to wrap the food. Are you with me* and learners said *yes. Now there in front of you, you have got A, B, C and D. Therefore let's identify material number A-D. Thereafter we check which material is more suitable for wrapping the food. Are you with me* and learners said *yes. We must also give the reason why do we think that material is suitable and why do we think that material is not suitable for you to wrap the food, are you with me* and learners said *yes. in terms of its softness they are different are you with me* and learners said *yes. If you check some you find that you can wrap different food with almost three materials but those three materials they are different in terms of quality are you with me* and learners said *yes. Identify material number A, what is it which is there in picture number A?* And learners said *clip wrap, the teacher said no. B and learners said plywood. The teacher said no. C and learners said paper and he said no. d and learners said wax wrap. The teacher said* *which one out of the four do you think is more suitable to wrap the food? And you give me the reason.*

24-28 minutes

the teacher said for example there are visitors or you're about to receive visitors from Gauteng is Good Friday they want to visit or they're visiting your area therefore you are preparing food for them which one do you think we can choose to wrap the food and why? The learner said *A cling wrap* and the teacher said *what is the main reason for choosing A why not B?* A learner said *because A is easier to wrap than B (*teacher repeated what the learner said to the class*).the other learner said A because it's clean and no dust will get in (*teacher repeated what the learner said to the class)*.* The other learner said *A, because is more flexible than b (*teacher repeated what the learner said to the class*).* The teacher then wanted learners to say their opinion about B which was plywood. The learners said *B because that you can make a box that we can put food.* Other learner said *yes A the cockroaches can get in but B they cannot get in and B is recyclable and A is not recyclable.* The teacher said *between the paper and wood which one can be recyclable?* The teacher asked for the definition for recycling. The teacher told learners *they have seen old cars that are no longer working at the community and they are people who move around collecting old good and give the owners something in return, like banana but they will take them somewhere where they will get more money than those bananas and those thing they will be used again.*

28-30 minutes

Learner said *recycling is when you are taking old materials and recycling them and using them again.* The teacher said *yes so it means that you are taking the old material you renew them so that you can use to saw the very same thing that was store there again.* The teacher then said *between B and A which one can be more recyclable?* A learner said *A, because plastic can be reused than the wood and wood cannot be reused. plastic can be reused because it can take time to get damage.* The teacher told learners to open page 76 and go through the case study fast (while learners were busy checking the case study) then he told learners to go through it at home since the period was over and they were also told to answer questions on page 77.

Day 2 lesson

0-4 minutes

The teacher greeted the learners and they greeted back (the teacher and learners were standing when greeting each other). The teacher told the learners to organise themselves and sit properly. Learners were told to take out their textbooks and open page 76 and page 77 (this was the page that learners were told to attend to at home in the previous lesson). The teacher told the class that the lesson will be on the impact on the environment. The teacher said *we want to know what they say about the impact of the environment. The first thing that we are going to do is to define the word impact and thereafter environment. We want to see what is it that makes environment as a whole. Are you with me* and learners said *yes*. Those who did not have books were told to share with others. The teacher said *the production and the use of materials has an impact on the environment. If you still remember we have learnt about different materials. We said a matter which is anything that occupies space and has mass. If you still remember we said we used different materials to make different objects of items. Then we taste those materials that are made out of different materials. Now all those materials or objects that are made out of different materials they have got their own uses. We use them to do different things. Are you with me* and learners said *yes.* The teacher said *After using those things sometimes we find that because we are no longer interested on those materials or all those objects that are made out of those materials we turn to put them somewhere. We turn to throw them* *somewhere. Sometimes we can throw them in the lithosphere. Sometimes we can throw them on the lithosphere. Are you with me* and learners said *yes.* The teacher said *so now let us go back for a bit to see what is it that we talked when we throw those materials those objects that are made out of different materials in the lithosphere. What do you understand by the word lithosphere?* A learner replied *thin layer of rock and soil* (the teacher repeated what the learner had said). He said *the other words you are talking about the surface area*. *On the surface area you still remember we have what we called a living and non-living things. The two things they are inter-dependent. Are you with me* and learners said *yes. In other words the living things depend upon the non-living things. What are the living things that are on the surface area?* (Learners raise up their hands).

