EXPLORING SENIOR PHASE NATURAL SCIENCE TEACHERS' CLASSROOM PRACTICES: A FOCUS ON PLANET EARTH AND BEYOND STRAND

BY

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I declare that the above dissertation is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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SIGNATURE DATE

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ABSTRACT

This research builds on and contributes to work in Natural Science teacher education and practice. The study places particular attention on the teacher's role in the science classroom through gaining more understanding on their classroom practices. A qualitative approach was employed. Data was collected from three grade 7 Natural Science teachers using observation and interview schedules. Analysis of the data then followed using the Classroom Practice Diagnostic Framework. The findings thereafter included inadequate teachers' teacher knowledge. The teachers' instructional strategies where not varied enough and centred on teacher lecture and the demonstration method. Finally, authoritative discourse was very prominent as well as system accountability. Recommendations were then given ranging from use of teaching methods that encourage an active and critical approach to learning, to improving classroom discourse by avoiding authoritative discourse. The implications of the research include better understanding of how teachers link their science knowledge to how they teach it, and better science application by the teachers and learners in South Africa.

Key words: *Teacher Knowledge, Classroom Practice, Instructional Strategies, Interactions, Discourse, Science Education, Teacher Development, Lecture Method, Demonstration, Accountability*.

TABLE OF CONTENTS

LIST OF TABLES

Pages

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1: BACKGROUND OF THE STUDY

This chapter discusses the legacy left by pre-independence educational policies and its influence on the current state of education. The need to strengthen science teachers' classroom practices through better Pedagogical Content Knowledge is also highlighted. It also states the problem statement which then guides the research aims and questions. The contribution of the study to the body of research is also given. The delimitations in carrying out the study are listed followed, finally in closing, by the chapter outlines.

1.1. INTRODUCTION

Due to the legacy left by pre-independence apartheid educational policies, which favoured the minority races, South Africa finds itself with a lot of 'catching up' to do educationally for the previously disadvantaged groups (Kriek & Grayson 2003).

Science education, unfortunately, is one of the learning areas affected to a larger extent by this situation as shown by Le Grange (2009, p.9) who says "Like the other subjects in the curriculum, Mathematics and Science education suffered under the Apartheid administration, particularly for the recipients of apartheid".

Naidoo and Lewin (1998, p.11) say the following about the teaching in the apartheid era, "South Africa has inherited a fragmented system of science education which fails to provide adequate access to the majority of the population and poorly serves those whom it does educate". Johnson, Hodges and Monk (2010, p.45) agree by stating that "Under Apartheid white, Indian, coloured and black children were provided with different educational systems that were separately organised, administered and funded". Post 1994 it therefore became the government's priority to undo the wrongs that had been done by the previous government. However as to be expected several challenges presented themselves.

The unavailability of suitably qualified teachers to teach science became a hindrance. According to Department of Education figures, in December 2015 there were 4 786 under qualified teachers in Gauteng province with the majority of these in science and mathematics classrooms (ENCA 2015).

These under qualified teachers are those who have only a grade 12 qualification. This would inevitably compromise the quality of science education delivered to the learners. Horak and Fricke (2013, p.6) agree when they say, “Some science teachers are not qualified to teach at that level e.g. the 2003 matric science teacher had matric science as his highest qualification, most science teachers need help first with content then with methodology”. Naidoo and Lewin (1998) further state that the quality of the science teachers’ qualifications is problematic as a result of poorly qualified instructional staff and ineffective instruction. In turn these poorly qualified teachers produce weak and poorly prepared students. Thus, teacher quality and performance may be closely associated with low levels of student achievement.

Suitable qualified science teachers also need to select the appropriate science classroom practices in order for teaching and learning to progress effectively. The selection of actual classroom practice by the teacher is constrained by the resources at hand and the normative behaviour of the school the teacher works in (Johnson 2010). Effective science teaching is not only dependent on resource provision but more likely it is the efficient and effective use of these resources which is important (Naidoo & Lewin 1998). This is further illustrated by Horak and Fricke (2013) who say that some teachers have a poor teaching style, some periods are spent by teachers writing copious notes on the board while learners copy them down, no real teaching is done. This is often due to a lack of textbooks, and sometimes because the teacher does not want to expose his own lack of knowledge in that section of work.

The teaching of science has to a large extent remained at a theoretical level without any experiments to enhance understanding and application of knowledge. This is illustrated by Makgato (2007, p.87) who says “The majority of schools that offer mathematics and physical science do not have facilities and equipment to promote effective teaching and learning”.

The dire shortage of teaching and learning aids or equipment in the South African classroom remains a major challenge to effective teaching and learning of science. According to Naidoo and Lewin (1998, p.4), “In most cases the textbook is the only resource, the textbook drives both teacher instruction and pupil learning (49% to understand science, 36% to provide exercises for the students, 15% to give notes)”. However Johnson et al

(2010) argue that although equality of opportunity is being created, equality of outcomes is still through unequal financial and human resource allocation. They further state that books, equipment, chemicals, glassware, specimens, audio-visual aids etc might be brought into some form of parity relatively rapidly. School ethos, staff qualifications, administrative expertise and parental support are much more difficult to change.

The training of teachers at universities as opposed to the teacher colleges may be viewed as a significant contributor to the problem. The teacher education system prior to 1994 in which colleges were segregated along the lines of race and ethnicity was flawed as it created partial, multiple and separate pathways to teacher education (Sayed 2002). This led to a situation where-by each type of college and university trained teachers for specific schools. This fragmentation of the teacher education system determined whether individuals were trained, how they were trained, and where they were posted.

As undesirable as the colleges where, moving teacher education to the universities has not had the desired effect. Naidoo and Lewin (1998, p.7) say "Approximately 75% of physical science teachers received their education at teacher training colleges for a 3year teacher diploma and approximately 25% trained at universities for a 4year degree or 3year degree with 1year teacher's professional diploma". Furthermore, although there are a substantial number of teachers in the system, it is probable that they entered teacher education programmes with poor matriculation results.

Currently at universities such as University of South Africa (UNISA) teachers in training do not get the desired face-to-face interaction with their lecturers as this is a distance correspondence learning institution, as observed by UNESCO (2012) who define distance education as an educational process in which a significant proportion of the teaching is conducted by someone removed in space and/or time from the learner. This could be a challenge for trainee teachers fresh from high school and not accustomed to the self-discipline that comes with distance learning, leading UNESCO (2012, p.66) to say "Distance learning can be soulless and isolated activity so that dropping out is more attractive than going on".

UNISA produces the majority of teachers who go on to teach in South African schools, therefore meaning that the majority of

these teachers are not adequately equipped with the skills to practice the correct classroom practices in a science classroom (Perraton 2002). This leads Makgato (2007) to say out-dated teaching practices and lack of basic content knowledge have left South Africa with a situation where poor, under-qualified and unqualified teachers teach learners in classrooms that are not only overcrowded but also underequipped. This in turn has produced a new generation of teachers who are further perpetuating the cycle of mediocrity.

The strengthening of science teachers' content knowledge and their classroom practices should therefore be an essential component of any professional development programme. Several approaches to this challenge have been proposed by various authors. Johnson et al (2010, p.56) says "Teachers can be introduced to new teaching technique as well as being supported in their content knowledge, perhaps with school based in-service training ". This will have the desired effect of teachers changing their classroom practice if and when they are provided with feedback on the nature of their behaviour that has already been reinforced through success.

According to Johnson et al (2010) the environment exerts a selection pressure on which of a teacher's pedagogic strategies are successful. Kriek and Grayson (2003, p.42) concur when they say "The actual classroom practice the teacher uses for a particular group of students on a particular day with a particular topic can only be selected from the teacher's stock of Pedagogical Content Knowledge(PCK)".

Teachers can choose to use any strategy they can think of but the success of the chosen strategy does not lie in the act of choosing. Rather, success lies in the fit between the strategy and the environment in which the teacher uses the strategy, 'Fitting strategies survive and unfit ones are not repeated unless the environment changes. The importance of time dedicated in preparation for the lesson is highlighted by Horak and Fricke (2013, p.5) who say "The more time that teachers spent preparing lessons after school, the better the South African learners score in science". Preparing ahead for the lesson would be crucial for the science lessons particularly the practical lessons that require a lot of collection and setting up prior to the commencement of the lesson.

1.2. PROBLEM STATEMENT

The number of learners, according to Doster, Jackson & Smith (1997) who are interested in science or doing well in science shows a steady decline in the grades 6 to 9. The average science class size in Grade 10 is 38, by Grade 12 it drastically drops to 23 (Naidoo & Lewin 1998). This is a worrying trend especially in South Africa as there is a science skills shortage. This trend of lowered performance needs to be studied in order to be reversed. One contributing factor could be that 51% of science teachers in middle grades were not adequately prepared in their content area (Jang & Chen 2010). Consequently their PCK could be inadequate to facilitate meaningful teaching and learning in the natural science classroom. Closely related to the teachers' PCK are the teacher's choices of classroom practice. This is illustrated by Mudau (2013a, p.14) who says, "Difficulty in teaching occurs when teachers through their classroom practices find it difficult to enhance learning among their students". The main purpose of this study will therefore be to examine in depth the nature of Grade 7 natural science teachers' classroom practices in the context of the strand Planet earth and beyond which many teachers, and learners alike, regard as abstract in nature. This is highlighted by Mushaikwa (2014) who says the topic is generally difficult for most to grasp because of the level of abstraction involved in conceptualising it and the fact that most students go to university with deeply seated misconceptions of astronomy.

1.3. AIMS AND OBJECTIVES

1.3.1 Research aims

- Identify the nature of classroom practices of three Natural science teachers when teaching topics in the Planet Earth and beyond strand in the south-west district of Johannesburg.

1.3.2 Research specific objectives

This study has the following specific objectives:

- To explore the nature of teacher subject content knowledge in the natural sciences

- To explore teacher instructional strategies during classroom practice.
- To explore the influence of teacher knowledge and instructional strategies in the shaping of teacher classroom practice.

1.4. RESEARCH QUESTIONS

The following question will guide the study:

1.4.1. What is the nature of teachers' classroom practices in the context of the strand Planet earth and beyond?

The following sub questions will help unpack the research question:

1.4.1.1 What is the nature of the teacher's teacher knowledge?

1.4.2.2 What is the nature of the teacher's instructional strategies?

1.4.3.3 How does the teacher's teacher knowledge and instructional strategies shape the teacher's interactions and discourse and the teacher's accountability?

1.5 RATIONALE OF THE STUDY

The state of science education in South Africa is a cause for concern. This situation can be attributed, in part to many science teachers' limited content knowledge, ineffective teaching approaches and unprofessional attitudes (Kriek & Grayson 2003). It is therefore essential that the mentioned causes of this state of affairs in the South African teaching field be learned more about. In this research, the classroom practices will be given an in-depth look. Le Grange (2009, p.5) says of the above, "Science teaching approaches and science content used in classrooms strongly relates to the learners performance in science". Thus, it is envisaged that this research will give in-service and pre-service teachers an insight into the significance of their choices in their classroom practices and in determining if these will positively or negatively influence their science teaching. The results of the research might further be used as case material in teacher education and as an important source upon which prospective teachers might reflect. It should also add in the micro resources for the fundamental basis of teachers' continuous professional development.

1.6 DELIMITATIONS OF THE STUDY

In carrying out the study, the researcher focused on three Grade 7 teachers of Natural Science. Their schools were located in the south-west of Johannesburg. The environments of the schools was varied, that is, schools in economically empowered suburbia to schools in destitute locations. The observations of lessons occurred during the fourth term as this is when the strand in science Planet Earth and beyond is covered in the Natural Science curriculum.

1.7 CHAPTER OUTLINES

In **Chapter One** an overview of the study is provided. This includes the historical background of education in South Africa. The shortage of suitably qualified teachers to teach science as well as their training institutions is looked at. The problem statement, research questions as well as the rationale for the study are included.

Chapter two provides a literature review for this research which encompasses evidence, views and opinions from prior studies conducted on teachers' classroom practices. The teachers' content knowledge and how it relates to their classroom practice is analysed. The conceptual framework on which this study is based on is also discussed in depth.

In **Chapter three** the researcher presents the research methodology. Here-in, the research design to be followed in the study is identified and discussed. Also included is the population and how it was chosen. The conceptual framework is also detailed in this chapter. Sampling methods and the tools to be used for data collection then follow.

Chapter four presents the analysis of the collected data through simplifying the raw data and then drawing conclusions thereafter.

Chapter five gives a summary of all major findings of factors related to teachers' interaction and discourse as shaped by their content knowledge and instructional strategies. Recommendations, implications for further studies and conclusion are then drawn.

1.8. CONCLUSION

Chapter one presented an overview and general outline of the study. The next chapter is a literature review of related studies previously conducted, predominantly from within South Africa but also international research on similar issues.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

The review of literature is essential as it provides a link between existing knowledge and the research problem being investigated, this leads to the enhancement of the significance of the study (McMillan & Schumacher 2014). Creswell (2014, p.178) adds by stating that literature reviews should, "… build on existing knowledge and add to the accumulation of findings on a topic".

The literature review is an integral part of the research process and makes a valuable contribution to almost every operational step as highlighted by Boote and Beile (2005) who say a literature review goes beyond the research for information and includes the identification and articulation of relationships between the literature and the field of research. It should give a theoretical basis for the research and then the researcher determines the nature of the research.

2.2 BACKGROUND TO SOUTH AFRICAN TEACHER EDUCATION

The state in which South African education finds itself in has been influenced by several factors amongst which are the policies of the apartheid government that existed pre-1994. That government put in place measures that segregated teacher education in the white, black, coloured and Indian communities and inevitably producing inferior educators in the latter three. This is evidenced in the statement that says by the 1960s, teacher education colleges were segregating student teachers along the lines of race and ethnicity, creating partial, multiple and separate pathways to education (Sayed 2002).

The different pathways created led to predetermined destinations for the different populations where-by the white teachers-to-be and learners had a privileged system and facilities. Sayed (2002, p.33) further says of the above "The fragmentation of the teacher education system determined whether individuals were trained, how they were trained, and where they were posted". This in essence meant that training provision was driven by the needs of the system as a whole and

as such, was motivated by the specific political and ideological rationale of the apartheid system. According to Adler and Reed (2012) the fragmentation of teacher education, in governance terms, led to a system which resulted in duplication of teacher training institutions, lack of overall coherence and articulation in the system, and limited quality assurance procedures and mechanisms.

The introduction of the Bantu Education Act in 1953 necessitated a system for training black teachers (Adler & Reed 2012). This training occurred at teacher training colleges were the trainees were offered inferior courses as compared to their white counterparts. Sayed (2002), highlights the above when he says one important effect of the fragmented system was the fact that the bulk of training in black colleges and universities was limited to the humanities and arts subjects. This was a consequence of the underdevelopment of mathematics, science and technology in the secondary school system for the black population (Adler & Reed 2012). Furthermore, under apartheid the black populations' options in higher education were effectively limited to 'teaching and preaching' (Msila 2007).

Teacher education was thus a strategic response to the lack of higher educational opportunities for the black population". Sayed (2002, p.5) agrees when he states that, "Most of the graduates from black teacher training colleges were trained in subjects such as religious studies and history". There was thus a vicious education cycle with too few teachers in mathematics, science and technology, resulting in poor quality education in these subjects in the school system. However, the South African education system has altered radically since 1994, when the new democratic government took over (Jita 2016).

The content-heavy Apartheid-era curriculum was soon replaced with a post-Apartheid outcomes-based curriculum that aimed to address key developmental goals such as values, knowledge and skills acquisition by learners (Magano 2009). The NCS Gd R-12 has generally been accepted as more "user friendly" as compared to the RNCS R-9 and 10-12 which was reported to be difficult to implement. C2005 was regarded as being complex with its implementers not being aware of what exactly to teach (Mushaikwa 2014).

2.2.1 Classroom practice as influenced by missionary education

From the onset, it is important to isolate the assumptions and values which appear to inform missionary education. The premises is that this model (missionary education) was imported by the missionaries who first introduced formal western education in most colonial territories of which South Africa was one of (Tabulawa 1997). Basically the model that informed missionary education was bureaucratic, reflecting the mode of manufacturing and commerce that was predominant in the nineteenth-century Britain. Tabulawa (1997, p.20) further states, "Because the education was for subordination and domination, it was authoritarian in practice".(Ottaway 1996) supports by stating that emphasis in schools was on inculcating into pupils attitudes related to hard work, strict discipline, subordination to their betters and Christian humility.

This strict rigidity of the school programme has remained a salient aspect of schooling as observed through learners' punctuality, quiet orderly work in groups, response to orders, bells and timetables, respect for authority, even tolerance for continuous monotony, boredom, punishment, lack of reward and regular attendance at place of work as being the habits to be learnt at school (Shipman 1967). To effectively carryout this function, schools had to be organised along bureaucratic-authoritarian lines. This model of schooling has ever since remained prototypical for schooling programmes in Africa, attempts to reform it have come to no avail (Tabulawa 1997)

2.3 MOVE OF TEACHER TRAINING FROM COLLEGES TO UNIVERSITIES

In the early 1990s colleges were still primarily responsible for training primary school teachers and universities on secondary school teachers. This prevented the rational sharing of resources, and prevented collaborative interaction between colleges and universities (Adler, Pournara, Taylor, Thorne & Moletsane 2009).

According to Sethusha (2012, p.16) "By 1994 there were 19 education departments responsible for teacher education, with 32 autonomous universities and technikons, and about 105

colleges of education scattered throughout the apartheid/homelands system". "In 1998 the Minister and the DoE produced the Incorporation of Colleges of Education into Higher Education Sector Report (1998b)" as cited by Sayed (2002, p.41). One of the biggest drivers of this push was, according to Adler and Reed (2012) cost cutting measures as the say, "Teacher education training was more expensive at colleges compared to universities as a result of the lower lecturer : student ratios at colleges". Therefore moving teacher education training to universities where lecturer: student ratios where higher would save the state financially.

The process of incorporating colleges of education into universities resulted in the universities becoming the main providers of both primary and secondary education. Hence, the governance of teacher education systems which resulted in the structural integration of all teacher education colleges into higher education institutes has resulted in a shift of teacher education from a provincial to a national competency (Sayed 2002). In moving teacher education to universities the state has effected a complex balance between decentralisation and centralisation, a consensus which Sethusha (2012) says is likely to rapture and in some cases already has.

By 2001, the new state had restructured the teacher education landscape, the college sector had been incorporated into the higher education system and there remained 23 public institutions offering teacher education (Adler 2009). This repositioning of teachers therefore meant that they were now both curriculum designers and deliverers and knowledge producers under pressure from their institutions to either publish or perish (Parker & Adler 2012).

As was to be expected, the move from colleges to universities would 'spark' a lively debate on the advantages and disadvantages of such a move. In the view of Sayed (2002) colleges made a case for being 'special' kinds of providers that are more intimately connected with the realities of schooling than universities. Thus, this debate has reproduced the traditional theory/practice divide, with universities being type cast as theory-driven. Thereafter formal teacher development and upgrading programmes and institutions mushroomed across South Africa, offering teachers in-service opportunities to upgrade their qualifications, and prepare for delivery of the new curriculum (Parker & Adler 2012).

Msila (2007, p.19) agrees with the above when he says “The quality of training varied enormously, particularly in the case of institutions that had formed opportunistic private-public partnerships”. There are indications that internationally the field of teacher education and training is increasingly moving out of the university and under the control of the state, into the sites of practice where professional and practical knowledge discourses rather than forms of disciplinary and intellectual knowledge are likely to dominate (Nuangchalerm 2012).

South Africa, on the contrary, is one of the few Anglophone countries on the African continent which in 2005 did not have a separate and dedicated system of teacher education colleges (Sayed 2002). The move has effectively sited teacher education firmly within the higher education sphere. This also runs counter to the international trend, which increasingly places teacher education at school level (Diamond 2012). The Malawian approach is essentially a school-based teacher education training system. In Wales and England, a significant proportion of the time trainees spend in a teacher education programme occurs at the school level (Sayed 2002). The examples above reflect a move toward making teacher education more school-based and to reducing training time spent at universities and colleges.

2.4 NATURAL SCIENCE IN THE SENIOR PHASE

Science, according to the National Curriculum Statement (NCS) (2011) is a systematic way of looking for explanations and connecting the idea we have. It further states that science also explores the frontiers of the unknown, there are many unanswered questions such as; Why is climate changing around the world? What is making the universe expand? What causes the earth’s magnetic field to change? Many of these questions can be answered through exploring the learning strand Planet Earth and beyond.

As with all knowledge, scientific knowledge changes over time as scientists acquire new information and people change their ways of viewing the world (Kurup & Webb 2014). Careful selection therefore, of content and use of a variety of approaches to teaching and learning science should promote understanding of science as a discipline that sustains enjoyment and curiosity about the world and natural phenomenon (NCS 2011).

Natural Science at Senior level lays the basis of further studies in more specific science disciplines such as Life Sciences, Physical Sciences, Earth Sciences or Agricultural Sciences (Kurup & Webb 2014). When teaching Natural Science, it is therefore important to emphasise the links learners need to make with related topics to help them achieve a thorough understanding of the nature and the connectedness in Natural science.

2.4.1 The curriculum at senior phase.

The curriculum as we know it today has gone through several revisions to arrive at the National Curriculum Statement Grade R-12 (NCS). According to (DBE 2011), since 1994 three revisions of the curriculum have been embarked on in order to simplify the aims and content of what to teach and learn in the schools as well as to ease the implementation process. The Revised National Curriculum Statement (RNCS) Grades R – 9 came about as a result of a review in 2000 and thereafter the National Curriculum Statement Grades 10 – 12 in 2002. Following some implementation problems the 2000 and 2002 curriculums were combined to form the current National Curriculum Statement (NCS) Grade R-12 which was implemented in 2012 (Mushaikwa 2014).

The NCS Grade R-12 led to the a single comprehensive Curriculum and Assessment Policy document (CAPS) specifically developed for each subject one of which is the Natural Science. The NCP CAPS according to Brooksbank and Fontaine (2013), is based on the following principles:

- Social transformation - ensuring that the educational imbalances of the past are addressed.
- Active and critical learning - encouraging an active and critical approach to learning.
- High knowledge and high skills – to set high, achievable standards.
- Progression - content and context progress from simple to complex.
- Human rights, inclusivity, environmental and social justice
- Valuing indigenous knowledge systems – acknowledging the rich history and heritage of this country.

- Credibility, quality and efficiency – providing an education that is comparable in quality, breadth and depth to that of other countries.

2.4.1.1 Implications for Natural Science

In the light of the above points, the NCS Grade R-12 CAPS aims to produce learners who are able to identify and solve problems and make decisions using critical and creative thinking. These learners should also demonstrate in Natural Science an understanding of the world as a set of related systems by recognising that problem solving contexts do not exist in isolation (Brooksbank & Fontaine 2013).

The implementation of NCS Grade R – 12 impacted on Natural Science in that the learning strand Planet Earth and beyond was introduced to learning area (Natural Science). This strand consists of matters to do with astronomy, a topic which used to be under geography at high school. However its introduction has caused several challenges to some teachers who express difficulties due to lack of knowledge of basic astronomy, this then translates into their failure to teach it (Mushaikwa 2014).

2.5. THE LEARNING STRAND PLANET EARTH AND BEYOND IN THE SENIOR PHASE.

The learning strand Planet Earth and beyond is divided into three topics, that is, Relationship of the sun to the earth, Relationship of the moon to the earth and Historical development of astronomy. The table below will give an overview of the learning stand Planet Earth and beyond as well as the topics and their content.

Table 2.1 Overview of Planet Earth and beyond.

Topic	Content
Relationship of the sun to the earth.	• Solar energy and the Earth's axis. • The earth's seasons. • Solar energy and life on earth. • Stored solar energy
Relationship of the moon to the earth	• The relative positions of moon, Earth and sun. • Gravity • tides
Historical development of astronomy.	• Early indigenous knowledge • Modern developments

The learning strand Planet earth and beyond deals with the relationship between the sun and the earth, placing particular focus on how the seasons come about and how solar energy sustains all life on earth (Smith, Thurlow & Curry 2012). The sun is one of the almost 200 billion stars in the Milky Way galaxy, but it is by far the most important to life on earth. It is the main source of energy on earth and it sustains life on earth (Engelbrecht, Kendrick, Robinson & Turley 2013). In this strand learners are made aware of the relationship of the sun to earth through earth's receipt of energy from the sun in the form of heat and light energy referred to as solar energy. This radiation of solar energy by the sun happens as it sits at the centre of the solar system.

The relationship of the sun to earth with reference to the earth's movement around the sun is also investigated by the learners. In this section learners are shown the earth's tilted axis at 23.5° (Marston 2011). The consequences of the earth's rotation on its tilt such as day and night and the seasons are also looked at. In order for understanding of the above the learners should know the imaginary lines such as the equator which divides the earth into the southern and northern hemispheres (Engelbrecht el al 2013).

The sun is said to be the source of all life and energy on planet earth. Plants make food using solar energy through

photosynthesis, and then change this food into starch that contains energy (Smith 2013). Therefore all plants and animals depend on photosynthesis for the energy they need for the processes of life. A bonus of photosynthesis is that plants give off oxygen during the process of photosynthesis which is vital for respiration (Marston 2011). Energy from the sun can also be stored in dead plant and animal matter as evidenced by fossil fuels which are formed when the dead plants are covered with layers of mud. The coal, oil and gas which are formed store energy which plants absorbed from the sun millions of years ago (Engelbrecht 2013).

The moon's relative positions and their relationship to the earth leads learners to understanding phases of the moon as observed from earth. Engelbrecht (2013, p.18) observes that, "The moon is a satellite that moves through a 28-day cycle to orbit once around Earth and at the same time to spin once on its axis". This means that the same side of the moon is always facing the sun. The moon is always half in the sun and half in the shade. This is responsible for the phases of the moon. The relationship of the moon to the earth is further highlighted in the formation of tides which are a result of the gravity of the moon that pulls on the water in the seas and oceans, this pull of the moon on earth causes formation of two high and two low tides over a day and night (Marston 2011).

Earlier generations of people noted predictable movement patterns of the moon, sun and stars and used these patterns to measure time and develop different calendars with years months and days (Marston 2011). Careful calculation of the time helped farmers with the planting and harvesting of crops and with planning the year's activities (Gardner & Mushin, 2016). Sailors and nomadic people used the patterns of the fixed stars to find their way. Long ago, people told stories about their observations of the moon, the sun and the stars. By telling these stories to their children, they passed on their knowledge to the next generation. An example is a story from Engelbrecht (2013, p.17) told long ago by the San people about the moon:

According to the San legend, the moon is a man and he made the sun angry. Every month, when the moon became round and rich, the sun's knife started to cut away pieces of the moon every day. The moon begged the sun to leave the last piece of the moon for his children. The sun agreed, and it is from this tiny piece that the moon grows to become full again.

Through this method, knowledge was passed on from generation to generation (Smith 2013).

2.5.1 Learners' science and the abstractness of Planet Earth and beyond

By learners' science according to Osborne, Bell and Gilbert (1983) we mean the views of the world and meanings for words that learners tend to acquire before they are formally taught science. Learners' science develops as they attempt to make sense of the world in which they live in, in terms of their experiences, their current knowledge and their use of language (Gardner & Mushin 2016). This observation is essential in the context of the research in question. The study will focus on the learning strand Planet Earth and beyond which is comprised of concepts that are abstract in nature to the learners and hence more challenging to grasp. Particular attention will be paid to the concept 'The relative positions of moon, Earth and sun' as through it learners are able to understand the distances between these three bodies, how their various positions impact on one another and the size of solar system.

Learners, like scientists use similarities and differences to organise facts and phenomena and, in the observation of facts and phenomena search for elements and relationships among elements to build structures of relationships (Kelly 2000). In addition, learners, like scientists gather facts and build models to explain known facts and make predictions. However, there are at least three ways according to Osborne, Bell & Gilbert (1983) in which learners' science differs from scientist's science as summarised below:

- Young learners seem to have difficulty with the kinds of abstract reasoning which scientists are capable of. They tend to view things from a self-centred or human-centred point of view, and they consider only these entities and constructs that follow directly from everyday experience.
- Learners are interested in particular explanations for specific events. Unlike scientists, they are not concerned with the need to have coherent and non-contradictory explanations for a variety of phenomena. With their limited experience and concern for a specific explanation only. Learners can catch on to any one of a number of possible

explanations which are reasonable from their more restricted outlook.

- The everyday language of our society often leads learners to have a view distinctly different to the scientists view. Such views may not change as the child grows older or they may even become with time, increasingly different from scientists' science. In both cases it becomes more difficult to effect a change to the scientists' view as time passes. For example, I have found, Bell (1999) that young learners often have a more scientific meaning for the word 'animal' than older learners. Older learners often restrict their meaning of the word to large four-legged terrestrial creatures. Similarly younger learners tend to have a more scientific meaning for the word 'living' than older learners. Thus 'fire' tends to be non-living to young learners, but many 11-12 year olds consider fire to be living. These older learners have more exposure to the metaphoric view of 'living' both in and outside the classroom.

2.5.2 Possible activities for teaching the strand Planet Earth and beyond.

The classroom climate refers to characteristics such as how students interact amongst one another, how they view the teacher, and feelings of openness, acceptance, trust and respect (McMillan & Schumacher 2014). Once this understanding has been achieved, other dimensions such as the classroom activities can be related to student learning and teacher input. Students then learn through their active participation in the attainment of knowledge by gathering information and processing it by solving problems and articulating what they have discovered (Kurup & Webb 2014). In the teaching and learning of matter related to the strand Planet Earth and beyond certain activities will be appropriate.

Drawing and labelling of diagrams can be embarked on by the learners. Drawing and labelling can be utilised to explain the sequence of processes and events that lead to the storage of solar energy in oil, coal, and gas (Smith 2013). The tilt of the earth as well as the direct and oblique rays of sunlight energy may also be illustrated on a diagram as shown in Figure 2.1 and Figure 2.2

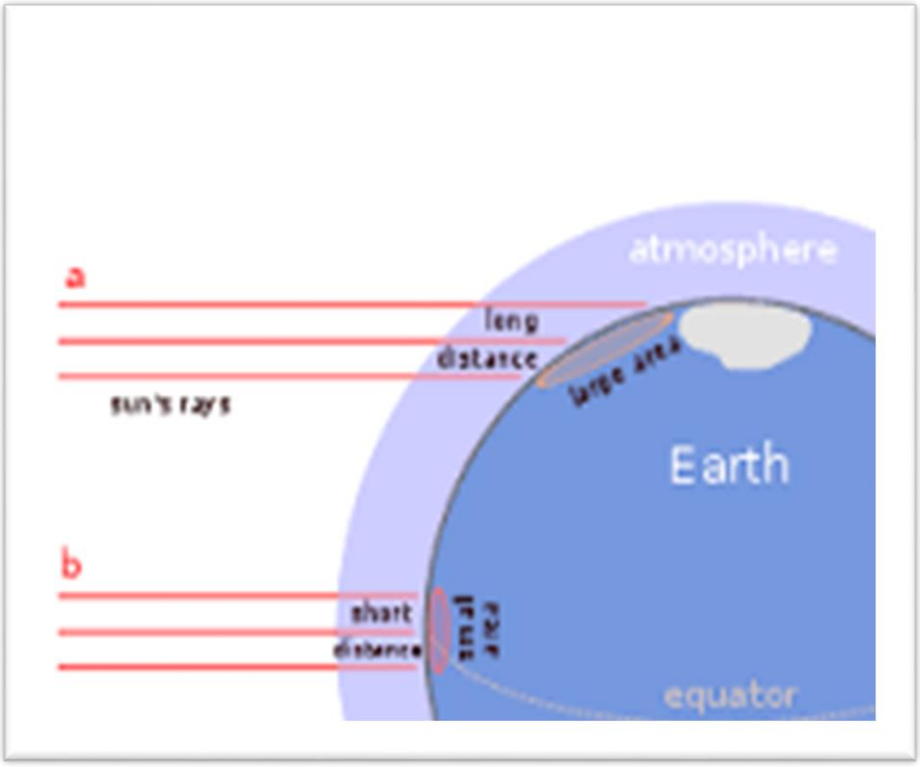


Fig 2.1 Sun's rays on earth

The sun's rays at a travel a longer distance and strike the earth's surface at an oblique angle over a larger surface area, hence the sun's rays have less intensity on the earth's surface. At b the sun's rays travel a shorter distance and cover a smaller surface area leading to higher intensity of the sun's rays on this area.

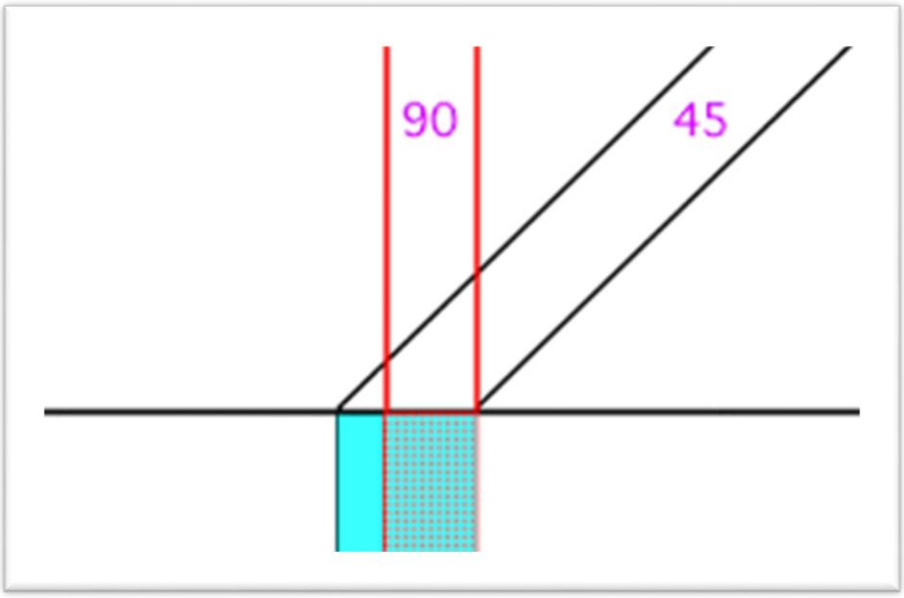


Fig. 2.2 Angle of sun's rays on earth's surface

The sun's rays at a in fig 2.1 are illustrated above coming into contact with the earth's surface at an angle of 45^0 and those at b coming at an angle of 90^0.

Demonstration in a science lesson involves showing by reason or proof, explaining or making clearly by the use of relevant examples or experiments (Marston 2011). In teaching through demonstration, students are set up to potentially conceptualise class materially more effectively (Kriek & Grayston 2003). Marston (2011) further states that demonstration often occurs when students are unable to understand application of theories. Teachers not only demonstrate specific learning concepts within the classroom, they can also participate in demonstrative classrooms to help improve their own teaching strategies.

The effects of demonstrative classroom teaching includes a change of perspective in relating to students, more reflection in teachers' own classroom strategies, and more personal responsibility for student learning (Kriek & Grayson 2003). In the teaching of the learning strand Planet Earth and beyond (Smith 2013, p.46) says in the demonstrating of the passage of the earth around the sun a learner can hold a torch, for the sun, and another learner can carry the globe at its tilt. They further state that demonstration of the pull of gravity can be done by swinging a ball attached to a rope a string in a circular motion.

Practical work means tasks where by students observe or manipulate real objects or materials for themselves (individually or in small groups) or by witnessing teacher demonstrations (Hodson 2003). In demonstrating the passage of Earth around the sun learners could use an apple with a stick pushed through it to represent the earth's axis and a torch representing the sun. In a darkened room one learner one holds the torch while the other carries the globe at its tilted angle around the torch. Learners should observe how the apsides change as earth revolves around the sun. The North and South poles marked on the apple will show when it is summer and winter in the Southern and Northern Hemispheres.

Practical work can:

- Motivate pupils by stimulating interest and enjoyment
- Teach laboratory skills
- Enhance the learning of scientific knowledge

- Give insight into scientific method and develop expertise in using it
- Develop scientific attitudes such as open-mindedness and objectivity

As with all classroom activities, the effective teacher plans practical work with specific learning objectives in mind (Ritchie 2013). Different practical tasks have different learning objectives and may be more or less successful in achieving the intended learning outcomes. Practical activities in the strand Planet Earth and beyond could include the making of a model of the globe using a ball showing the south and the north poles, the equator and the southern and northern hemispheres (Smith 2013). This could be an appropriate practical activity for grade 7s.

2.6 SCIENCE TEACHERS' CONTENT KNOWLEDGE AND THEIR CLASSROOM PRACTICES

2.6.1 Science teacher's content knowledge

The way in which science teachers are trained will have a great influence on how they will fare as science teachers themselves. Through increasing teachers' science content knowledge and thereafter having them apply that knowledge through actual experiences supports substantial teacher learning and positive change in the classroom (Jean Pierre, Oberhauser & Freeman 2005). King, Shumow and Lietz (2001, p.56) agree when they say, "The quality of science instruction depends to a significant extent on the approach taken to teach students". It tends to be difficult if not impossible to teach in ways that one has not learned (Jean Pierre 2010).

Science and mathematics teachers need to experience for themselves the science and mathematics learning they will want their students to do. As with pre-college schooling, instructors in higher education institutions not only teach the content of their courses, they also model teaching practices and strategies for prospective teachers in their classes (Windschitl 2002).

The above is emphasised by Magano (2009, p.44) who says, "The type of methods and resources that the teacher decides on, their relevance and appropriateness, determine the level of acquisition of specified knowledge and skills by the learners". (Park 2005) illustrates the above in Figure 2.3 where-in the

relationship between various sub-domains of teacher knowledge is shown with the four commonalities that constantly appear being highlighted. These commonalities, pedagogical knowledge, subject matter knowledge, subject content knowledge and knowledge of content, form the basis for basis for teaching (Park 2005).

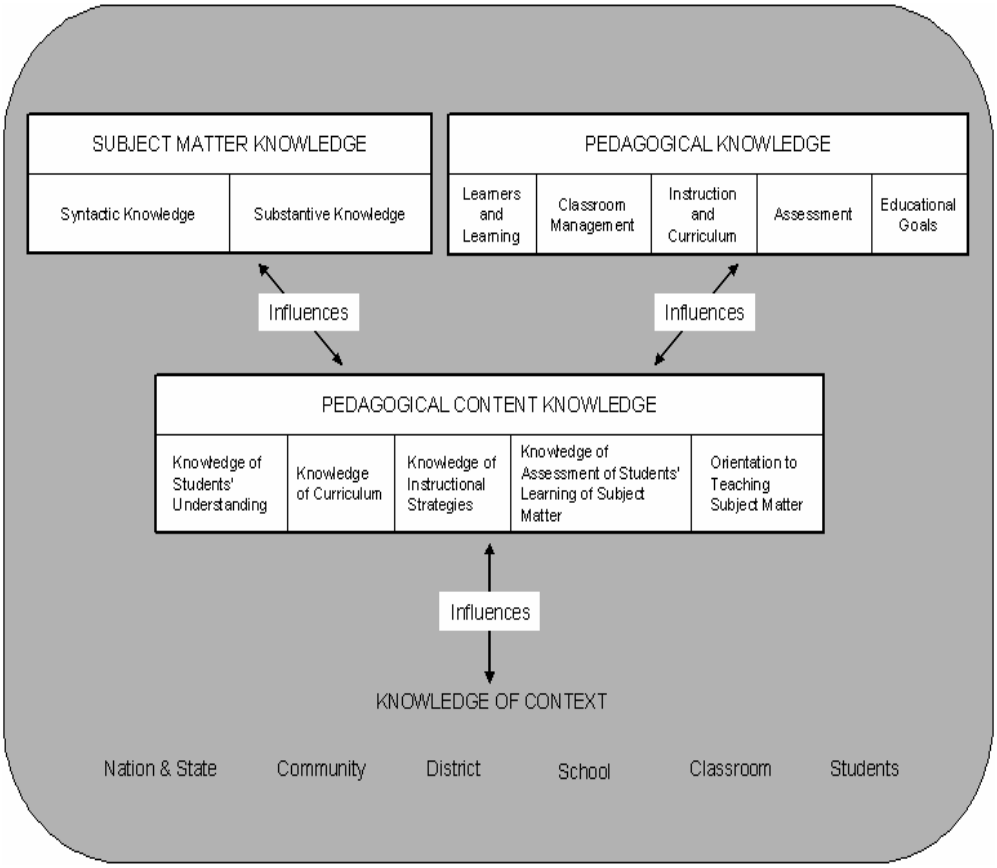


Fig 2.3 Model of teacher knowledge [Modified from Grossman 1990]

The teacher should have adequate knowledge of the context in which he finds himself teaching in. This context knowledge refers to the nation, community, school, classroom and ultimately the students. Contextual knowledge will then lead the teacher to having better pedagogical content knowledge. Good pedagogical content knowledge by the teacher influences his subject matter knowledge as well as pedagogical knowledge. The mentioned process of influences can also occur in the inverse manner.