4-8 minutes

Learner 1 said *animals*. Learner 2 said *grass.* Learner 3 said *trees.* Learner 4 said *peoples*. The teacher said *they are lots we can mention the way we like. But anyway we said those materials when we throw them there in the lithosphere they are going to cause the problem. We are going to identify the problems in which those items made out of those materials, when we throw them on the surface what is it they are going to do on the living things. But before we do that lets go again to hydrosphere. What is hydrosphere?* A learner said *all of the water found on earth.* He said *yes and hydro means...* both teacher and learners said *water*. The teacher said *it means now we are in a place where we got water. And again in water we have living things as well as non-living things. Can we identify a bit of living things in the hydrosphere thereafter we are going to see how they are going to be affected by those objects made out of those materials when you throw then in hydrosphere.* Are you with me and learners said *yes***.** Learner 1 said *fish.* Learner 2 said *sharks.* Learner 3 said *star fish.* Learner 4 said *sea tortoise.* Learner 5 said *whales.* Learner 6 says *sea snakes and* *fish. They are lots in other words we also have plants and animals in the hydrosphere. Are you with me* and learners said *yes. Now when we say an impact on the environment so in other words those objects that we have identified that we said they are made out of those materials. After we have use them we are going to throw them somewhere. Let's assume we take a plastic of cool drink then after we finishing whatever which is inside that container, can be the tin of cool drink then you throw it away. Where is it going? Let say you throw it in the lithosphere where do you think it will go and do in the lithosphere?* A learner *said it will damage the area of the grass*. The teacher *said let just we have got a grass and you turn to throw away the plastic that was having a juice inside after you finish it you decide to throw it away. Whenever you throw it will occupies the space. Matter which is anything that occupies space and has mass. Are you with me* and learners said *yes*. The teacher said *As it occupies that space you find that either there was living or non-living.*

8-12 minutes

The teacher said *let's say it occupies the space where there is living things, for example a grass it turn to be on top grass. what is going to happen on that grass as its space has been occupied, what do you think it will happen if I throw an empty tins or a plastic on top of grass and why?* Paul *said the grass will turn yellow because it will not get enough sunlight.* The teacher *said it will first get dry or it will turn yellow then after it will dry then it dies. Are you with me* and learners said *yes*. The teacher said *apart from that we find that there are animals that are depending upon that area. What kind of animals do you think they are making living out of the space which is now occupied by empty cans or plastics that you throw it there because wherever it can be on the grass we have got living things there. The grass hoppers will die and the mice will moult because the grass will be damaged.* The teacher explains to learners that *the grass hopper and mice or rats depend on each other so if grass hopper dies the rats will be affected because it won’t be having the food. So that empty bottles, cans, plastics, old elongated iron that we throw it disturb the life in a particular area. Are you with me* and learners said *yes.* The teacher said *okay apart from the grass hopper sometimes you find that you have got some caterpillars they are lot as we can mention. Are you with me* and learners said *yes.* The teacher said an*yway lets go to hydrosphere. In hydrosphere we said we have got lives we have got living as well as non-living things. We gut plants and animals and they are depending upon each other. Are you with me* and learners said *yes. Okay somewhere there in Durban, in a beach we were enjoying ourselves during Easter.*

12-16 minutes

We have to go there during the holidays. We eating different things that are wrap by different plastics. We drink from different containers. Thereafter we decided to throw those things inside the water. Or the big ship is coming from Russia to South Africa thereafter people inside eating different things that were wrap either by containers, by plastics and thereafter they decided to throw away those plastics in the ocean. And there is a life of living and non-living things. What do you think it will happen to the lives of hydrosphere? A learner said *the animal in the ocean will die when they eat the plastics.* He said *yes the animal sometimes fish they can decide to eat the plastics. Obviously when they eat the plastic sometimes it can be difficult for them to digest those plastics in their stomach. Are you with me* and learners said *yes.* The teacher *said the animal will die as those plastics are made of different things and there are also chemicals added to make the plastics.*