Since 1994 the new democratic government has emphasised the centrality of mathematics and science as part of human development strategy for South Africa. Performance in this area according to Reddy (2005, p.49), "… is one of the indicators of the health of our educational system". Mathematics, science

and technology have come to dominate expectations regarding what counts as successful school preparation and further study. These learning areas are regarded as essential in any modern society (Bosman 2009). Competence in these gateway subjects at a school level opens up opportunities for empowerment through understanding of common technologies and provides better access to tertiary education and higher skills and livelihoods (Supovitz & Turner 2009).

The above mentioned attention to science can be justified by a research carried out by Third International Mathematics and Science Study of 1998 (TIMSS 1998) which found out that South African Learners performed worst amongst 38 participating countries. The grade 7/8 and grade 12 learners representing South Africa, were considered scientifically illiterate.

Another important finding of the study was that the majority of South African pupils cannot communicate their scientific conclusions, have difficulty articulating their answers and even experience trouble in comprehending several of the questions. In light of the above it is noted that more professional development activities should centre their focus on teachers' understanding of the nature of science and ways to translate these understandings into classroom practice (Lederman, Khalick, Bell & Schwartz 2012). Sethusha (2012, p.74) agrees when she says "In science education research, the word 'change' is often associated with a need to improve practice, content knowledge, and attitudes".

Since science learning standards require that students demonstrate their understanding of scientific inquiry, teachers and students both need to seriously focus on the skills, knowledge and attitudes associated with inquiry-based science instruction (King 2013). Teachers are expected to plan for lesson activities that will ensure that learners in natural science attain inquiry and investigative skills, observational experimentation skills (Magano 2009). Anderson (2008, p.22) agrees when he says "Science inquiry is central to science learning, it is expected to be prominent in science teaching.

The importance of science inquiry, however, does not imply that all teachers should pursue a simple approach to teaching science. King (2013, p.14) further highlights that in light of the

statement ‘Learning about science vs learning to do science’, “Experts in science education currently emphasise movements towards a more inquiry-based approach”. Changes in the education policy have given way to great changes in the expectations of the way in which teachers should teach and the way in which learners should learn in the classroom (Magano 2009).

2.6.2 Science teachers’ classroom practices

Classroom practice, according to (Sethusha 2012) refers to activities that are organised, directed and guided by the teacher. As teachers involve learners in the lesson, a substantial amount of class time is taken up with various forms of practice, which include reading, writing, demonstrations and other similar activities (Columbia 2001). Therefore, by observing how students undertake and practice activities, teachers learn a great deal about learner progress and sources of problems (Jita, 2016).

The dearth of inquiry teaching was the widespread philosophic persuasion in favour of a textbook approach (Anderson 2008). The textbook was viewed as an authority, and furthermore, teachers were persuaded that learning from a textbook was a discipline students needed to master. Some teachers also lack the ability to select age appropriate, useful content and activities appropriate for the phase, consequently they tend to rely on textbooks and to act as ‘tellers of science’.

Professional teacher development grounded in academic content is much more likely to affect instructional practices and student outcome (Jean Pierre 2010). Lederman et al (2012, p.35) agrees when he states that “Activities that are content focussed, but do not increase teachers’ knowledge and skills have a negative association with change in teachers’ practice”. Bosman (2009), agrees when she says many students agree that they lack basic science background knowledge themselves and do not feel confident with the content especially in the fields of Earth and space, Matter and materials and Energy and change. They tend to focus on topics and content from the biological sciences.

The need for knowledgeable and well-trained teachers is crucial, hence successful instructional practices in science classrooms consistent with the standards have been identified

by a number of scholars. The idea of teaching science as a problem solving discipline is a core tenet. Strategies associated with effective science teaching in this vein, as identified by King (2013) include:

- Reducing the emphasis on drill and memorization of information.
- Increasing the emphasis or applying knowledge to the students' environment.
- Using manipulatives to model scientific ideas.
- Fostering scientific reasoning.
- Using the textbook as a resource rather than as the focus of instruction.
- Promoting scientific literacy among all children including girls and minorities.
- Tailoring instruction to students' prior knowledge and emerging understanding.

Even though teachers need to learn how to teach constructively, acquire new assessment competencies, learn new teaching roles, learn how to put students in new roles and foster new forms of student work, the task for preparing teachers for inquiry teaching includes much more (Anderson 2008). Coherence between teacher professional development activities, the school policies, and other professional experiences supports increased teacher learning and improved classroom practice (Jean Pieere 2010). Most importantly, these strategies represent issues in curriculum and instruction over which the individual classroom teacher has a large measure of control, (Lederman et al 2012). In support of the above Supovitz and Turner (2009, p.50) highlight that, "Research found that teachers often reshape or ignore policies that are intended to influence their basic classroom routines". Anderson (2008), agrees when he says the connection between teachers' beliefs and values on one hand and their classroom practices is apparent in research. Research indicates that teachers focus on what works in terms of student involvement or classroom management, rather than on melding theory and practice.

Often, the dislike and fear of science and science teaching can be directly related to teachers' own experiences during primary and secondary school. Negative perceptions of science during their own years at school caused a 'mental block' against the subject field lasting into their tertiary education (Bosman 2009).

In comparison with all other professions, teachers have the longest apprenticeship of learning by being students and simultaneously observing teachers for many years (Windschitl 2002). Teachers are therefore less likely to be guided by instructional theories than by familiar images of what is 'proper and possible' in classroom settings (Lederman 1999).

2.6.3 Teachers' adaption to pedagogical changes

Classroom research has tended to attribute the failure by teachers to adopt pedagogical innovations to technical issues such as poor teacher training programmes leading to poor teacher quality, lack of resources and selective examinations, among many others (Tabulawa 1997). As a response to these problems, massive investments of time and resources have been made in interventionist programmes such as teacher in-service programmes, workshops and seminars, all aimed at changing the teachers' classroom behaviour. But still however, according to Tabulawa (1997, p.6), "Very little alteration in the classroom interactive process has occurred". Kelly (2000), asks of the above, why has so little pedagogical change occurred in spite of so much energy and resources having been committed to combat these technical problems.

The technicist stance (typical of behaviourist input-output model of curriculum development) to pedagogical change tends to ignore the wider social context that influences the locus of pedagogic change (Tabulawa 1997). The neglect of the social context (hence the adoption of the technicist stance) sterms from the faulty notion that pedagogical styles are value-neutral. The technicist stance, however, does not recognise that pedagogical views are socially and historically grounded, and that they have been derived from different epistemological traditions and these have been built on different epistemological assumptions (Kelly 2000).

2.6.4 Factors influencing the teachers' choice of classroom practice

The final act by the teacher to select a classroom practice that they will use in their teaching of natural science is influenced by a variety of factors. The teacher's personal beliefs, attitudes, perceptions, teaching style, content interpretation, PCK on classroom instruction from which interpretative skills and high quality teaching originates will significantly contribute to his

choice of classroom practice (Magano 2009). Khalick (2012, p.205) further states that, “Teachers use classroom instructional methods that correlate with their personal teaching style, experiences and capabilities than with what policy prescribes”.

2.6.5 Teacher’s planning as an influence to classroom practice.

During lesson planning, content must first be analysed and then organised in such a way that learners can make sense of it in a meaningful way (Magano 2009). Planning should start with the objectives, where the teachers first decide on the learning outcomes intended for the lesson, as well as the assessment standards that describe the achievement of the learning outcomes. Ritchie (2013, p.842) adds by stating that, “The teacher can then refer to content when selecting the relevant learning activities, hence without adequate planning or preparation the teacher’s selection of classroom practice can be negatively affected”. The practice of planning is as important as the practice of teaching (Carlgren 2006).

2.6.6 Professional teacher development

Wenglinsky (2002, p.30) asks the following, “What professional development do teachers receive in support of their classroom practices?” Although professional development may not have realised its potential, it is still seen as the best bet for changing teaching practices, because alternative methods, such as policies and programs that regulate teacher behaviour, have fared no better (Supovitz & Tuner 2011). The effects of classroom practices, when added to those of other teacher inherent characteristics, are comparable in size to those of student background therefore suggesting that teachers can contribute as much to student learning as much as the students themselves (Wenglinsky, 2002).

Other researchers have found that other teachers often reshape or ignore policies that are intended to influence their basic classroom routines, as observed by Aikenhead, 1996 p.32) who says, “In virtually every instance in which researchers have examined the factors that amount for student performance, teachers prove to have a greater impact than program”. Wenglinsky (2002, p.37) agrees by saying, “Regardless of the level of preparation students bring into the classroom, decisions that teachers make about classroom practices can either greatly facilitate student learning or serve as an obstacle to it.”

In light of the above, staff development must therefore engage teachers in concrete teaching tasks and be it should be based on teachers' experiences with the learners. Studies have proven that teacher development undertaken in isolation from teachers' on-going classroom duties seldom have much impact on teaching practices or student achievement (Supovitz & Tuner 2011). Professional development must focus on subject-matter knowledge and deepen teachers' content skills. Furthermore, programs that pay attention to subject matter knowledge as well as on student learning of particular subject matter are likely to have larger positive effect on student learning than are programs that focus on teaching behaviours (Wenglinsky 2002).

High quality professional development must immerse participants in inquiry, questioning and experimentation and therefore model inquiry forms of teaching (Aikenhead 1996). Supovitz and Tuner (2011), sum up the importance of professional development to classroom practice by stating that the implicit logic of focussing on professional development as means of improving student achievement is that high quality professional development will produce superior teaching in classrooms, which will in turn, translate into higher levels of student achievement.

2.7 THEORETICAL FRAMEWORK

The theoretical framework plays an important role in guiding the entire process of the research study. Theoretical frameworks play an important role in that they provide a particular perspective, or lens through which to examine a topic (Burr 2015). The theoretical framework is an explanation of a phenomenon or abstract generalisation that systematically explains the relationship among given phenomena, for purposes of explaining, predicting and controlling such phenomena (Steier 2003).

The purpose of the theoretical framework is to clarify concepts and propose relationships among the concepts in a study (Sitsebe 2012). In this study the use of a theoretical framework will be needed to shed more light on how a teachers' content knowledge and instructional strategies shape the teacher's

interactions and discourse in the science classroom during the learning strand Planet Earth and beyond.

2.7.1 Social constructivism

By virtue of its application in nature, a good theory in the social sciences is of value precisely because it fulfils one primary purpose; to explain the meaning, nature and challenges associated with a phenomenon, often experienced but unexplained in the world in which we live, so that we use that knowledge and understanding to act in more informal and effective ways (Steier 2003). Social constructivists according to (Burr 2015), view knowledge as being constructed as opposed to being created. This would be appropriate for the study as the researcher seeks to understand how teacher's content knowledge and their instructional strategies influence their discourse in the natural science classroom.

Social constructivism originated as an attempt to come to terms with the nature of reality, (Mathews 2003). It has its origins in sociology and has been associated with the post-modern era in qualitative research (Park 2005). Social constructivism further proposes that individuals mentally construct the world of experience through cognitive processes (Steier 2003). In addition Berger and Luckmann (1991) are concerned with the nature and contraction of knowledge, how it emerges and how it comes to have the significance for society. They view knowledge as created by the interactions of individuals within society which is central to constructivism.

The division of labour, the emergence of more of more complex forms of knowledge and what they term economic surplus gives rise to expert knowledge. Kirk and Miller (1986), suggest that the search for a final, absolute truth be left to philosophers and theologian. Social constructivism places great emphasis on everyday interactions between people and how they use language to construct their reality.

2.7.1.1 Constructivism and classroom practice

According to Bosman (2009) although teachers do not necessarily follow a deliberate constructivist approach to teaching science in their classrooms, a number of implications, as taken from Bentley, Ebert and Ebert (2007), for teaching practice can be derived from it:

- A constructivist approach recognises the value of a child inherent curiosity
- Science is viewed as a dynamic continual process of increasing a person's understanding of the natural world.
- Knowledge construction occurs within each individual through interaction with other people and the environment.
- The teacher following a constructivist approach largely functions as a facilitator of knowledge construction and takes the following alternative roles: presenter, observer, question asker and problem poser, environment organiser, public relations coordinator, documenter of learning and theory builder.

Bosman (2009, p.8) further states, "In the constructivist approach, knowledge is regarded as an individual construction of reality through interaction with other people and the environment". A typical classroom setting consists of learners from various environments and by implication, different learners from various environments and, by implication, different realities. Hence in this study the researcher has chosen to use schools that have learners from different socio-economic backgrounds. Cultural aspects thus become an important factor in constructing science knowledge.

2.7.2 The conceptual framework

A conceptual framework is an analytic tool with several variations. It is used to make conceptual distinctions and organise ideas. One such tool is the classroom practice diagnostic framework (CPDF) as a diagnostic tool for science classroom analysis used to diagnose teaching difficulties, (Mudau 2013a).

2.7.2.1 The Classroom Practice Diagnostic Framework.

The Classroom Practice Diagnostic Framework (CPDF) will be used as a conceptual framework to answer the research questions of this study. The CPDF will show the specific direction by which the research will have to be undertaken under the umbrella of social constructivism. According to Mudau (2013c, p.637), "The CPDF is designed for the teacher who perceives certain science topics to be difficult to teach". In this instance, the CPDF will be employed on teachers who perceive the learning strand the Planet Earth and beyond to be rather challenging than the other three learning strands.

The tools to be used in this study, the interview schedule and observation guide, will ideally shed more light on the teacher's shortcomings in this learning strand and/or the challenges they encounter when teaching this strand in science. This will be possible because the framework (CPDF) draws, from not only the emphasis of interactions but also taps into the instructional strategies the teacher employs, teacher knowledge and teacher accountability (Mudau 2013c).

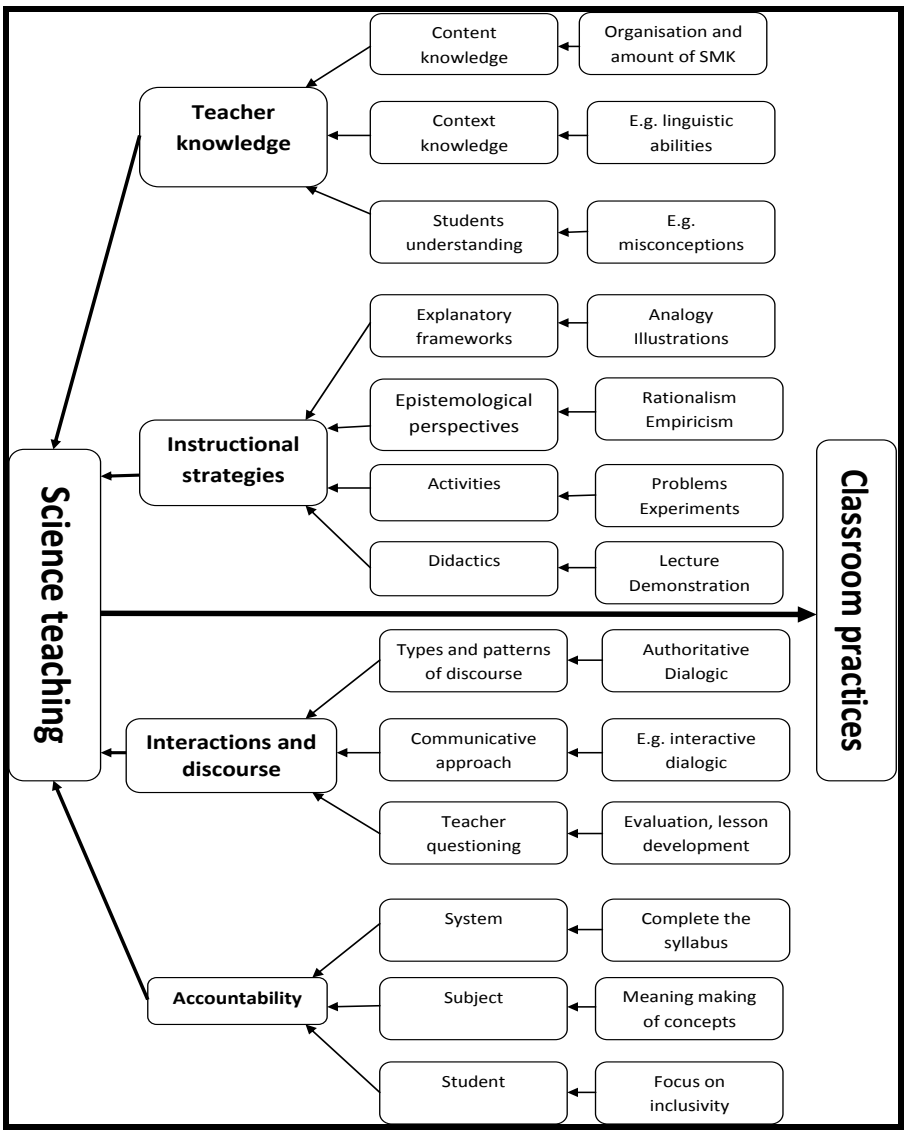
Teacher knowledge in the CPDF is the source of all effective teaching and learning as it influences every action of the teacher as it contains the important knowledge in respect of teaching (Mudau 2013c). This will be applicable in this research as the researcher attempts to discover how the teacher's knowledge as influenced by their training may have a contribution to the classroom practices that one employs in the teaching of the science strand The Earth and beyond in a senior level classroom. Thereafter the teacher is expected to call upon his prior knowledge in order to decide on the instructional strategies to be used in the teaching and learning activity.

The instructional strategies consist of epistemological perspectives, traditional teaching methods, explanatory frameworks and as well as activities (Mudau 2013c). As with all learning, the interaction and discourse that takes place between the teacher and learners has a bearing on the success or lack of, in the lesson. It is for this reason that there will be emphasis on the types of questions that the teacher poses during the lesson in the learning strand The Earth and beyond.

The communicative approach taken by the teacher will also fall under scrutiny as it has a significant bearing on how the lesson progresses. Patterns of discourse represent the initiatives taken by the teacher as well as the feedback he/she provided (Mudau 2013c). Accountability will be centred on system accountability, subject accountability and student accountability. Analysis of accountability is essential as shown by Hamilton, Stecher, Russel and Miles (2015, p.32) who state that, "Accountability mandates are influencing teachers' instructional practices in distinct ways". As shown in the diagram, after all the inputs and outputs of the various factors can the researcher then reach a diagnosis of the lesson at 'D'. The CPDF will therefore be used in this research to diagnose the kinds of instructional strategies, interactions and discourse used by the teacher to create an

enabling environment for inquiry, knowledge reinforcement and problem solving in the lesson.

Figure 2.4 the expanded classroom practice diagnostic framework



The expanded CPDF, figure 2.4 will then be used in analysing the lessons presented by the three teachers. Through the use of the CPDF the research questions of the study will be answered. There is consensus among various findings that teachers who are actively involved in participatory learning activities tend to achieve their set goals before a lesson than those who use the rote method (Mushaikwa 2014). Through the use of the CPDF it is hoped that there will be a definitive outcome on how the classroom practices chosen by an educator have or have not assisted them in attaining their goal. This will give useful feedback to the teacher as the framework

gives emphasis on the teacher with a view of finding ways to help the practicing teacher to be better (Mudau 2013c).

2.8 CONCLUSION

This chapter has reviewed literature as interpreted by the researcher regarding the science teachers' classroom practice as influenced by several factors. The background of South African education contributes significantly to the current state of education and hence was dwelt on. The shift of education training from former teacher training colleges to universities is shown to influence the classroom practices of science teachers together with their content knowledge of the science field.

What follows is a discussion of the methodology employed in this study.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

Research is a process of steps used to collect and analyse information in order to increase our understanding of a specific topic or issue (Creswell 2014). In this approach to research the researcher should pose a question, collect data to answer the question and finally present an answer to the question. Mertler and Charles (2011), meanwhile define research as a careful, systematic, patient investigation, which uses the scientific method, undertaken to discover or verify facts and relationships. This approach presupposes that a concern, with no ready answer, is identified after which it is addressed by following a set out procedure. The earlier definition by Creswell appears to be a better fit for the research that the research seeks to carry out.

The study focused on the classroom practices employed by the teacher in a natural science classroom as influenced by their content knowledge and instructional strategies. As the study is a social constructivist one, the way the teacher interacts with the class will fall under scrutiny. As illustrated in the above, difficulty in teaching can occur when teachers fail to make their classroom practices assist them to achieve the desired end (Mudau 2013b). Particular emphasis was placed on the learning strand The Earth and beyond. This is a learning strand of particular interest as it is very abstract in nature as it has to do with subject matter that is out of our common knowledge.