16-20 minutes

The teacher said *apart from that you find the plastics have different colours. Those* *colours it means there are chemicals there. Are you with me* and learners said *yes. Obviously when they are in the water the colours will be washed away from the plastic. When they drink that water the animal they are going to be affected. Are you with me* and learners said *yes.* The teacher said *What else apart from the plastics?* A learner said *oil.* The teacher said *Yes obviously it can affect the lives of those animals that are there. Are you with me* and learners said *yes.* The teacher said *spilling of oil in the ocean when animal drink water with oil on it they will be affected as a result they will die. What do you think we can do to avoid loss of lives in the lithosphere and hydrosphere? Are you with me* and learners said *yes.* The teacher told the class to ask if they don’t understand what he said. Learners said *do not dump trash*. A learner said to *warn people that they must not throw stuffs in the water or anywhere else.* The teacher said *how do we warn them?* The teacher said *how can you warn people coming from somewhere else.* Learners said *we make floating signs.* The teacher said *what materials do you think we can use to write any information on it as we said we have got some sharks and whales there in the ocean.* Learner said makes *the sign of metals.* The teacher said *how do we put the signs on the oceans? Take something that can float on top of water. It is the same you put something that can floating a certain animal may come across as it float that thing and eat.* Other learner said *where the ship are staying we should put the sign there*. The teacher said *so it means that where there’re harbours people before they live with those ships they must get a lesson. Are you with me* and learners said *yes.* The teacher said *they must have at least a workshop inform them that they must not throw anything inside the ocean. Are you with me* and learners said *yes.* The teacher said *if they are continuing throwing those things in the ocean what is it that we can do? We educate them before they leave with their ship but still there are some certain things thrown there in the ocean.*

20-24 minutes

A learner *said put the police force that will control the ocean.* He said *we can put the force that will be monitoring the ocean all the time. In other words impose the harsh law and send them to prison. Let's go to lithosphere what do we do now? We can take practical example in our school when we go at the back of those zozos there are lots of dirty things there. What do we do to avoid those things? There was live there but there is no longer life because you disturb those animals that were staying there at the back, either the rats or grass hopper, ants, cockroaches or so ever as you throw those thing that side. So now what do we do to avoid those things so that it won't happen again because we are living all the time with them. You move out there you will see other things occupying the space. On the way to your home there are materials occupying the space. In your yard that are materials occupying the space. How can you educate your school colleagues, your community to stay away of disturbing the lives on the environment.*

The teacher told learners somewhere in their area where there are a stream people are throwing things and asked what is thrown.

Learners said *pamper* and he said *they are materials and are occupying the space.*

24-28 minutes

A learner *said I can advise them to buy dustbins and if the dustbins are full they can take them to the dump yard.* The teacher said *do you think the people in the village they can buy a dustbins* and learners said *no.* The teacher said *they can't buy the dustbins what do we do?* Learner said *they can burn those pampers* (the class laughed). Other learner said *we can tell them to use old buckets as their dustbins.*

28-34 minutes

The teacher said *the question is where are you going to take those buckets to? Other learner said to the dump yard and the teacher said with what? (Learners did not know what to say). we are dealing with* *the community in the most rural area so what do we do, that is why they decided to dump those things there (streams around the village).* Another learner *said I will advise them not to use pampers and use the cloth.* The teacher said *the other things you have to engage the leaders, traditional leaders as well as those political leaders to provide you with the car from the municipality to come and pickup those used pampers. Are you with me* and learners said *yes.* The teacher told learners to look at the question in their textbook on page 77. The teacher read the first question as follows; *make a list of five ways in which plastics are useful.* Learner 1 said *we can wrap the food.* Learner 2 said *help making cars.* Learner 3 said *carrying.* Learner 4 said *they help to make airplanes*. He read the second question as follows; *make a list of five ways in which plastics are harmful. Obviously these once we have already identify them.* The teacher allowed learners to add if they have something to say. Learner said *kill animals.* The teacher said *the last question says write a short paragraph summarising the benefits and the impact of plastics at each stage from manufacture to disposal. Who can say something useful about the plastics and the harmfulness of the plastics as it is manufacture until you throw it away?* One learner summarises as the teacher requested. The teacher concluded the lesson by giving learners an activity of writing a paragraph advising the community not to throw pampers in the village stream.