The learning strand The Planet Earth and beyond deals with content that teachers and learners do not encounter in their day-to-day lives hence making it challenging to easily relate to. The other challenge that this strand poses is that it features at the end of the year in the fourth term. During this term a lot of activities, academic and non-academic, take place hence interrupting school activities.

3.2. RESEARCH DESIGN

The research design is where the researcher reports step-by-step what was done in the study (Mertler & Charles 2011). The purpose of this step-by-step description is to show that research proceeded scientifically and followed established conventions

and for the readers of the research to follow and what the researcher did. This study followed a qualitative method of the exploratory type which was employed in answering the research questions. This according to Creswell (2014) is advantageous in that using qualitative methods should provide a better understanding of the research problem and question.

In this research, the qualitative method was appropriate as the researcher seeked to better understand science teachers' classroom practices as they occur in a natural setting, the science classroom, without external constraints and control through observation and the use of an interview. Qualitative data such as the interview that was utilised in this research, with its open ended questions provided actual words of people in the study and offer more perspectives of on the study topic (Creswell 2014).

3.3 THE RESEARCH SITE

The research was conducted from the south-west of Johannesburg, in Gauteng which encompasses Soweto and Roodeport. The rationale for choosing this area is that the researcher had easy access to these schools as they were within a 10 km radius of his residence as well as his workplace. The schools in the above area have a diverse mix of schools ranging from poorly resourced to well resourced, impoverished informal settlements to suburbia and a mix of races for both teachers and learners. The racial and economic status diversity of the teachers gave a more representative finding.

3.4 THE POPULATION

The target population in this research were science teachers in the senior phase of schools. A population is a group of individuals who share the same characteristics (Creswell 2014). The population for this research was therefore science teachers from schools in the south-west of Johannesburg, Gauteng. They were all science teachers in the senior phase and all have taught the strand in science The Earth and beyond. The teachers involved were qualified teachers with a minimum of a diploma qualification in teaching in general or specialisation in science teaching. The grade being taught by the target population was 7. They all therefore had some common

defining characteristic that the researcher could identify and study (Creswell 2014).

3.5 THE SAMPLE

The researcher had to select a sample from his target population. Researchers selectively choose the persons, situations and events that will most likely yield fruitful data about the evolving research questions (McMillan & Schumacher 2014). In this study grade 7 natural science teachers were chosen as the sample. The events were the teachers conducting a lesson in the strand Planet Earth and beyond.

3.5.1 Nonprobability purposive sampling

Purposive sampling referred to as judgement sampling as well involves the researcher in selecting a sample that he believes will adequately represent a given population. In purposive sampling the researcher selects the sample using his experience and knowledge of the group to be sampled (Gay 1995). The researcher selected the teachers to be used in his study with the assumption that they hold data that can contribute to answering the research question.

The science teachers from the south-west of Johannesburg who were available to demonstrate a lesson in the science strand The Planet Earth and beyond were utilised as the sample in order to observe the scientific processes they follow in the teaching and learning process, classroom practices. The generalizability of the findings was then limited to the characteristics of the participants as this type of sample has no precise way of generalizing from the sample to any type of population (McMillan & Schumacher 2014).

3.5.2 Sampling criteria

In order to come to an understanding of the interactions the science teacher had with his learners, the researcher observed the teacher in his natural environment, in this case, the science classroom followed by an interview. Through the researcher's subjectivity was it then be possible to give a new hypothesis from the data collected (Litchman 2005). Although four teachers were observed and interviewed, the findings from three were utilised. The extra teacher was to be utilised if one of the three teachers' withdrew from the study due to whatever reason.

3.6 THE CASES

The cases used in this research will now be discussed. Pseudonyms will be used for the teachers as well as their schools.

3.6.1Mr Dube from Masendu Primary School.

Masendu Primary School is located in a township area. This section of the township is made up of predominantly isiZulu and Sesotho speakers. The language of learning and teaching is English, at first additional level, and isiZulu and Sesotho offered as home languages. The school had an enrolment of 613 learners and a teaching staff compliment of 15. This equated to an average class size of 41 at the school.

As the school was a primary school ending at grade 7, Mr Dube was the only natural science teacher at the senior phase with two other teachers offering Natural Science and Technology to the learners at intermediate phase. Mr Dube's highest academic qualification was a BEd Intermediate and Senior Phase with a major in Technology education. Mr Dube had been teaching natural science at different grade levels for five years. The length of learning periods at the school was one hour with the teachers moving to the classroom where a class was based.

3.6.2 Mr Nyoni from Plumtree Junior Secondary School.

Plumtree Junior Secondary School is a former Model C school located in a suburb. It was however composed mostly of learners from the townships of Soweto who predominantly come by train and scholar transport for its better infrastructural facilities. The enrolment at the school stood at 501 learners and 19 teachers giving a teacher learner ratio of 1:26. The language of teaching and learning was English while Afrikaans was offered as a first additional language.

Mr Nyoni was one of two Natural Science teachers at the school. Of the two teachers Mr Nyoni volunteered to be part of the study. As the school only offered three grades, Grade 7,8 and 9, teachers such as Mr Nyoni taught most of the grades in one learning area or the other. Mr Nyoni's highest academic qualification was a BEd majoring in science education. Mr Nyoni

has 11 years teaching experience of which only three years were not spent teaching science from the 11years. Apart from teaching science Mr Nyoni wss the deputy principal at the school.

3.6.3 Ms Langa from Juba Primary School

Juba Primary school is located between a township and an informal settlement. There are no permanent structures in the school as its classrooms are containers. The school has been in this state for over 4 years now. The school enrolment stood at 832 at the time of conducting the observations. The language of learning and teaching was English. IsiZulu and Afrikaans are also offered at the school as first additional languages. The classrooms were mostly bare and not much teaching and learning aids for science were visible as the school was still considered to be in a temporary phase awaiting construction. At Juba Primary School teachers moved from one classroom to the next when each one hour period was complete.

Ms Langa's highest academic qualification is a BEd Intermediate and Senior Phase specialising in English education. Her teaching experience is three years and she had spent the equal number of years teaching science. Apart from Natural Science she also taught English to the Grade 6s. Ms Langa holds no other post apart from educator at the school and hence does not have many other responsibilities that may interfere in her teaching of the assigned classes.

3.7 DATA COLLECTION

Data collection in this research occurred from a qualitative perspective of the exploratory paradigm. Data collection involves gathering information about variables in the study. The researcher decides where data would be collected, when it would be collected, by whom and if necessary specifics of the experiment (McMillan & Schumacher 2014). In a qualitative research the researcher usually acts as the observer or interviewer, this is advantageous as the researcher gets information directly from the source. As there are fewer participants in this method, the qualitative approach permits an in-depth exploration of the participants.

3.7.1 Gaining access to the people and the site

In order to carry out the research, the researcher needed to gain permission at a multiple level to enter the site and to involve the people at the location of the study (Creswell 2014). In the case of this study permission had to be granted by the Gauteng Department of Education (GDE) in order for the researcher to visit the schools in the south-west of Johannesburg which fall under the district 12 (D12) of the GDE. The researcher then requested permission from the principal of the schools as well as that of the teachers to be involved in the research. This is an essential step as your ability to gain access to people and sites can help determine if you research the issue (Creswell 2014).

3.7.2 Tools

After gaining access to the site and the people the researcher had to then embark on the core of the research, collecting data.

3.7.2.1 Collection of Qualitative data

Often, researchers observe participants and then conduct follow-up interviews with research participants who provided written feedback that warrants further investigation. Through observation the researcher heard and saw how the participants conducted their natural science lessons with particular emphasis on the classroom practices that they employed. Three participants were observed for the study as they taught the learning strand Planet Earth and beyond. By observing naturally occurring behaviour over many hours or days MacMillan and Schumacher (2014) suggest that the researcher will likely get a rich understanding of the participants being studied.

By observing the natural science teachers as they conducted their lessons in a natural day-to-day environment the observer was able to take in the context under which these lessons are conducted which brought about deeper understanding of the influences on the participants in choosing the classroom practices that they employed. During the observation the researcher used an observation guide to take notes as the lesson progressed.

The observation guide also assisted in keeping the researcher focussed on the key aspects of the study without getting distracted by other aspects of the lesson that were not concerned with the study. The researcher in this study played a nonparticipant role in the observation. Here-in the researcher

did not participate in the class activities. Suggestions were not rendered to the participants on better classroom practices that may suit the natural science lesson as this would ultimately influence the reliability and validity of the study.

The interviews were then conducted on teachers after they had been observed conducting the science lessons. This helped in the elaboration and better understanding of some the actions that were observed in the delivery of the observed lesson. The interview, according to Mertler and Charles (2011, p.45) “Is a conversation between the researcher and participants in the study”. The process involves a one-to-one exchange that permits the interviewer to pose questions and when necessary probe or otherwise follow-up to obtain clearer responses in greater depth such as those that may have arisen from the observation as is the case with this research. In this research the interviews were conducted with the teachers in order to clarify, expand on or explain what was observed in the lesson regarding their classroom practice as the interviews were conducted after the lesson observations had been completed.

The interview questions were semi-structured as this allowed for a fair amount of flexibility on the part of the respondent as compared to the structured interview which does not allow the respondent to be more flexible in their responses. On the opposite end of the structured interview is the open-ended interview which may result in responses from the respondents that stray too far from the subject and do not serve to answer the research questions.

In order to conduct a successful interview, a pilot test with a group of respondents who share similar characteristics with the research participants is necessary so as to see it the questions make sense (Gay 1995). From the feedback in the pilot test, the researcher was able to revise the questions before interviewing the participants. The interview questions were then now focused on clarifying the respondents’ classroom practices as guided by the questionnaire. The researcher then tried by all means to avoid asking leading questions, avoid interrupting the respondent and listened more and talked less. Debating with the participants over their responses was not be done.

During the interview the researcher collected the data through an audio recorder as this provided a verbatim account of the interview session. The participants were set at ease regarding

the recording, which some may be uncomfortable with, by clearly promising confidentiality to all that was recorded. The researcher then transcribed the tape recordings and labelled each teacher recording accordingly using a code name.

3.7.3 Data analysis

By assessing the process of the study (i.e., qualitative), we develop a complex picture of social phenomenon (Creswell 2014). Inductive data analysis was used as the research sought to use the qualitative method to arrive at findings that were conclusive in the classroom practices of teachers. Through organising data into categories as well as identifying patterns and relationships among the categories, the researcher was able to make meaning from the data. The pieces of information collected through qualitative research helped to create a picture as opposed to predetermined hypothesis that may limit what is to be collected and may cause bias (McMillan & Schumacher 2014). Qualitative data was quantified by coding data from interview, codes are assigned numbers and descriptively analysed for frequency occurrence (Creswell 2014)

3.7.4 Ensuring rigour.

Rigour is concerned with the trustworthiness of the research and its findings. Rigor has to do with four aspects of trustworthiness which are relevant to qualitative studies (Krefting 1991). The four aspects being truth value, applicability, consistency and neutrality. In order to establish the truth value in the research, confidence in the findings was gained through member checking.

Without being intrusive to the respondents, checking of their responses through repetition of their responses and oral questions in an informal manner. Applicability of the research was done through the pilot interview which gave an indication of what to expect in final interview. The researcher then proved for consistency by conducting the interview with a different group to see that the responses are consistent with the first group. The freedom from bias in the research procedures and results may then be arrived at through peer examination.

By recording data objectively and comprehensibly, including the use of audiotapes and videotapes rigour was enhanced. During the observation of the lessons, the researcher videotaped the activities in the science classroom with focus on the participants

and the classroom practices they employed. During the interviewing sessions, audio recordings were made of the interactions between the researcher and the participants.

Objectivity of the study refers to the proper distance between the researcher and the participants that minimises bias. The objective researcher is seen as scientifically distant, that is, as someone who is not influenced by, and does not influence the study (Seale & Silverman 1997). By keeping focussed on the objectives of the study, that is, learning more on the classroom practices of the participants and not interfering with the progression of the lessons, the researcher maintained a distance that did not make him interference nor too detached from the setting and participants.

A study's credibility is threatened by errors in which research participants respond with what they think is the preferred social response, that is, data are based on social desirability rather than on personal experience (Seale & Silverman 1997). In order to counter this, the researcher used prolonged engagement with the participants through informal observations before the final observation. The use of numerous interviews and observation period allowed the researcher to identify the occurrence of this problem.

3.8 CONCLUSION

In this chapter the researcher has outlined the research methodology that was utilised in the study. The research design is discussed and so is research site and population. This leads on to the sampling methods that were utilised. The CPDF is discussed as a conceptual framework that is used to guide the research and as well as diagnose the teachers classroom practices. Finally the measures to ensure rigour conclude the chapter.

Analysis of the data will then be discussed in the next chapter.

CHAPTER 4: DATA PRESENTATION, INTERPRETATION AND DISCUSSION.

4.1 INTRODUCTION

In this chapter, the data collected will be analysed in order to reach a better understanding of the classroom practices employed by Natural Science teachers of some schools in the south-west of Johannesburg. Three teachers, who will be named by their pseudonyms, where observed presenting a natural science lesson and thereafter interviewed. They are Mr Dube, Mr Nyoni and Ms Langa. The Classroom Practice Diagnostic Framework (CPDF) is used to analyse the data and to come up with answers to the research questions.

4.2 CASE 1: MR DUBE

4.2.1Teacher knowledge

In this section, Mr Dube's teacher knowledge is presented.

4.2.1.1 Content knowledge

The amount of Subject Matter Knowledge (SMK) and the organisation of SMK in Mr Dube's mind with a focus on the learning strand Planet Earth and beyond was under scrutiny. This is essential as understanding how science teachers learn and continue to learn about teaching is paramount to helping them at each stage of their careers (Scneider & Plasman 2011). During the presentation of the lesson it was evident that the teacher had content knowledge that was adequate for the grade 7 learners. However there were instances in which he did not display this SMK for example in the introductory phase of the lesson where the following is said:

Teacher:
The planets move around the sun, do you still remember those planets.

(Learners list some of the planets and then one responds)

Learner:
Pluto

Teacher:
Are we still using Pluto?

The teacher's response to the learner is a question and he continues on with the lesson. It is apparent that the teacher is

aware that Pluto is no longer included in the list of planets. He however does not go further as to explain to the learner why this is so. This could have been a learning opportunity that could have benefited not only the learner in question but the rest of the class. This deficiency is further noted in the interview in which he professes to some lack of SMK in some concepts of the learning strand Planet Earth and beyond. Below is an extract from the interview:

Researcher:
Do you think your knowledge of science, with the strand Planet Earth and beyond, is adequate?

Mr Dube:
No

Researcher:
Elaborate on your response.

Mr Dube:
I feel I still have to learn more about the diversity of the planet earth especial through doing some researches, attending some seminars or even reading more. At times before I teach it I feel I must read more to prepare myself to I present it to learners.

With adequate SMK the teacher would have explained how Pluto was downgraded from being a planet to a dwarf planet. Without going into detail the teacher could have explained to the learners that planets have to meet three criteria in order to qualify as planets but Pluto fails to meet one of these which states that a planet must have cleared the neighbourhood of its orbit in space (Collet 2015). It is hence a dwarf planet as dwarf planets are celestial bodies that only meet the first two criteria in the new definition of a planet.

The manner in which planet earth's revolution was dealt with could have left some learners unclear of this concept. The teacher somehow rushed through it and omitted crucial information in this process as evidenced in the following short transcript:

Teacher:

Revolution is where-by planet earth moves around the sun. Revolution takes 365 and a quarter days. So revolution takes one year. Revolution results in seasons. Which seasons do we have?

Learners:
Summer, winter, spring, autumn.

Teacher:
So revolution results in four seasons. Somewhere there its winter, somewhere there its summer, (Demonstrating with globe on drawing on board).

In the above extract the teacher left out key information regarding revolution which could adversely affect the effectiveness of his lesson. With better SMK the teacher would have made mention of the elliptical orbit of the earth around the sun. This would have been key in helping learners conceptualise how the seasons come about as influenced by the ellipse shape formed by the orbit of the earth. Mention could then have been made of the difference in distances from the sun on earth's orbit and how this then influences the seasons.

However, there were several parts of the lesson where Mr Dube demonstrated adequate SMK. In explaining and demonstrating the earth's axis he went in depth into the understanding of this concept through using relevant scientific terms. He also approached it from various viewpoints with the intention of helping understanding in learners as shown by the transcript below:

Teacher:

(Holding model of earth) Imagine there is a line a line which goes through the earth, it's an imaginary line. It is not there that you can go and touch it. It is through this imaginary line that the earths tilt is measured from.

There was evidence of Mr Dube's mastery of the content he was teaching through his non reference to any texts or material through-out the lesson. This can only come about if a teacher has taught a learning area over a long period of time and has subsequently internalised the learning area content, the steps to follow when teaching it and how to progress with teaching it. In the case of Mr Dube, he has been teaching Natural Science at this grade for five years which works to his advantage.

4.2.1.2 Context knowledge

Taking into consideration learners' prior knowledge is essential in ensuring that effective teaching and learning occurs (Mushaikwa 2014). Mr Dube had to therefore demonstrate that he did take due consideration of the learners' knowledge of the solar system that the learners brought into the lesson which would in turn be utilised to learn the rotation and revolution of the earth.

In the lesson delivered Mr Dube intends to teach learners on the different movements of the earth, rotation and revolution. But before embarking on the topic for the day he probes learners for their knowledge of the solar system in general. Following is an example of how seeks their prior knowledge:

Teacher:
What comes into your mind when you hear the term Solar system?

Learner:
When we talk of the solar system we talk of our sun and its planets.

Teacher:
Do you still remember those planets?

Learners:
(Chorusing) Yes

Teacher:
Let's list those planets.

Learners:
Learners list the planets.

Teacher:
Of all the planets there is only one which has life, earth, of which we are going to look at today.

The refreshing of learners mind on the planets of the solar system should make the learning of the concept for the day easier as Mr Dube would have gauged the learner's knowledge.

This, it is anticipated, will guide Mr Dube in choosing an appropriate course to take in the lesson.

Mr Dube further made deliberate attempts to know the prior knowledge of the learners in terms of their linguistic abilities. A list of key terms to be used in the learning of planet earth's rotation and revolution was placed on board and class discussed these. Below is an extract of the instance in the lesson when the above occurred:

Teacher:

Before we look at the movements of the planet earth there are some words to do with the movement of the earth around the sun that we will look at. Could someone read the first word and try to explain it

Learner"

The first word is axis
(It was followed by orbit, rotate and revolve)

The learners did manage to explain the words to the satisfaction of the teacher. This was a clear pointer to Mr Dube that the content to be taught in the lesson on the day on rotation and revolution of the earth was not entirely new to the learners.

Consideration of the resources in the classroom as well as the classroom size were not sufficiently observed by Mr Dube. His class size was 39 learners and his classroom was fairly large. This would have called for him to carry out some of his demonstrations centrally in order for all the learners to have a clear view of what is being demonstrated. The demonstrations were carried out from the front of the classroom with learners in the middle of the classroom to the back either craning their necks or partially standing in order to get a better view of what was transpiring in the front. The learners in the front therefore had an unfair advantage over those at the back. Clearly conducting the lesson from one position was not ideal.

Mr Dube did not place a lot of importance on considering the different socio economic backgrounds of the learners in his lesson. He mentioned the viewing of some models of the solar system online that learners might have observed. This would not be true of all learners to have access to the internet from home. Although Mr Dube was conscious of the timetable, he did

not pace his lesson well leading to him rushing through vital aspects at the end of the lesson such as the tilt of the earth's axis.

4.2.1.3 Students understanding

Misconceptions, that Schneider and Plasman (2011 p.539) simply refer to as "Knowledge that students generally are unaware is wrong", could hinder learners' understanding of the rotation and revolution of the earth. These misconceptions were addressed by Mr Dube early on before he proceeded with explaining the concept for the day. The misconception that the sun is the one that moves while the earth is stationery was dealt with by Mr Dube. Following is how Mr Dube went about dispelling these misconceptions:

Teacher:
Which objects in our solar system are stationery and which these are constantly in motion?

Learner:
The earth and some planets

Teacher:
Do they move or are they still? And what do you mean some planets? Be specific.

Learners:
(Inaudible murmuring)

Teacher:
Can anyone help her?

Learner:
The planets are all moving.

Teacher:
What does not move?

Learner:
The sun.
Teacher:

Good. The sun is stationery and the planets move around it. We will today see how this happens and why we sometimes wrongly think the sun is the one moving.

In doing the above Mr Dube has made a concerted effort to ensure that understanding of the rotation and revolution of planets occurs without being hindered by the misconception that the sun moves around the earth. However as the lesson developed, learner's understanding was limited to stating whether they understood or did not understand what he had just said to them. Learners were not given the opportunity to play a more central role in the lesson as would have been ideal.

The prior knowledge that the learners brought into the lesson that was going to help learners in understanding the concept of earth's rotation and revolution was canvased for by the teacher at the onset of the lesson. The teacher posed questions that called upon the learners to activate their prior knowledge of the relationship of the earth and the sun. This was done by Mr Dube in the following manner:

Teacher:
In Grade 6 you learnt about the solar system. Is there anyone who can tell us what they still remember about the solar system?

By doing the above the teacher will learn where the learner's knowledge level is regarding the concept at hand then he may build on this going forward in the lesson. In order to cater for the learners' varied linguistic abilities, Mr Dube selected key words in the lesson that could influence learners' understanding of the relationship of the earth and the sun. The words were axis, orbit, rotate/rotation and revolve/revolution. The class then discussed the meanings of these words in the context of the Planet Earth and beyond.

4.2.2 Instructional strategies

In this section the instructional strategies selected by the Mr Dube in ensuring that the concept of rotation and revolution of the earth are understood by the learners was analysed.

4.2.2.1 Explanatory frameworks

Explanatory frameworks are intended to make learners understand concepts by describing what is to be learnt with the teacher using models or illustrations (Tabulawa 2004). In his presentation Mr Dube appeared to be very comfortable with using illustrations to explain concepts. He made several drawings to illustrate planet earth's rotation and revolution. This method worked very well for him as observed by the researcher as shown by his representative drawings. This was made simply by what he called his passion for art. As Mr Dube explains earth's axis, he uses the chalkboard to draw a representation of the globe and a tilted axis and states the following:

Teacher:

An axis is a line that goes through or passes through an object, like this (drawing on the chalkboard) and remember this is an imaginary line (drawing it with a broken line where it passes through the earth). Is that understood?

Learners:

(Chorusing) Yes sir.

In order to illustrate the movements in the solar system he draws the sun first and emphasises that it is stationery. He then draws the earth with trailing lines to show that it is in motion. The trailing lines are circular representing rotation of the earth and the linear ones representing the revolution of the earth.

The utilisation of models also occurred in the lesson presented. However, there is doubt over the pre-planning of the use of the models used for the demonstrations. This is because in demonstrating the tilt of the earth's axis Mr Dube uses a fairly small model of the earth in the form of a globe. He then seems to improvise on the spot by taking a whole broom from the corner of the classroom. The broom, complete with the bristles, was not an ideal object to use as it was not representative and could have drawn learner's attention from the concept being learnt. The scenario that unfolded can best be explained by Mr Dubes' responses to the following questions:

Researcher:
Do you teach them learning strands differently?

Mr Dube:

Yes I teach them differently.

Researcher
How so?
Mr Dube:
Planet Earth and beyond mostly I teach it through apparatus and improvised models, then Life and living I use the immediate environment as the source of knowledge. Take children out, take them to a garden, to a pool, to a mountain, to a desert or a zoo. They learn direct as they interact with their environment.

Researcher:
What challenges do you encounter in teaching the learning strand Planet Earth and beyond?

Mr Dube :
Normally unavailability of equipment and apparatus and teaching aids.

Researcher:
What teaching and learning aids do you use in your teaching of science?

Mr Dube:
I normally use some improvised models made by myself or made by learners which cannot be direct representative of the actual what, Planet Earth and beyond like the globe, you have to improvise.

Researcher:
How do these teaching and learning aids enhance your teaching?

Mr Dube:
They help me to make learners understand and to make my explanations and even my illustrations simpler.

Although improvised teaching and learning aids are acceptable, this however does not mean these improvised objects can be identified and collected as the lesson progresses. Doing so shows that there was no planning ahead for the lesson as shown by Mr Dube in his use of the broomstick to demonstrate the earth's tilt.

4.2.2.2 Epistemological perspectives.

The inductivist view argues that science knowledge is derived inductively from observation (Tabulawa 2004). From the observed lesson, Mr Dube's epistemological perspective may mainly be centred on the belief that knowledge is mainly gained through observing and engaging in practical work. This was evidenced in the number and frequency of these activities in the lesson. In his teaching of the tilt of the earth he asks the learners to observe what happens as he rotates the apple and later the globe. He then asks learners to orally answer questions on what they have observed. To help the learners understand how day and night are created, Mr Dube uses a demonstration through which learning is to be achieved, further showing his preference for the empiricist approach to learning? In the interview he states the following regarding learners' acquisition of knowledge:

Researcher:
Which teaching and learning methods work best for you in the science classroom/lesson?

Mr Dube:
Mostly I prefer investigations, experiments and projects.

4.2.2.3 Activities

Mr Dube did not lead the class in activities that are varied enough to facilitate effective teaching and learning. The only type of activity that he used was the demonstrations, this in spite of his earlier assertion that states:

Mostly I prefer investigations, experiments and projects.
There was no evidence or mention of ongoing projects related to the concept. Mr Dube did not give any form of self-teaching project or assignment after the lesson. A project in which learners were to go and build simple models that show the relationship of the sun and its planets would have sufficed. A model of the planets or the earth from previous lessons would

have been ideal in helping learners each demonstrate the earth's tilted axis, it rotation as well as its revolution. Experimentation was not afforded to the learners so that they could experience discovery learning. Opportunities for discovery learning did avail themselves on several occasions, however the most glaring of these was on the effects of the earth's rotation in terms of the days and nights on earth.

Teacher:
When the planet earth is spinning on its axis, it takes 24 hrs to spin around its own axis. Rotation is 24 hours long and rotation results in a day and a night. Is it understood?

Learners:
(Chorusing) Yes sir.

Teacher:
So earth spins on its axis for 24 hours.

Apart from the missed opportunities, the last statement could be misleading to the learners as they may think that the earth spins/rotates in cycles, that is, 24 hours then a break or pause for one day and then the next cycle and so on. So there was a need to state that this is a continuous process that is broken down into the 24 hours according to one's position on the planet earth.

It is however observed that Mr Dube would not necessarily have to squeeze all activities such as simulations, experiments, demonstrations and investigations into one single lesson as this is not practically possible or feasible. Hence Mr Dube says of the above:

Researcher:
Is there a particular routine you follow in your teaching of natural science?

Mr Dube:
No, I don't follow any particular routine.

Researcher:
If yes, why do you choose this routine?
If no, why do you choose to constantly change routines?

Mr Dube:
My routines depends mostly on the topic being taught at a time, also the grade level, the understanding of the learners, so I have to vary depending on the topic or concept being taught at a time and how the learners understand.

4.2.2.4 Didactics

Mr Dube's teaching was over-dependent on the traditional teaching method of lecturing. The amount of time spent lecturing was not proportional to the length of the lesson making the lesson very unbalanced in this way. This is not ideal as it has been shown that learners do not learn best through the lecture method as it does not call upon learners' active participation. In the following extract Mr Dube goes at length to explain the representation of the earth through the use of a globe:

Teacher:
Of the planets we have listed only one of them supports life and this is planet earth where we live. Is it understood?

Learners:
(Chorusing) Yes sir.

Teacher:
We normally use a globe, a globe is the model of the earth. So this planet can move in real life. All planets move around the sun, is it understood?

Learners:
(Chorusing) Yes sir

Teacher:
So we are going to look at the movements of this planet around the sun, is it understood?

The above extract shows the over utilisation of the lecture method by Mr Dube. In almost all that he said in the above, learners could have played a leading or more active role in how the lesson progressed. The learners could have been given the opportunity to also state what they knew relating to the different

aspects before the teacher went on to lecture them. This could be demoralising to the learners who knew for example, what a globe is and would have liked to share their knowledge with the rest of the class but the teacher did not afford him that opportunity.

Mr Dube's use of the demonstration method was more relevant and of a fair frequency. He used the demonstration method in showing how the earth spins on its axis. His demonstration of the two simultaneous movements of rotation and revolution initially did not the go as intended as one of the learners he was using to do this was unable to follow his instructions. However, after stepping in and helping the learner to do the two movements simultaneously then was there effective demonstration taking place. Following is how he achieves this:

Teacher:
Lesedi will represent the planet earth and one of the movements is rotation. Turn, turn Lesedi. This represents rotation of the earth. One other movement is revolving. I will call Boitumelo to be our sun. Lesedi will again be the planet earth. So as Lesedi who is representing our planet earth, she must be spinning and at the same time she must be moving around the sun. As he says the above the learner (Lesedi representing the earth) only walks around the sun (Boitumelo). In so doing she is only representing the revolution movement without the rotation. The teacher then holds her by her shoulders and turns her around while also walking her around the sun (Boitumelo) and then adds emphasis by saying:

Teacher:
Lesedi, as you spin you must also keep walking around Boitumelo. Ok, do you all see that, as she is spinning she is also revolving? So this all leads us to what? We have identified the two ways in which the earth moves, that is rotation and revolution.

4.2.3 Interactions and discourse

The way in which Mr Dube and his class conversed during the science lesson will now be focussed on. This is an essential component as it sets the atmosphere in the classroom. From

the interactions and discourse the working relationship of the teacher and the learners can be observed.

4.2.3.1 Types and patterns of discourse

At the introductory phase of the lesson Mr Dube's discourse was admirably thought provoking to the learners. Mr Dube posed probing questions related to the solar system. This was all in an effort to gauge learners' prior knowledge and this indeed did give him an indication of their knowledge on the solar system hence giving a direction in which to follow in the lesson at hand. Some of the probing questions were framed thus:

Teacher:

What do you know about the solar system? What comes into your mind when you hear the term solar system?
Do you still remember those planets around the sun?

How do the planets relate to the sun?

After the introductory phase of the lesson, the tone changed and the teacher took on an authoritative stance. From here-on Mr Dube explained concepts and only asked the question 'Is it understood?' This question did not also sound like a genuine question that learners could respond negatively to, so in all instances in the lesson the learners chorused 'Yes sir'. The question was more a mannerism of the teacher than it was a question to ask learners' understanding. It also seemed to be a way in which the teacher paced himself or urged himself to go on to the next aspect of the lesson. The concepts to be taught took precedence over the learners' own perspective on the concept. As previously illustrated, this is an extract of how in general the lesson proceeded from there-on:

Teacher:
We normally use a globe, a globe is the model of the earth. So this planet can move in real life. All planets move around the sun, is it understood?

Learners:

(Chorusing) Yes sir.

4.2.3.2 Communicative approach

Mr Dube's communicative approach in the lesson was to a large extent interactive-authoritative in nature. Although interaction did occur between the Mr Dube and the class, it was all in one direction. This means that there was no balance in terms of their communication. In this instance Mr Dube asked the questions and the learners answered, not to benefit the learners but as a sign for himself that he may proceed to the next aspect of the lesson. There was no time for example in the lesson whereby the learners asked a question from the teacher in order to get clarity. This is not the norm in science lessons where it is expected that the learners will seek clarity on many aspects just taught in the lesson. It is also not possible that all learners may understand the concept simultaneously. Mr Dube did not leave clear question and answer times. If this time had been stated it is highly probable that questions could have arisen.

The authoritative nature of Mr Dube is observed several times in the lesson whereby he does not give allowance in his lesson for learner-to-learner interaction in the form of group work or pair work. This is characteristic of an authoritative teacher who believes that learning is knowledge transmission from the teacher to the learner and that no effective learning occurs amongst learners themselves. The effectiveness or success of the lesson is, according to Mr Dube, centred on what he has done not what the learners have done or learn. Hence he says:

Researcher:
With reference to your lesson do you think you achieved your objectives looking particularly at the way you delivered the lesson?

Mr Dube:
Ya, the methods which I used, I think I used they tried to help and explain and illustrate especially the movement of the earth and sun from rotation to revolution and the use of the model I think it helped a lot in helping learners try to understand the movement of the earth around the sun.

In the above there is no mention of the learners' input in reaching this conclusion that the lesson was a success.

4.2.3.3 Teacher questioning

Although there was a lot of questioning used by Mr Dube, it is of paramount importance to examine the motivation behind the questions posed by Mr Dube. Initial questioning by Mr Dube was productive in nature as he was seeking to get the prior knowledge that the learners brought into the lesson. This would assist him in having a clear direction I which to take in the lesson.

As the lesson progressed Mr Dube's questions became more of lesson developmental in nature. Questions were posed not to solicit a response to be discussed by the class but more as a connection from one part of the lesson to the next. There were hardly any questions that could have been said to be for the purpose of constructing knowledge or of evaluative purposes. An example is when the lesson is transitioning from the introduction to its development, a question is asked to progress on to the next stage. After listing of the eight planets in the solar system the following transpires:

Learners:
(List the eight planets)

Teacher:
Those are the planets, of which amongst those planets where there is life is earth. Is it understood?
Learners:
(Chorusing) Yes sir.

Teacher:
Right we want to pick one planet where we live, planet earth. Is it understood?

Mr Dube does not afford the learners an opportunity to respond to his questions. He does not pause to give the learners a chance to voice their opinions as per his request.

4.2.4 Accountability

Mr Dube's accountability to his teaching as influenced by the system, subject and students will now be focussed on.

4.2.4.1 System

On a micro scale Mr Dube focused on completion of the syllabus through setting out to attain the lesson objectives and aims. His primary aim was to have learners knowing the two different movements of the earth around the sun. In setting out to achieve his aims for the lesson he missed out on several learning opportunities such as the instance when a learner named Pluto as one the planets in the solar system. Since this did not fall under the scope of the lesson he went on ahead without explaining to the learner or asking other learners on the current status of Pluto as a dwarf planet. Completing the lesson on time, and on a macro scale the syllabus, seemed to take precedence to learners understanding to Mr Dube.

4.2.4.2 Subject

The instructional strategies that Mr Dube employed showed that he made deliberate attempts to help learners come to an understanding of content to be learnt. Mr Dube used the demonstration method more prominently and he seemed comfortable with its use. The steps he followed before, during after the demonstrations showed that he had a good understanding on how learners acquire knowledge.

Before demonstrating the earth rotation on its axis, Mr Dube first put up four words on the board that were vital in the understanding of the concept at hand. The words were: axis, orbit, rotate and revolve. Thereafter he used a model of the earth in the form of a globe to demonstrate the earth's rotation. In order not to have learners fixate on the globe as the only possible model of the globe, he also used an apple with a pencil pierced through its centre to demonstrate the rotation of the earth on its own axis. Emphasis of key learning points such as the angle of axis and the earth's orbit was achieved through a diagram drawn on the board.

4.2.4.3 Student

Mr Dube's class of 39 learners was fairly large there-by hindering intimate contact between all the learners and the teacher. Not much effort towards actively involving all learners in the activities was evident. The various demonstrations in the class were mostly conducted by the Mr Dube, solo, except the

one involving the two learners showing the earth rotate and revolve around the sun. Learners could have been called upon in the other demonstrations too to maximise their participation.

The sheer size of the class meant that there was a wide range of learning abilities in the learners. This would have called upon the teacher to give examples and work that would cater for this range of learners. This was however not evident which would mean the above average, average and below average learners would somehow be disadvantaged by this scenario. As the class was also composed of exclusively black African learners, Mr Dube could have taken the opportunity to probe what their indigenous knowledge systems (IKS) say about the rotation and revolution of the earth. In so doing the their IKS could be in cooperated in the teaching of the concept, used to assist in the teaching of the concept or to rectify any existing misconceptions that may hinder grasping of the concept.

4.2.5 Findings

4.2.5.1 Under-utilisation of content knowledge

Mr Dube demonstrated adequate content knowledge in the delivery of his lesson as evidenced by his working through the content to be delivered without consultation of relevant literature or materials. However it was observed that he did not put to maximum use of this knowledge in the lesson presented. It is through increasing teachers' science content knowledge and then having them apply that knowledge through actual experiences supports substantial teacher learning and positive change in the classroom (Jean Pierre, Oberhauser & Freeman 2005).

Mr Dube seemed to lack in his application of content knowledge in the lesson. Although he had the knowledge to make the lesson a success his choices in application seemed to be somehow constrained. He could have been more specific and more detailed in his demonstration of the earth's tilt. He however left out specific angles of tilt (which he had on diagram drawn on chalkboard) and the effects of the tilt on earth.

His organisation of the SMK left a lot to be desired as well. After having left out the key component of the tilt of the earth in relation to the sun, he brought it up as an after-thought when discussing day and night as caused by earth's rotation. This is

not desirable as the learners may fail to make the connection to the tilt of the earth earlier learnt. Mr Dube may ideally have mentioned the angle of tilt and its effect twice rather than omit it in the first instance. Repeating earlier mentioned facts is advantageous as it works as reinforcement or as emphasis especially when taking into consideration the abstractness nature of the learning strand Planet Earth and beyond. Saville (2011, p.4) supports the above by saying, “Repetition is of vital importance in the learning process”.

4.2.5.2 Teacher teaching the way he was taught.

In conducting his lesson, it was observed that Mr Dube displayed a more traditional approach to his teaching. This traditional approach entailed a lot of lecturing to the learners and very limited contribution by the learners in the direction of the lesson or what was to be learnt. This leads to Cox (1989, p.18) stating that, “One reason that sciences are taught using a more teacher-centred approach could be because teachers teach the way they have been taught”. Teachers use classroom instructional methods that correlate with their personal teaching style (Khalick 2012).

Although Mr Dube had started the lesson in a dialogic discourse stance at the beginning of the lesson, he later became authoritative. A lot of teacher talk was evident in the lesson with minimal input from the lesson. This is despite that student-centred teaching has been thoroughly researched and the benefits well documented, including a more positive attitude towards science, a better understanding of science content and improved reasoning skills (Windschiti 2002)

A new movement toward a student-centred approach (e.g. active learning, inquiry-learning, problem-based learning) has been found to be more effective in all areas tested (Cox 1989). Despite all the new trends in teaching science Mr Dube still chose to stick to the traditional methods of teaching. No active learning in what-so-ever form was evidenced. Encouragement of learners’ inquisitiveness through enquiry learning was not evidenced either, this despite the (NCS 2011) stating that Natural Science should develop discovery through carrying out investigations.

Mr Dube’s long experience in the teaching field could also work to his disadvantage as it is more difficult for teachers such as

him to change their approach to teaching. When a person teaches a lesson, they are more likely to teach using the methods they have experienced in their education than using a different, even superior method (Windschiti 2002). In the lesson, interactions where mostly in one direction: teacher lecturing and occasionally posing a question for the learners to answer. There was no time afforded to the learners to express their thoughts on what was being taught or to ask their own questions which is detrimental to the effective learning of Planet Earth and beyond strand. This leads to Cox (1989) stating that teachers thought the traditional approach was the easiest way to teach.

4.2.5.3 Teacher focus on end result at the expense of learning by learners

Mr Dube had in his mind the primary focus of achieving what he set out to do before the end of the lesson. He set out to do this and in the process disregarded other variables of the lesson that presented themselves. According to (Kanika 2016), a teacher having professional accountability is concerned with students' harmonious development. In his lesson delivery little accountability towards the learners was displayed by Mr Dube. In the instance when a learner listed Pluto as one of the planets in the solar system, he did not take the opportunity to explain why it no longer qualifies as a planet. Hence, a teacher's accountability includes starting any work with appropriate knowledge (Supovitz & Turner 2009).

The rapid pace of the lesson also demonstrated that Mr Dube had his sights on completing the lesson on time having taught all that he had planned. Every attempt was made by the teacher to deliver the lesson timeously, although it helped him meet his targets such as completing the syllabus it disadvantaged the learners as they were not afforded time to interact amongst themselves. The learners were not afforded the opportunity to experiment with the concepts that were being taught. The learners could have benefited immensely if they had worked in groups to show day and night with simple implements to represent the sun and the earth. Through sharing ideas and different view-points on the relationship between the sun and earth can effective learning occur?

4.3 CASE 2 (MR NYONI)

4.3.1 Teacher knowledge.

Mr Nyoni's teacher knowledge will be analysed with content knowledge, context knowledge and students understanding forming subheadings.

4.3.1.1 Content knowledge

Mr Nyoni demonstrated adequate content knowledge of science, and that of The Planet Earth and beyond as a strand in particular. Organisation of Subject Matter Knowledge was showed logical sequencing in the presentation of the lesson. Amount of SMK however left a lot to be desired as it was observed that he dwelt more in depth on content in the first half of the lesson but towards the conclusion he was barely scratching the surface. Processing and articulating what the teacher wanted the teacher wanted to deliver did not occur (Kuruo & Webb 2013). This could have been as a result of rushing to conclude the lesson. In the interview he stated his confidence in content knowledge of science by stating the following:

Researcher:
Do you think your knowledge of science, with the strand Planet Earth and beyond, is adequate?