Appendix Q

Data analysis scheme

Theme	**Category**	**Characteristics**
Teacher knowledge	**Content**	concepts
	Context	Curriculum
		Socio economic background
		Resources
	Learners' understanding	Prior knowledge and experiences
		Interests of learners
		Areas of Difficulties
		Misconception
Instructional strategies	**Teaching methods**	Questioning
		Lecture
		Demonstration
		Discussion
	Explanatory Framework	Illustrations
		Models
		Analogy
		Examples
	Activities	Investigation
		Project
		Experiment
		Classwork and homework
Classroom interactions and discourse	**Types of discourse**	Dialogic discourse
		Authoritative discourse
		Reflective discourse
	Patterns of discourse	Initiation-teacher
		Response- learner
		Evaluation-teacher
	Teacher questioning	Drives lesson
		Improve learning
		Develop thinking skills
		Encourage and motivate
	Communicative approach	Interactive-authoritative
		Non-interactive-authoritative
		Interactive-dialogic
		Non-interactive-dialogic

Appendix R

Coded transcript

Appendix O: Charity observation transcripts

Observation of charity: May 2018 at Presented Secondary School in Grade 8 Natural Sciences Classroom

Day one lesson

Description
(0-10 minutes)
The classroom was conducive for teaching and learning. The classroom was clean. Learners were seated on the desks and they were sharing desks. The desks were arranged in rows and column with enough space for teacher and learner to move around. Charity greeted the learners and learners greeted back. All the learners were on their school uniform. The teacher then introduced the visitor (Ms. Netshivhumbe) to the learners. The teacher told the learners to open page 90. The teacher said *particles model of matter* and then he asked the class *what is matter*? (He wrote on the board). Learner replied *model that helps us understand that matter is made from particles and how they affect the behavior of matter.* The teacher did not comment on the learner response but pointed on the other learner and learner said *matter is that occupies space and has mass.* And the teacher said *matter is anything that occupies space and has mass* (he wrote the definition on the board and learners take notes). The teacher said *we have three state of matter* and he wrote on the board. Thereafter he said *mention three state of matter* (learners raise up their hands). Learner said *solid*. Learner said *liquid* and learner said *gas*. The teacher wrote the states of matter on the board. The teacher proceed, *today we are going to deal with the arrangement of particles of solid, liquid and gas* (focus of the lesson). The teacher draw a table of three columns on the board and first column was for solid, second was for liquid and third was for gas. The teacher said *name of water in the solid state* and the learner said *ice* (he wrote on the board). The teacher said *name of liquid state of water* and learner said *water* (he

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misconception

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prior knowledge, experience

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content

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Appendix S

Turn it in report

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ORIGINALITY REPORT

9%	9%	2%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	uir.unisa.ac.za Internet Source	2%
2	repository.up.ac.za Internet Source	2%
3	dspace.nwu.ac.za Internet Source	1%
4	www.education.gov.za Internet Source	1%
5	my.unisa.ac.za Internet Source	1%
6	writepass.co.uk Internet Source	1%
7	Amelia L. Abrie. "The botanical content in the South African curriculum: A barren desert or a thriving forest?", South African Journal of Science, 2016 Publication	<1%
8	Lindelani Mnguni. "Citizenship education and the curriculum ideologies of Natural Sciences	<1%

Appendix T

Editors' letter

Academic consultancy
"Perfection is our DNA"

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July 2018

To whom it may concern

This letter is to confirm that I, Keegan Bruce Schmidt, freelance copy-editor, have edited and proofread the research article entitled ***"classroom practices of some natural sciences teachers of the Vhembe district, Limpopo province"*** by ***Ndivhuwo P. Netshivhumbe*** for grammar and spelling.

I have not changed any of the ideas presented in this proposal, only the grammar and spelling has been altered for the purposes of clarity. This is to confirm that I have edited the document to a level I deem satisfactory.

Should you have any questions feel free to contact us

Keegan Schmidt
Qualifications:

- BIS (University of Pretoria)
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