Mr Nyoni:

It is adequate

Researcher:
Elaborate on your response.

Mr Nyoni:
I can integrate the knowledge that I have and also connect and integrate the policy and the textbook, then then information becomes adequate.

In response to the question in the observation guide, does the teacher demonstrate adequate content knowledge of the learning area to teach it? The researcher responded by stating the following:

The teacher has demonstrated adequate content knowledge in the teaching of the relationship of the earth and the sun through the systematic build-up of the lesson from the known to the unknown.

This further demonstrated Mr Nyoni's good organisation of SMK in strand Planet Earth and beyond.

4.3.1.2 Context knowledge

Contextual knowledge was not taken into much consideration by Mr Nyoni. The lesson was taking place in a library utilised as a classroom. The setting of the classroom hence did not encourage and foster science learning as there were no teaching and learning aids to make learners experience being in a science environment. The use of the library as a classroom should have motivated Mr Nyoni to make deliberate efforts to make the library a conducive environment that encouraged science learning. This however did not happen as there were no teaching and learning aids relevant to science evident in the classroom. Neglect of context consideration leads to poor teaching quality (Kelly 1986).

The size of the classroom also did not promote the carrying out of a variety of activities. Mr Nyoni attempted to demonstrate the planets in the solar system orbiting around the sun. A learner was chosen to represent the sun. Eight other learners were chosen to represent the planets in the solar system. They were then required to simulate the movement of the planets around the sun. The following is what transpired:

Teacher
Right, what I want you to do is to move at once without bumping each other. Just move a bit (beckoning to the learners to try and give room to each other for movement). Just move, move, move without bumping on each other.

Kriek and Grayson (2003, p.106) say the following of demonstration, "In teaching through demonstration, students are set up to potentially conceptualise class materially more effectively". The demonstration carried out by Mr Nyoni did not however carry out its purpose as there was not sufficient space in the classroom to demonstrate the how each planet has its

own orbit as it revolves around the sun. The main point which Mr Nyoni wanted to illustrate in the demonstration was that the planets do cross paths in their movements around the sun. This was however not attainable in the confined space that they had. Mr Nyoni therefore did not take into consideration his context in terms of the classroom size when planning the demonstration that he attempted with the class.

4.3.1.3 Student understanding

At the onset of the lesson Mr Nyoni made what was initially thought by the researcher to be an error. However when this error was repeated soon after by Mr Nyoni the researcher realised that it may not have been an error but a teacher misconception. Mr Nyoni said the following statement to the learners:

Teacher:
Our planet and earth have a relationship. What is the relationship?

Learners:
(Silence from the learners)

Teacher:
The planet and earth have a relationship, what is that relationship?

Learner:
They go together

Teacher:
When you say they go together, what do you mean? How?

Learners:
(Silence from the learners)

This showed a probably deep seated misconception by Mr Nyoni that ‘Our planet’ and the earth are two different entities. The cause of the problem could be the manner in which Mr Nyoni refers to planet earth as our planet. This is not a scientific way of referring to the earth especially for Grade 7 learners. This manner of identifying scientific phenomenon is not acceptable and is referred to as child science. This child

science may cause misconceptions in students and affect their comprehension (Mudau 2012c). The use of this child science term may have led to the Mr Nyoni referring to one object using two different terms. Learners were then confused as to how to respond to Mr Nyoni's question, hence the silence that followed on both occasions. The challenges Mr Nyoni encounters can be identified and understood in his response to the following interview schedule:

Researcher:
What is different in your preferred learning strand to the strand Planet Earth and beyond in terms of your understanding, how you teach it and the content.

Mr Nyoni:
The difference to start with is in the terminology that we use. Science uses scientific terms, so when you are looking at Planet earth and beyond compared Matter and Materials we are talking of simple terms. Planet Earth and beyond you are talking about Mars. Not even the teacher has been to Mars. It's something that you are supposed to read and comprehend and as a teacher you are unable to comprehend and as a teacher you are supposed to give direction to the learners. The teacher might not understand the topic, what more for the learners. The planet Earth and beyond has not been given enough attention in terms of material supply so that teachers are fully equipped to deliver it to learners. In Matter and Materials learners can even go and experiment at home with different surfaces. The strands become easier according to how available the material is. I have more knowledge on Matter and Materials.

It can therefore be ascertained that Mr Nyoni struggles with terms used in the learning strand Planet Earth and beyond. His linguistic abilities in the learning strand are therefore not adequate for a Grade 7 science class as through his admission he needs to read more widely on the strand to improve on his vocabulary in the strand.

4.3.2 Instructional strategies

The choice of Mr Nyoni's explanatory frameworks, activities and didactics will be examined.

4.3.2.1 Explanatory frameworks.

According to Magano (2009, p.23), “The type of methods and resources that the teacher decides on, their relevance and appropriateness, determine the level of acquisition of specified knowledge and skills by the learners”. Mr Nyoni used some representations to enable learning of the relationship of the sun and earth to occur. These were however not regular enough and not representative of what was being learnt as observed from lack of participation by the learners who could not answer oral questions thereafter. In Mr Nyoni’s efforts to help learners understand the orbits of the planets around the sun, he gave an example of how a train moves along its tracks at all times. The following is how he went about illustrating this to the learners:

Teacher:
How many of you have seen a train?

Learners:
(Lifting hands and murmuring)

Teacher:
Where does a train move?

Learner:
In a railway line.

Teacher:
Do trains often bump on one another?

Learners:
(Chorusing) No.

Teacher:
No, because they move in their own railway line. Same applies with our planets. Now we are talking about how planets is positioned. Each planet is positioned to move in its own way? What is the name given to the way where-by each planet travels around the sun?

Learner:
Orbit

The example chosen by Mr Nyoni, in this instance, seemed to help the learners understand the concept of planets orbiting around the sun. Learners are interested in particular explanations for specific events (Osborne, Bell & Gilbert 2007). Further on in the lesson Mr Nyoni explained the tilt of the earth at an axis. This is an important aspect of the relationship of the sun and earth as it has many effects on the earth. Mr Nyoni did not see it necessary to use a chart, model of the earth, diagram or sketch to illustrate the concept of the tilt of the earth at an axis. This could have a negative effect on how well or how quickly they understand other concepts later on related to the tilt of the earth such as the seasons and the differing of temperatures from the north-pole to the south-pole relative to the earth's position in its orbit around the sun.

In the observation schedule, the following was noted about the Mr Nyoni's explanatory frameworks:

Question:
Are there a variety of teaching and learning aids used to help learners understand the content?

Remarks:
The teacher did not utilise many teaching and learning aids. The white board was used for jotting main points and illustrating relationships of earth to the sun. The learners were then used to demonstrate the orbits followed by the planets around the sun.

To further illustrate and explain Mr Nyoni's reluctance to use a variety of teaching and learning aids, he responded as follows to the posed questions:

Researcher:
What do you feel could improve your teaching of natural science particularly in the learning strand Planet Earth and beyond?

Mr Nyoni:
Now when I'm teaching this strand Planet Earth and beyond, one thing that can help teachers is to be workshopped thoroughly on that area and be given materials of Earth and beyond in terms of more depth in order to demonstrate like when you are talking of the solar system, learners only see the

solar system in their text books, but if you have got a model of that, that you can demonstrate the learners will understand it better because it bring it into simplicity. At the same time we need the model of the earth and sun as practical models that you can demonstrate, this is the sun, this is the earth and then this is the relationship that we talk about because earth and beyond is built on two things, the sun and the earth.

The relationship, how does the sun relate to the earth? Remember when we talk about the earth we are talking about the biosphere where there is life, and then now what is it that the sun does to this biosphere where there is life? So human beings have got life and then also have got plants, all these are living things. So it is not for learners to understand from a theoretical part but they need practical things that they can work with, for example we have the skeletal model, the learners will see that this is the skull, so the brain is inside the skull unlike when you are telling them and also at the same time I spoke of workshops. Teachers need to be workshopped with expert teachers in the area so that they understand the nitty gritties of the planet earth because at the end you find out that you also have to talk of the spheres and lines of axis. So teachers have to understand then it makes it easy for learners to also grasp.

In the above statement it can be said that Mr Nyoni is aware of his inadequacies with regard to the use of teaching and learning aids in his lesson. His explanation does not hold merit as he says workshopping of teachers may be required in order to be able to understand and use the various materials needed for the learning strand. Inadequate teaching and learning material as provided by the school would have been better understood as a reason for insufficient materials for the lesson. In the following extracts Mr Nyoni comes up with very valid reasons for the use of teaching and learning aids. He however does not implement all this in the lesson. This leads Wenglinsky (2002, p.37) to say, “Regardless of the level of preparation students bring into the classroom, decisions that the teachers make about classroom practices can either greatly facilitate student learning or serve as an obstacle to it”.

Researcher:
What teaching and learning aids do you use in your teaching of science?

Mr Nyoni:
In my teaching of science the first learning aid that I use is the environment, then I prepare the flashcards. My learning aids they vary depending on the concept that I'm teaching. Planet Earth and beyond, I use the globe. I can use other teachers as a teaching aid. It can be a science teacher to come and give an explanation about a particular topic.

Researcher:
How do these teaching and learning aids enhance your teaching?

Mr Nyoni:
The learning aids enhance my teaching, when we go back to the old system, the learners learn best when they see and they are able to manipulate than what they learn.

4.3.2.2 Epistemological perspectives.

The way in which Mr Nyoni demonstrated how knowledge is gained will now be focussed on. From the activities that Mr Nyoni carried out it would be safely said that he has an empirical view to how knowledge is gained. Yount and Horton (1992, p.103) says of empiricism, "Knowledge is gained from experience". In his lesson Mr Nyoni led learners to new knowledge through letting them observe phenomenon and take active part in its acquisition. When he wanted learners to learn how the planets orbit around the sun he asked learners to take part in a demonstration.

By taking part and observing what unfolded in the lesson, learners would acquire knowledge. Similarly when he wanted to introduce orbits to the learners, Mr Nyoni used a short illustration of how trains move on railway lines. He then linked this to the orbits of planets. Despite the creativity that rationalism promotes, Mr Nyoni did not employ it in his approach to teaching (Yount & Horton 1992). Mr Nyoni sums up his view on knowledge acquisition by stating the following:

Researcher:
How do these teaching and learning aids enhance your teaching?

Mr Nyoni:
The learning aids enhance my teaching, when we go back to the old system, the learners learn best when they see and they are able to manipulate than what they learn.

4.3.2.3 Activities

An integral part to effective teaching and learning are the activities that the teacher utilises in helping to make learners understand what is being taught. The activities in question should be relevant to what is being taught. The activities chosen by Mr Nyoni will now fall under the spotlight. As alluded to in preceding sections, Mr Nyoni did make attempts to use activities such as demonstrations in particular to try and bring about knowledge acquisition by the learners. He was however let down by his lack of preparation for the demonstrations. This lack of preparation was witnessed in the demonstration on planets' orbits around the sun which ran out of space rendering the demonstration ineffective as learners were unable to observe the simultaneous orbiting of planets around the sun.

Problem solving as an activity in teaching the relationship of the earth and the sun was not utilised by Mr Nyoni although opportunities did avail themselves. In the use of train tracks to illustrate the train's orbit, Mr Nyoni could have used this activity in a problem solving form which could have supported the view that knowledge is constructed as opposed to created (Burr 2003). Asking learners to work in pairs or groups to figure out how planets do not collide as they orbit would have added a more challenging and exciting dimension to the lesson. In the interview he again shows his knowledge of the ideal way to teach the concept but does not implement this in the lesson presented. Following is an extract from the interview:

Researcher:

Which teaching and learning methods work best for you in the science lesson?

Mr Nyoni:
The teaching and learning methods will vary depending what topic you are teaching. Some topics that work best in the science is group work where learners on their own they are made to discover things about whatever concept they are dealing with. They give feedback on each other, then the teacher only monitors. Then also the other teaching style can employ is the lecture method whereby you are telling the learners what to do. It is an old system of teaching because it frustrates the learners. The knowledge is from you to them so you don't know or you cannot gauge how they receive it. So when they are in groups they are able to manipulate, they are able to play with concrete objects and they are able also to challenge each other

4.3.2.4 Didatics

Mr Nyoni's teaching style leaned a lot to the lecture method. A lot of 'chalk and talk' was observed in Mr Nyoni's teaching. This is despite what current trends in science recommend as shown by King (2013, p.98) who states that, "Experts in science education currently emphasise movements towards a more inquiry-based approach". Mr Nyoni explained concepts to the learners and as he did so he quickly noted on the board the words that he considered key to their understanding. While attempting to bring about understanding on the relationship between the sun and the earth Mr Nyoni states the following:

Teacher:
Without sunlight, plants wouldn't grow. When the sun provides heat and light, let's look at light, what is it that the plant will use that light for? Now do you see the relationship that the sun and the earth have? Do you see the relationship? Without this there won't be this (gesturing with two hands and the researcher assumes that the hands represent the sun and the earth. It is not known what the learners assumed). So that process is photosynthesis (jotting the word on the board). So plants make their own food. You see the relationship?

4.3.3 Interactions and discourse

The way manner in which Mr Nyoni conversed with the learners, what he said and how he handled verbal interactions in the science lesson will be analysed.

4.3.3.1 Types and patterns of discourse

The common trend in Mr Nyoni's type of discourse was authoritative discourse. In this type of discourse the teacher uses traditional methods like the lecture method and focused only on science concepts without acknowledging alternative conceptions (Mudau 2013c). Mr Nyoni showed a heavy reliance on the lecture method which was rather overused used in the lesson at the expense of other more effective methods such as group work and pair work. In discussing the relationship of the earth and the sun Mr Nyoni says the following:

Teacher:
The planet earth and the sun have the following relationship, there are things that the earth gets from the sun and the other way around.

The above statement could have been turned into a thought provoking question such as, What is the relationship between the earth and the sun and how does this relationship manifest itself?

Through the use of other methods understanding would have come quicker and with less effort. Mr Nyoni did not therefore encourage an active and critical approach to learning as proposed by (Broosbank & Fontaine 2013). It was observed that Mr Nyoni's explanations were very protracted and at some instances led him astray from his aims of the lesson. For long periods of time, than was necessary, Mr Nyoni talked of photosynthesis which did not have a direct relation to what he wanted to teach learners. This was as a result of narrations by the teacher that eventually made him loose focus of his aims for the lesson.

4.3.3.2 Communicative approach

In the communicative approach attention was focussed on how the teacher managed the discourse in the class with an aim to ensuring that learners grasped the concept of how the earth and sun related to one another. Mr Nyoni's communicative approach could be classified as interactive-authoritative, here-in

interaction takes place between the Mr Nyoni and the science class. However, the content and the direction of the interaction is on Mr Nyoni's terms which goes against the ideals of allowing learners input into the direction the lesson takes (Bell 1999). Following is Mr Nyoni's explanation on the earth's axis:

Teacher:
The earth's axis is an imaginary line that goes in the centre of the earth from the north-pole to the south-pole. Now this is what it means. We draw our earth and then we have an imaginary line from the north to the south-pole.

In an ideal communicative approach, at the time when he says 'This is what it means', Mr Nyoni could have involved the learners by probing what this means to them and discussing shortly before telling them the correct answer if they are wrong or emphasizing or adding on to their answer if they were on the right track.

4.3.3.3 Teacher questioning.

The reason Mr Nyoni asked questions during his teaching of the relationship of the sun and earth will now be dealt with. Mr Nyoni's questions were, to a large extent, aimed at developing the lesson and to a lesser extent aimed at constructing knowledge in the learners. He posed questions in order to show that he is rounding up or emphasising a point that has been identified. Following is Mr Nyoni's approach to questioning in the lesson:

Teacher:
The sun gives the earth two forms of energy. Which are these forms of energy?

Learner:
Heat and light

Teacher:
Do you see the relationship? The sun gives us two forms of energy, heat and light. Is it necessary or does the earth need light and heat?

Learners:
(Chorusing) Yes. Why do you think earth needs light and heat?

Learner:
We would die without light and heat.

Mr Nyoni however had a questioning technique that is detrimental to learner's learning. In asking questions he frequently phrased these as statements that he would leave out the key word or desired answer at the end. He would also sometimes say the statement and give the first syllable of the word as a clue. Following are examples of instances where-by Mr Nyoni did the aforementioned:

Teacher:
Plants make their own food through the process of photo…

Learners:
Photosynthesis

Teacher:
The heat from the sun is given out in different dire…

Learners:
ctions

Teacher:
The sun gives out heat in all directions through radia….

Learners
Tion

4.3.4 Accountability

In this section focus will be on what or who Mr Nyoni felt accountable to as judged from the lesson observed.

4.3.4.1 System

It can be said that Mr Nyoni somehow felt accountable to the system as witnessed by how he somehow rushed through some of the parts of the lesson. When he was reaching the end of the lesson he brought forth an important element of this strand, the earth's tilt. He however rushed through this and it was clear to the researcher that the learners could not have acquired lasting

knowledge on the earth's axis from that brief encounter they had with it from the teacher.

4.3.4.2 Subject:

Mr Nyoni appeared to have strategies that he is comfortable with when teaching and he stuck to them no matter what. He used the lecture method and to a limited extent demonstrations. These seemed to be his trusted strategies in making meaning to the learners for the concepts at hand, (Grobe & McCall 2004). This however is inaccurate as a variety of other other strategies are available and the more they are implemented in the lesson the better so as to avoid monotony and hence keep learners interested in the lesson. Mr Nyoni asserted to this in the interview when he stated the following:

Researcher:
Is there a particular routine you follow in your teaching of natural science?

Mr Nyoni:
The routine that we follow is one. You follow the lesson plan. Actually they can be two, you are following the lesson plan from the CAPS document, so now the routine will be the actual method that you use. You start from the introduction, to the lesson development then to the conclusion. But now what will differ is the activities that you engage with the learners in those steps of teaching. So basically there is no specific routine. The learners themselves, the ability of the learners to master the concept drives you in a certain way to teach the lesson and the environment or the setup, whether you have got equipment or you don't have science equipment in the lab. All those are factors that contribute to the routine that one must employ.

Researcher
What's the advantage of changing routines as you have just stated?

Mr Nyoni
When you are changing routines you are doing that to accommodate every learner. When I'm one style type of person, which means that one learner is understanding out of 40 learners, then I have killed the 40 learners in the class. Then they will go home or where ever they are going without

mastering the concept. But to change the routine you are trying to be diverse in order to accommodate every learner, all the abilities of the learners you are trying to in cooperate them.

Taking into consideration learners' different skills acquisition may require changes in approaches by the teacher (Magano 2009).

4.3.4.3 Student:

Accountability to the learners did not feature at all in Mr Nyoni's lesson. He did not make any efforts to accommodate the range and variety of learners in his class. A learner by the name Lerato (pseudonym) featured prominently in the demonstrations, class discussions and in responding to Mr Nyoni's questions. This therefore raises the question of how the other learners were catered for or taken into consideration by Mr Nyoni in both his planning for the lesson and during the presentation of the lesson. In trying to cover his inadequacies in the learning strand Mr Nyoni might be teaching learners without consideration of their different levels of understanding (Grobe & McCall 2004). This is illustrated by his response to the following question:

Researcher:
What challenges do you encounter in teaching the learning strand Planet Earth and beyond?

Mr Nyoni:

The dissemination of known information. How do I break it to the level of the learners? It is an abstract topic. There is a big gap in what is in the textbook and what scientists continually discover. While I'm teaching at A, a learner has identified something at E, so how do I bridge that gap because while we are here the learner has read about discoveries at Mars while the teacher is unaware of those. It's a problem with the teachers, how equipped are we? The strand deals with technology about the internet, about googling but here I'm with technology challenge. The teacher becomes frustrated with the learners who keep asking questions that I have no answer to.

The above may be a challenge to the teacher as she may be experiencing difficulty in teaching the stand Planet Earth and

beyond due to lack of knowledge of basic astronomy (Mushaikwa 2014)

4.3.5 Findings

4.3.5.1 Teacher knowledge and instructional strategies theoretical than practical.

Mr Nyoni demonstrated above average teacher knowledge as well as instructional strategies required to teach the natural science at grade 7. This demonstration was however not during the lesson delivery but during the interview conducted with the researcher. Jean Pierre, Oberhauser and Freeman (2005, p.56) state of the above, “Increasing teachers’ science content knowledge and then having them apply that knowledge through actual experiences supports substantial teacher learning and positive change in the classroom”. Although Mr Nyoni was able to articulate himself well on how the lesson should have been conducted he did not apply that knowledge practically in the lesson. He also answered the knowledge based questions in a manner that demonstrated that he had adequate knowledge in the learning area natural science and the strand Planet Earth and beyond.

In the lesson presented Mr Nyoni however did not put his theoretical knowledge to practice. He presented himself differently in the interview compared to the lesson which may have been caused by inadequate preparation for the lesson in the form of organising and presenting his teaching and learning aids. Mr Nyoni faces challenges in the implementation of what he knows in the lesson.

The cause of Mr Nyoni’s lack of implementation of what he is aware of in the teaching of natural science could be as a result of not knowing how to link his knowledge to the lesson at hand. Another cause could have been inadequate planning which was caused by the use of a classroom that he does not regularly use for his science lessons as the usual classroom had been assigned to an isiZulu language class which was much bigger in number. Without proper planning he would not manage to deliver the lesson in an ideal manner where-by all his views such as that of the use of group work would be utilised in the understanding of the rotation and revolution of the earth around the sun.

4.3.5.2 Over-utilization of the lecture method.

In his teaching of the relationship of the earth to the sun, Mr Nyoni over relied on the lecture method to bring about understanding to the learners. Mr Nyoni seemed to believe that narrating to learners what he knows about the earth and the sun and their relationship, he would somehow be imparting knowledge to the learners.

The lecture method on many occasions made Mr Nyoni lose focus on what he was attempting to achieve in the lesson. This was witnessed in the instances when he spent too much time on discussing the process of photosynthesis which was out of the scope of the lesson. The time spent on concepts not related to the lesson at hand resulted in some key concepts being rushed through as he had run out of time for the lesson.
In order to better understand why Mr Nyoni relied so much on the lecture method a look at his responses in the interview can give more light on this. His responses to questions were protracted, contradictory at times and in several instances he backtracked on something he had said in the previous sentence. Mr Nyoni could safely be said to be an individual who loves to converse. This characteristic of his has however influenced his preferred method of teaching, that being the lecture method which, although is suitable for demonstrating the rotation and revolution of the earth, was over-utilised.

4.3.5.3 Rigid structure of lesson

Mr Nyoni's communication with the class and the activities embarked on pointed to a fairly rigid structure in the lesson. No room was given to deviate in order to allow learners to express their understanding before or after a key aspect. This accommodation of the learners would have allowed for learners to build their understanding in their own way which usually leads to lifelong learning. In another example of this rigidity, when the demonstration on planets' orbit around the sun could not occur as planned because of the lack of space, Mr Nyoni could not adapt the demonstration in any other way to bring about learning and understanding to the learners. Mr Nyoni attempted to force ahead the demonstration although it was

clear that the purpose of the demonstration would no longer be met. Eventually the demonstration was abandoned altogether.

4.3.5.4 Subject accountable teacher

Mr Nyoni paid a lot of attention to how he built new knowledge in learners and the means through which he achieved this. According to Mudau (2013c, p.640), “Accountability to the subject had the focus on the instructional strategies the teacher used in engaging students to make meaning out of the content presented”. In Mr Nyoni’s lesson emphasis was on providing facts to do with the relationship of the the earth and the sun through the lecture method. When not utilising the lecture method Mr Nyoni used the demonstration method which he used often to back up what he had lectured to them. In the learning and teaching of the Planet Earth and beyond strand the demonstration method is suitable in helping learners make meaning of concepts such as the rotation and revolution of the earth but ideally this should be used together with other methods.

4.4 CASE 3 (MS LANGA)

4.4.1 Teacher knowledge

Ms Langa’s teacher knowledge regarding the teaching of the learning strand Planet Earth and beyond in science will be given an in-depth look. Teacher knowledge will comprise content knowledge, context knowledge and student understanding.

4.4.1.1 Content knowledge

Ms Langa demonstrated inadequate content knowledge in her teaching of the of the earth’s rotation and revolution around the sun, this is illustrated by Mushaikwa (2014) who says such difficulty by teachers could be as a result of lack of basic astronomy knowledge. This was evidenced in her organisation of SMK which was not desirable as it did not unfold in a step-by-step manner in accordance with the stage of the lesson. In the observation guide the following was noted by the researcher:

Question:

Does the teacher demonstrate adequate content knowledge of the learning area natural science to teach it?

Researcher:
Although the teacher possesses knowledge on the learning strand Planet Earth and beyond, it does not seem to be sufficient enough for the grade level (Grade 7) to which she delivering her lesson to.

During the interview Ms Langa was asked for her views on science knowledge based questions and she responded by stating the following:

Researcher:
Do you think your knowledge of science, with the strand Planet Earth and beyond, is adequate?

Ms Langa:
Oh yes it is adequate.
Researcher:
Elaborate on your response.

Ms Langa:
However it could be improved through learning approaches, teaching differently, example planet Pluto was downgraded from a planet to being a dwarf planet. You need to keep up with new things happening in science.

Ms Langa's deficient content knowledge was also demonstrated in her presentation of the lesson. Some concepts were not presented in an ideal manner leading to learners not understanding what was to be derived from it. In talking about the causes of the seasons Ms Langa led the learners in a discussion that unfolded in the following manner:

Teacher:
What does the sun do for us on earth? What does it provide us with?

Learner:
The sun provides us with four seasons.

Teacher:

Yes, the sun creates four seasons. What are those seasons?

Learners:
Winter, spring, summer and autumn.

As evidenced above, the learner responded to the teacher's question with a response that was not correct. The sun alone does not cause the seasons that we experience on earth. The seasons we experience are a result of several occurrences in solar system such as the elliptical shape of the earth's orbit around the sun and the tilt of the earth's axis. Scientific knowledge requires teachers constantly acquire new knowledge and change their way of viewing scientific phenomenon (Kurup & Webb 2013). If Ms Langa's content knowledge was at the required grade 7 standard she would have corrected the learner or expanded on his response. In the following extract Ms Langa makes an assertion that is not specific and may lead to confusion in learners later in the lesson or lessons in future in the strand Planet Earth and beyond. When discussing the earth's rotation around the sun she states the following:

Teacher:
In which two ways does the earth move?

Learner
It rotates and revolves

Teacher
Correct. The earth rotates and revolves. The earth only rotates around the sun. Remember only the earth is rotating around the sun. The sun doesn't move.

Ms Langa's statement may be true for the lesson as she is dealing with the relationship of the earth to the sun. However teaching concepts in isolation can be disadvantageous. Some learners could be imagining other planets in this lesson on the earth's and sun's relationships. If the teacher says only the sun is rotating she needs to specify in what context she says that as shown by Brooksbank and Fontaine (2013) who say problem solving contexts do not exist in isolation.

4.4.1.2 Context knowledge

Classroom research has tended to attribute the failure by teachers to adapt to technical issues such as lack of resources

(Tabulawa 1997). However, Ms Langa has demonstrated clear efforts to gain an understanding of the context that the learners and herself find themselves in and to an extent took this into consideration in her delivery of the lesson.

The lesson was conducted in a multi-purpose classroom and not a specialised science laboratory or science dedicated classroom. Learners spend the school day in their classroom and have different teachers come in for different learning areas. This classroom, as was to be expected had minimal science material in it. Ms Langa was able to take this into consideration and bring along all the teaching and learning materials that she would need for her lesson.

The class size was relatively small at 28. Class sizes in the school averaged at 42 learners per class. The class in question was accommodated in a photocopying room that was converted into a classroom. Due to its small size in area, the class was made up of fewer learners. Due to the lack of space, Ms Langa conducted her explanations and demonstrations at a position in the classroom where she was visible to all and did not need to make many movements due to the restricted space. Before conducting one demonstration with the learners, she says the following:

Teacher:
Ok, those in the front please shift your desks backwards so that everyone can see what we are showing here in the front.

4.4.1.3 Students understanding

The prior knowledge that the learners brought into the classroom and that would be used in helping learners have a better grasp of the relationships between the earth and the sun was not explored enough by the teacher. One way of ensuring effective science teaching is tailoring instruction to students' prior knowledge and emerging understanding (King 2013). The introduction phase and early steps in the lesson are usually used as a barometer to gauge learners' prior knowledge that they bring to the lesson. However, Mrs Langa did not align her introductory phase to what would be learnt on the earth in

relation to the sun. Following is an extract of her line of questioning:

Teacher:
What does the sun provide us with on earth?

Learner:
Energy

Teacher:
The sun provides us with energy. We need energy in order for us to live on this earth. What does energy do?

Learner
The energy is the ability to do work

Teacher
Good. What else does the sun provide us on earth?
Learner
Light

Teacher
Yes, we need light on earth because if it was dark and then during the day we need light to live throughout the day.

It is evident from the discourse between the teacher and the learners that build up for the lesson is not occurring. No link to the earth's rotation and revolution around the sun can be made, leading (Kelly 1986) to say very little or no meaningful classroom interactive process has occurred. Ms Langa is also quick to explain her understanding of what she has asked. She does not give learners adequate time to express their view point and therefore losing the opportunity to get to know learners' prior knowledge. At a later stage towards the conclusion of the lesson Mrs Langa makes mention of the learners' misconceptions on the earth's rotation and revolution. She tells learners what their misconception regarding the movement of the earth is. This however, is not accurate as it is an assumption that Ms Langa is making. It is not a misconception that she has identified from the learners during her teaching but one assumed by Ms Langa. She says the following regarding this misconception:

Teacher

Do we understand the movement of the earth around the sun?

Learners
Yes mam

Teacher
Do still remember that the sun doesn't move, what moves?

Learners
(Chorusing) Earth.

Teacher:
The movement of the earth is rotation. So it's so interesting you thought that the sun is moving. Didn't you think the sun is moving because you see that it's moving from this side to this side (pointing in two opposite directions)?
Learners:
(Chorusing) Yes

In the observation schedule, the following was noted by the researcher:

Question:
Are there variety of teaching and learning aids used to help learners understand the content?

Remarks:
Adequate teaching and learning aids for the lesson are utilised such as a globe of the earth and an apple and pencil to demonstrate the tilt of the earth along its axis.

Question:
How often does the teacher check if learners are understanding?

Remarks:
The teacher is periodically checking for learners' understanding especially after explaining or the demonstration of a particular concept.

Question:
How does the teacher check if learners are understanding?

Remarks:

- Learners respond to teachers' questions.
- Learners are requested to demonstrate learnt concepts such the rotation and revolution of the earth.
- Requesting learners to summarise covered aspects of the lesson.

Regarding the above, learners should also demonstrate in natural science their ability to relate their understanding of content (Brooksbank & Fontaine 2013).

4.4.2 Instructional strategies

Ms Nyoni's instructional strategies in the bringing about understanding of the relationship of the earth and the sun will now be focussed on. This is an essential component of the teaching and learning process as shown by King, Shumow and Lietz (2001, p.52) who say, "The quality of science instruction depends to a significant extent on the approach taken to teach students"

4.4.2.1 Explanatory frameworks

Ms Langa's explanatory frameworks were not varied enough to make understanding of the concept of earth's rotation and revolution easy for the learners. Teachers are expected to plan for lesson activities that will ensure that learners in natural science attain inquiry and investigative skills, observational experimentation skills (Magano 2009). However, Ms Langa based most of her explanatory frameworks on referring to diagrams in the textbook. This might be a better option if she is not confident with her drawing skills and if the number of textbooks is adequate for the learners. The number of textbooks allowed for each learner to have their own textbook, which is ideal. However it is felt a variety of frameworks would have sufficed for the lesson. The use of the textbook is illustrated in the following transcript:

Teacher:
The earth travels in orbit, which is the path the earth travels around the sun. If you can look at the picture in your books you will see the earth there (holding up book)

Learners:
Yes mam

Teacher:
You see the picture? There is the sun, and the earth here moves around the sun.
The challenges Ms Langa experiences in her explanatory frameworks may be explained in the following extract from the interview where she alludes to some barriers:

Researcher:
What challenges do you encounter in teaching the learning strand Planet Earth and beyond?

Ms Langa:
The challenges are that you cannot bring the concrete examples in the classroom like bringing the earth so that learners the earth and learners see the sun, that's why it's so difficult, you have to use the globe for demonstration of the earth.

Researcher:
What teaching and learning aids do you use in your teaching of science?

Ms Langa:
In science we using projectors, computers, charts and models

Researcher:
How do these teaching and learning aids enhance your teaching?

Ms Langa:
It helps the learners understand the concept much better than seeing it.

In conclusion, in the observation guide the researcher makes the following observation:

Question:
What reference material, if any, does the teacher refer to during the lesson?

Remarks:
The teacher is regularly referring to the textbooks and instructing learners to look at diagrams and illustrations related to what is being discussed in the lesson.

4.4.2.2 Epistemological perspectives

The manner in which Ms Langa believes learning to occur will be looked at. From the lesson delivered she does not have a clear cut epistemological perspective. However, she seemed to lean more to empiricism than rationalism. Rationalism is hardly evident in the lesson presented. Ms Langa did not allow for learners to make meaning on their own. She constantly lectured to learners. She also asked questions that she answered herself. Empiricism, meanwhile, which states that knowledge is derived from experience (Sitsebe 2012) is somewhat observable in Ms Langa's lesson. This was through her use of demonstrations that she carried out to show how the earth rotates and revolves around the sun. Ms Langa also used the demonstration to show the earth's tilt at an axis. This goes to show that she believes in learning through experiences such as taking part in demonstrations and through observing.

4.4.2.3 Activities

The activities utilised by Ms Langa in conducting the lesson on relationship between the earth and the sun will now be looked at. In order to help learners understand the concept of earth's rotation and revolution as related to the sun, Ms Langa relied mostly on the use of demonstrations and neglected to use any other activity. Ms Langa did this despite the NCS (2011) stating that suggested activities for this the learning strand Planet Earth and beyond in this concept of rotation and revolution of the earth are investigations, practical work and demonstrations. She used learners to represent the sun and the earth and assisted them to demonstrate how the earth's rotation results in day and night. This is how she utilised the learners for her demonstration:

Teacher:

Let us see how the earth and the sun relate to each other. Who is going to be the sun? What's your name?

Learner:
Zama

Teacher
Zama will be the sun then I will be the earth. (Holding up globe of the earth and walking around learner will also rotating the globe)

Demonstration, according to Marston (2011, p.54), "Involves showing by reason or proof, explaining or making clear by use of examples or experiments". In spite of the demonstration being an ideal way to teach the earth's rotation and revolution, Ms Langa did not employ it in a manner that is effective for learning. In carrying out the demonstration, Ms Langa should not have placed herself to be part of the demonstration. She chose a learner to represent the sun and she represented the earth. Using learners and guiding them in the demonstration could have been more effective. During Ms Langa's demonstration, she explained what was happening and why it was happening. She did not use this time to ask for learners' views. Immediately after the demonstration Ms Langa proceeded to explain concepts such as day and night instead of allowing learners to lead the discussion in this regard.

4.4.2.4 Didactics

Ms Langa centred her teaching of the rotation and revolution of the earth mainly on the traditional methods of lecturing and demonstrations. Kriek and Grayson (2003, p.106) say the following about demonstrations, "In teaching through demonstrations, students are set up to potentially conceptualise class material more effectively". However, huge proportion of the lesson was spent by Ms Langa relaying her knowledge on the relationship of the earth to the sun to the learners.

Not sufficient time was given to learners to express their understanding on the concepts covered. Her lecturing was also heavily dependent on the text book. She read from the textbook after which she explained at length what she had read. This was seen by the researcher as a waste of time as she could have at least read and then discussed what was read with class

through questioning. Alternatively she could have briefly lectured and then followed it up with a discussion or question and answer session. Among some strategies associated with effective science teaching is using the textbook as a resource rather than as the focus of instruction (King 2013).

Demonstration was also utilised by Ms Langa although not in a way that could help learners come to understanding of the concept easily. The activities before, during and after the demonstration did not compliment or reinforce what was being taught through the demonstration. As mentioned in previous sections, the demonstration of the earth's rotation and revolution around the sun could have been approached in a better and more effective way than Ms Langa did. In the lesson observation, the following was observed:

Question
Does the teacher employ a variety of teaching and learning methods in the lesson?

Remarks
The teacher is employing, to a large extent, the question and answer method. The lecture method is also evident in the lesson delivery. Demonstration is also being used by the teacher in an attempt to bring understanding to the learners.

4.4.3 Interactions and discourse

In this section on interactions and discourse Ms Langa's preferred means of conversing with the learners will be closely looked at.

4.4.3.1 Types and patterns of discourse

Ms Langa's type of discourse during the course of the lesson was largely authoritative discourse. This was bound to affect the environment created in the classroom, as illustrated by McMillan and Schumacher (2010) who say the way in which teachers and students talk and act toward one another affects the feelings openness, acceptance, trust and respect in the lesson. Ms Langa had an over dependence on the use of the

lecture method to convey knowledge to the learners. This is not ideal for effective teaching. There was no evident holistic teaching of the learner as would have been ideal. Use of other methods would have resulted in good classroom practice by Ms Langa. She was aware of the importance of varying methods in teaching science as she says in the interview:

Researcher
Is there a particular routine you follow in your teaching of natural science?

Ms Langa
No, not exactly.

Reasearcher
If yes, why do you choose this routine?
If no, why do you choose to constantly change routines?

Ms Langa
Because science has different topics and those topics they require different approaches.

However, in the lesson presented Ms Langa did not demonstrate this knowledge on the importance of taking into consideration learners' view points and approaching the lesson on earth relationship with the sun in as many ways as possible in order to accommodate all learners and their varied learning styles. Teachers use classroom instructional methods that correlate with their personal teaching style and therefore should like-wise accommodate learners' learning styles in their instruction (Khalick 2012).

4.4.3.2 Communicative approach

The manner in which Ms Langa communicates with the learners is important in ensuring that she is effective in her lesson delivery. It would seem she hoped to bring about understanding in the learners through the non-interactive-authoritative communicative approach. The researcher categories Ms Langa thus, as a result of her reluctance to engage learners in communication that is two way. Jean Pierre (2010) says, "It is difficult if not impossible to teach in ways which one has not learned". Learners only responded to what was asked by the Ms Langa and were never afforded the opportunity to discuss

issues according to how they viewed them. In the observation guide the researcher records the following:

Question
Do learners seem to be taking active part in the lesson?

Remark
Active participation is noted through learners responding to teacher's questions, not however through their own initiatives.

There was no time given for group and pair work which is essential in helping learners to learn from one another, as some learners learn best in this way. Her communication was also authoritative as witnessed by her lack of in-cooperation of open dialogue in her classroom. This non-interactive-authoritative communicative approach is most apparent when Ms Langa dictates to learners what their misconceptions are regarding the movement of the in the following extract:

Teacher
The movement of the earth is rotation. So it's so interesting you thought that the sun is moving. Didn't you think the sun is moving because you see that it's moving from this side to this side (pointing in two opposite directions)?

By stating the above about the learning and teaching of the effects of the earth's rotation and revolution Ms Langa has exposed her own misconceptions regarding the learners. Over and above the learners' misconceptions, the teachers' misconceptions can hinder learning of science (Kelly 2000).

4.4.3.3 Teacher questioning

When posing questions to her class, it can be said the purpose for this by Ms Langa was partially evaluative and lesson developmental. After all her lecturing, Ms Langa would ask questions related to what she had asked. This was observed to be her way of gauging learners' understanding of what they had just heard from her.

Teacher
After every four years we get a leap year. Ok

Learners
(Chorusing) Yes mam.

Teacher
So what do the quarter days every year give us?

Learners
A leap year.

Ms Langa's questions are also developmental for the lesson. She uses questioning to bridge the gap between aspects and concepts in the lesson. This allows the lesson to be seamless only if the questions are relevant and structured well enough. Although her questions were relevant for one or both the stages, she struggled with structuring good questions for the purpose of bridging gaps. In some cases the questions disjointed the lesson. They served the opposite of their purpose. In the following extract is an example of how the question does not serve its purpose. After discussing the southern and northern hemispheres the teacher the teacher wanted to proceed to summarising the lesson. The following was her question:

Teacher
Do we understand movement of the earth around the sun?

The question was more evaluative and could build on the summary of the lesson but it did not link with the previous discussion on the hemispheres. It is important to emphasise the links learners need to make with previous lessons and related topics to help them achieve a thorough understanding of content (Khalick 2012).

4.4.4 Accountability

The motivation behind Ms Langa doing all she did in the classroom will now be analysed.

4.4.4.1 System

Ms Langa appeared to pay a lot of attention to making sure she completed the concept for the day. This could be observed in how she wanted to keep the textbook close at hand in all that she did during the lesson. This could have been her attempt at

keeping track of what she has to do. It could also be her way of ensuring that she completes all that has to be completed within that particular time frame. Such actions by the point to a teacher who are obsessed with completing the syllabus at the expense of effective teaching and learning (Grobe & McCll 2004).

4.4.4.2 Subject

Subject accountability refers to the teacher focussing on the instructional strategies in order to help learners make meaning of what is being taught (Mudau 2013c). This cannot be true of Ms Langa as she only focussed on using the traditional lecture method as well as the demonstrations. Scientific methods such as experiments and investigations where not utilised. King, Shumow and Lietz (2001, p.56) say of the above, “The quality of science instruction depends to a significant extent on the approach taken to teach students.” The personal preference of the lecture method and the demonstrations could be at the detriment of learners’ effective learning of the relationship of the sun and the earth.

4.4.4.3 Student

Not much attention was paid by Ms Langa on the learners’ worldview in guiding her in the direction of the discussions and the lesson as a whole. Instead of using learners’ personal experiences positively to encourage learning, the teacher used her own misconceptions about the learners to guide her in the lesson, (Grobe & McCall 2004).

Ms Langa told the Grade 7 class that they still thought that it was the sun that moved and not the earth. This would be a serious misconception for a Grade 7 learner to make which would negatively affect how they understood the movements of the earth around the sun and the effects of these movements to planet earth. If she therefore thought the learners had such a gross misconception, it must have guided how she conducted the lesson which ultimately did not bode well to the learning of the relationship between the earth and the sun.

4.4.5 Findings

4.4.5.1 Inadequate content knowledge

Ms Langa demonstrated inadequate content knowledge in her delivery of the lesson based on the relationship of the sun and the moon, where focus was on the rotation and revolution of the earth. This was evidenced firstly by her over-dependence on the textbook as a reference. She did not use the textbook to occasionally refer to, but based the lesson on what was written and illustrated in the textbook.

It is expected that the teacher should demonstrate mastery of the content that she delivers to the learners. This is evident when the teacher has knowledge that is above that of the learners. As Ms Langa conducted her lesson, she did not demonstrate knowledge above and beyond what she or the learners read or saw in the textbook. This may have been as a result of lack of confidence in the strand Planet Earth and beyond and its content, however she did not allude to this in the interview or any other prior interactions with the researcher. It is therefore left to the researcher to classify this as lack of adequate content knowledge.

4.4.5.2 Over-dependence on traditional teaching methods.

Ms Langa over-used the traditional methods of lecture as well as demonstration at the expense of other science related teaching methods. Such methods as experiments, investigations and problems would have suited some parts of the lesson of the lesson but were not attempted. These methods promote science which is essential as shown by Anderson (2008, p.6) who says,"Science inquiry is central to science learning". Ms Langa appeared comfortable interchanging the lecture method with the demonstration method. This was not ideal for keeping the learners involved and interested in the teaching and learning process occurring.

In Ms Langa's use of the traditional methods of teaching, the demonstration method in particular, there were several points noted that could hinder the success of the method in teaching. Pre, during and post the demonstrations, Ms Langa did have activities that complemented the demonstration. There was no clear cut build up to the demonstration and

activities during the demonstration where teacher centred. After the demonstration Ms Langa did not use follow up activities that would have reinforced what was learnt in the demonstration, instead she proceeded on to the next aspect of the lesson without attempting to link the demonstration to the next activity.

4.4.5.3 Subject accountability by the teacher

Ms Langa paid more attention than was necessary on how her learners arrived at understanding of what was being taught. According to Mudau (2013c, p.640), “Accountability to the subject had the focus on the instructional strategies the teacher used in engaging students to make meaning out of the content presented”. Ms Langa had an empirical perspective to the way knowledge is reached, which suggests that knowledge is derived from experience (Yount & Horton 2013).

Most knowledge in the lesson was to be attained through taking part in some of activity such as being part of a demonstration or observing a demonstration in progress. During the demonstration Ms Langa would then give new information to the class. It is during these activities that she would pose questions related to the rotation and revolution of the earth. Although this was not a wrong way of helping learners acquire new knowledge in the learning strand Planet Earth and beyond, it was however over utilised. It could have worked well for some learners but other learners might not have benefitted from this approach of helping learners make meaning of the content that was being presented.

4.5 CONCLUSION

This chapter has analysed the classroom practices employed by the three respondents Mr Dube, Mr Nyoni and Ms Langa using the Classroom Practice Diagnostic Framework as a tool. The classroom practices they have used have led to a better understanding of the science teaching of these respondents. This has then allowed the researcher to arrive at the findings for each case.

Following will be the summary of findings and answers to the research questions as well as the recommendations that the study makes.

CHAPTER 5: SUMMARY OF FINDINGS, RECOMMENDATIONS, LIMITATIONS OF THE STUDY AND FURTHER RESEARCH.

5.1 INTRODUCTION

In this chapter the major findings of the study will be presented as guided by the research aim and the research questions. This will then be followed by the recommendations to be made in the improvement of teachers' classroom practices in the teaching of Natural Science. Further research that is possible at the conclusion of this research will then be suggested.

5.2 SUMMARY OF FINDINGS

Through the use of the CPDF several factors have been identified as negatively influencing the teachers' classroom practices in the south-west of Johannesburg as derived from the findings in the previous chapter. In no particular order, the factors include inadequate teacher's teacher knowledge, teacher's instructional strategies not varied and finally teacher's knowledge and instructional strategies that lead to authoritative discourse and system accountable teachers.

The findings of the research will be preceded by the research questions which they seek to answer in the study.

5.2.1 What is the nature of the teacher's teacher knowledge?

5.2.1.1 Inadequate teacher's teacher knowledge.

There was evidence of teacher's teacher knowledge that was inadequate to teach science at Grade 7. In some instances it could be seen that their knowledge was positively way above that required to teach the science class. All this knowledge was demonstrated in the pre interview discussions that the researcher had with the respondents as well as during the formal interview itself. However the teachers did not put into practice what they knew in the lesson. The implementation of their teacher knowledge in the lessons was not to the standard expected.

Inadequate teacher's teacher knowledge was also noted in the number of incorrect information given to learners. This inadequacy is detrimental to science learning as shown by Wenglinsky (2002) who says subject matter knowledge by the teacher has positive effect on student learning. Initial thoughts were that these were mistakes made by the teacher. However, as these were repeated immediately or at a later stage it became difficult to accept as a mistake, but rather to categorize as misinformation.

5.2.2 What is the nature of the teacher's instructional strategies?

5.2.2.1 Teachers' instructional strategies not varied

The dependence on the lecture method by the respondents to conduct their teaching was evident in their lessons. The lecture method is not recommended in teaching at this level of the grade 7s. Social constructivism views knowledge as constructed as opposed to being created (Burr 2015), therefore methods that foster learner interaction would be advocated for.

Through the use of the lecture method the respondents did not afford the learners opportunity to contribute in the lessons. Through actively contributing in the direction and content of the lesson, learners pay more attention and subsequently gain new knowledge with less effort.

Use of the lecture method also had the disadvantage of leading the teacher astray from the purpose of the lesson. The respondents spent a significant portions of their lesson lecturing on aspects unrelated to what was being focussed on for the lesson. The more time the teachers spent using the lecture method in the lesson the more they appeared to rush through the lesson towards its conclusion. This attempt at trying to cover a lot of aspects in a short while was a sign that time had not been managed well as a result of over-use of the lecture method.

There was an apparent inclination to the use of the demonstration method in teaching. The demonstration method can be a very effective method of knowledge transmission if correctly implemented. From the observed lessons it became apparent that there wasn't adequate preparation in the use of the demonstration method. This led to demonstrations that ran out of space to effectively portray what was intended to be learnt. There were no plans on what to do if the demonstration did not achieve its intended purpose leading to their abrupt abandonment.

Preplanning of the demonstrations was not done as seen by the implements that were utilised. Some of the implements used in, for example, the demonstration of the earth at an axis were just picked in the classroom randomly in the classroom. Such unplanned implements did not give a good representation of the real objects in either size or shape, they became very disproportional therefore rendering the demonstration ineffective. No preplanning of the demonstration was visible through, for example, setting up of implements before the lesson commenced. The post demonstration activities used were not ideal follow up activities or did not feature at all in some of the lessons. This therefore points to inadequate planning or no planning prior to the demonstration

.

5.2.3 How does the teacher's teacher knowledge and instructional strategies shape the teacher's interactions and discourse and their accountability?

5.2.3.1 Authoritative discourse and system accountable teachers as shaped by their teacher knowledge and instructional strategies and their accountability to the system, subject and students.

Discourse in the Grade 7 science classrooms was predominantly authoritative. This was not ideal in promoting a conducive teaching and learning environment. This authoritative discourse is closely tired with the lecture method utilised by all the three respondents.
Learners where expected to listen to what the teacher had to say concerning what was being taught.

The role of the learners was to respond to the questions, issues and scenarios as seen from the teachers' perspective. This is not an ideal situation as illustrated by Sitshebe (2012, p.128) when he says, "Natural science teachers must be concerned when they are not asked questions by their students for the entire lesson". The learners were not afforded the opportunity to explain how they viewed the relationship of the earth with the sun. This view from the learner's perspective would then lead the desired effective discourse in the classroom. In all the lessons observed teachers told the learners the way things were between the sun and the earth. The teachers would then pose a question that did not require an answer but more to as a pacing mechanism for the teachers. Learners would then be limited, in most instances, to a chorused response to the teachers' question.

System accountability appeared to be the main motivation behind the manner in which lessons were conducted. The teachers showed that they wanted to complete the work planned for that day and ultimately the syllabus. This was done at all costs by the teachers. Learners' understanding was not a priority for the teachers as they delivered the science lessons to the Grade 7s.

The need, at times desperate, to complete the syllabus was seen as teachers crammed concepts at the end of lessons that had not been well time-managed. The teachers did not show concern that the learners had no chance at taking in so much content, at such a pace and in such little time. Satisfaction was not derived from learner understanding but meeting targets, and in this case the targets where syllabus completion. Accountability to the system as a result of pressure on the school by the departments of education provide no information that helps students and educators improve their practices (Grobe & McCall 2004).

5.3 MAIN CONTRIBUTIONS OF THE STUDY

Previous studies on the classroom practices of teachers have mainly focused on the science as a broad field. However in this study there was specificity on the learning strand focused on. In this study the focus was on the learning strand Planet Earth and beyond in the teaching of natural science. The study of the teachers' classroom practices with a focus on Planet Earth and beyond was significant in the light of the perceived abstractness and difficulty of the strand. It is envisaged that the study has shed light on the teachers' negative contribution to the teaching of natural science through their inappropriate use of classroom practices.

As the school sites and the participants used were diverse in terms of socio-economic status and historical backgrounds the study was able to show that the challenges faced by the participants were similar despite their locations. Participants from previously advantaged schools and those from previously disadvantaged faced similar challenges regarding their choice of classroom practices when delivering their natural science lessons. This could therefore point to a deficiency in the training of the teachers coupled with insufficient in-service training of the teachers. Universities and Departments of Education can then use these findings to devise new approaches in the training of teachers or the content and form of natural science teacher workshops.

5.4 RECOMMENDATIONS ABOUT TEACHING SOME CONCEPTS OF THE PLANET EARTH AND BEYOND STRAND.

The researcher will now give recommendations based on the findings of this research into classroom practices of Grade 7 science teachers in the south-west of Johannesburg. The researcher recommends that teachers:

- Utilise the theoretical content knowledge they possess practically in the science classroom so as to enhance their science lessons in the Planet Earth and beyond strand.

- Use teaching methods in the science classroom that encourage an active and critical approach to leaning concepts in the relationships of the sun to the earth, rather than rote and uncritical learning of given truths as expounded in the NCS policy document.

- Ensure that their science lessons are more flexible and accommodative of learners understanding of relationships of the sun and earth. This means the teacher should be able to adapt the lesson as it progresses so as to allow for the learners' input to shape the lesson. In so doing the learners feel they are a significant part of the teaching and learning process happening.

- Get to know their learners contexts in depth and in cooperate this knowledge in planning and delivering of science lessons in Planet Earth and beyond strand

- Improve their discourse in the classroom and try to move away from authoritative discourse to ideally the reflective discourse where-in learners' prior knowledge is taken into account and focus is on learners' thinking.

Schools should support the teachers by:

- Creating science dedicated classrooms that are fully equipped with the teaching and learning materials for learning strands such as Planet Earth and beyond which requires a multitude of models.
- Encourage parent involvement in the learner's learning of science. By such initiatives by the school the teacher also benefits by getting an in-depth knowledge of the learner's context which the teacher will then utilise in his contextual knowledge of learners to shape science lessons.

- Not putting too much emphasis on the completion of the syllabus as a measure of a teacher's success in the science programme. Schools should instead emphasize the effective teaching of science using a balanced mix of non-traditional and traditional methods of teaching.

- Encouraging and ensuring that teachers have access to computer labs so that learners can view some models to do with the learning strand Planet Earth and beyond. The computers should ideally be connected to the internet in order for exploration by learners on relevant concepts.

The Department of Education's role in assisting the teachers and schools could include:

- Conducting action workshops where practical demonstrations on what is required in a science lesson on the learning strand Planet Earth and beyond are observed by the teachers. Teachers should also not be passive participants in the workshops but be involved in some parts of the workshop. Breaking up into smaller and trying out what has been suggested at the workshop could assist.

- Provision of schools with relevant teaching and learning aids would be of benefit to the teaching and learning of science. Most schools did have computers, for example, but did not have software that can help them enhance the teaching of the learning strand Planet Earth and beyond.

5.5 LIMITATIONS OF THE STUDY

As participating in the study was not compulsory, this could therefore not be overlooked as a limitation to the study since those who did not volunteer to participate could have been the participants who provided crucial information which could have given more understanding of the study.

The study was conducted on three Grade 7 natural science teachers in primary schools in the south-west of Johannesburg where-by two lessons per each teacher were observed. The first lesson was for familiarisation between the researcher and the participants. The second lesson was intended for the formal data collection. A longer period of observation would however have given a better insight of the teaching of the learning strand

Planet Earth and beyond. The study's findings are taken to be unique to that group of teachers and cannot be generalised to other science teachers in the south-west of Johannesburg or those in the rest of South Africa.

The study was conducted on one natural science strand, Planet Earth and beyond. Therefore, it would not be reasonable to generalise the findings across all the strands in natural science.

After participants had been observed and interviewed there were some aspects that were not clear to the researcher and needed to be clarified by the participants. This called upon the researcher to get in touch with the respondents and seek further elaboration on the aspects in question. In the interview, questions not on the schedule where asked to elicit a clearer response from the participants. This could therefore highlight that the pilot study did not fully serve its purpose in some aspects of the study. However, the follow-up actions taken by the researcher ensured that this shortcoming did not result in giving findings that are not a true reflection in the study.

The study was carried out on three participants from the south-west of Johannesburg. Questions are bound to arise from this such as: Would a bigger sample have produced more interesting and more representative findings to the South African science teaching landscape? What findings could have been generated had the study been wider spread than the south-west of Johannesburg. However, for the reason that an in-depth and extensive study was carried out, it gives findings that would not have been generated had the study been on a larger scale.

In the light of the above, it will however be stated that the study has made a concerted effort to better understand the classroom practices embarked on by science teachers that could lead to effective or ineffective delivery of lessons.

5.6 FURTHER RESEARCH.

This research set out to gain in-depth understanding on the classroom practices employed by science teachers in the south-west of Johannesburg. This goal was achieved, however further research can be conducted in the following areas:

- How the era in which the teacher trained influences their choices of classroom practices when teaching the Planet Earth and beyond strand.

- The high prevalence of teachers teaching science but who majored in other learning areas and its co-relations with their choices of classroom practices.

- A research on the effects of desirable and undesirable classroom practices on the performance of learners in the natural science classroom.

5.7 SUMMARY

In proposing this research I had set my goals on gaining deeper understanding on the classroom practices teachers utilised in their teaching of science. Three teachers were observed teaching the learning strand Planet Earth and beyond. This study revealed the classroom practices used by the teachers from the three schools.

The study showed that the teachers have a preference for conducting their lesson using predominantly the lecture and demonstration methods, there is inadequate variety of teaching strategies which is detrimental for understanding concepts on relationships between the sun and the earth. This is despite the mounting evidence in research that shows that these are methods that should not dominate science as they are teacher centred instead of being learner centred.

Modern and more effective methods were overlooked either because they were not comfortable with them or they did not know about them at all. Another main finding was that the teachers' teacher knowledge left a lot to be desired. Teachers did not demonstrate adequate content, context and student understanding in their lessons although surprisingly in the interviews they gave model responses to the questions. Authoritative discourse and system accountability by the teachers as shaped by their teacher knowledge and instructional strategies was evident in the lessons presented. The classroom discourse did not encourage free expression by the learners as it was authoritative by nature. The teacher led the interactions leaving the learners to a few responses to teachers' questions.

In order to overcome these challenges that teachers, and ultimately learners, face in the teaching and learning of science, a concerted effort is required from the teachers themselves, the school and the departments of education. Amongst a host of other changes, teachers have to use teaching and learning methods that are learner centred. Schools play a pivotal role in the classroom practices that teachers use, by providing teachers and learners with classroom environments that promote science teaching and learning, there could be a marked improvement in teacher's choice of classroom practices. The Department of Education should also make an input through providing workshops that not only provide theoretical knowledge to the teachers but that let teachers practice the different methods of approaching natural science teaching.

5.8 CONCLUSION

The chapter set out by introducing what will be discussed, this was followed the summary of the findings that emanated from the study. The recommendations that could improve the classroom practices of the Mr Dube, Mr Nyoni and Ms Langa were then given. Further research that can build on this current study was then given and finally the summary of the study was outlined.

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APPENDICES

APPENDIX 1
OBSERVATION GUIDE

1. Does the teacher demonstrate adequate content knowledge of the learning area natural science to teach it?
   Remarks:

   _____
   _____
   _____

2. Has the teacher made deliberate attempts to grasp and maintain learners' attention?
   Remarks:

   _____
   _____
   _____

3. Do learners seem to be taking active part in the lesson?
   Remarks:

   _____
   _____
   _____

4. Does the teacher employ a variety of teaching and learning methods in the lesson?
   Remarks:

   _____
   _____
   _____

5. Are there a variety of teaching and learning aids used to help learners understand the content?
   Remarks:

   _____
   _____
   _____

6. How often does the teacher check if learners are understanding?
   Remarks:
   _____
   _____
   _____

7. How does the teacher check if learners are understanding?
   Remarks:
   _____
   _____
   _____

8. What reference material, if any, does the teacher refer to during the lesson?
   Remarks:
   _____
   _____
   _____

9. Does the sequence of activities in the lesson seem to be planned for and scientific?
   Remarks:
   _____
   _____
   _____

APPENDIX 2:

INTERVIEW SCHEDULE

The purpose of this schedule is to identify and understand the nature of classroom practices of some natural science teachers in the south-west of Johannesburg as they teach the learning strand Planet Earth and beyond.

1. Is science given equal prominence as other learning areas at your school?

2. If yes, how? If no, what could be done?

3. What makes you enjoy teaching natural science?

4. How is science education essential to learners now and in later life?

5. Which teaching and learning methods work best for you in the science lesson?

6. Is there a particular routine you follow in your teaching of natural science?

7. If yes, why do you choose this routine?

   If no, why do you choose to constantly change routines?

8. What do you feel could improve your teaching of natural science particularly in the learning strand Planet Earth and beyond?

9. Which natural science learning strand are you more comfortable teaching?

10. Why do you enjoy teaching the learning strand that you have chosen?

11. What is different in your preferred learning strand to the strand Planet Earth and beyond in terms of your understanding, how you teach it and the content.

12. What challenges do you encounter in teaching the learning strand Planet Earth and beyond?

13. What teaching and learning aids do you use in your teaching of science?

14. How do these teaching and learning aids enhance your teaching?

15. Do you think your knowledge of science, with the strand Planet Earth and beyond, is adequate?

16. Elaborate on your response.

APPENDIX 3:
LETTER TO THE NATURAL SCIENCE TEACHER

Dear Parents/ Gardians

RE: Adult to participate in an interview

This letter is an invitation to consider participating in a study I, Oyindiye Mosi Bango, am conducting as part of my research as a masters student entitled' Exploring Senior Phase Natural Science Teachers' Classroom Practices: A focus on planet earth and beyond strand' at the University of South Africa. Permission for the study has been given by Department of Education and the Ethics Committee of the College of Education, UNISA. I have purposefully identified you as a possible participant because of your valuable experience and expertise related to my research topic. You will be one of three participants in the research.

I would like to provide you with more information about this project and what your involvement would entail if you should agree to take part. The importance of teachers' classroom practice in education is substantial and well documented. Getting to understand the classroom practices of teachers is important in helping to improve the teaching and learning process in the classroom. In this this interview I would like to have your views and opinions on this topic. This information can be used to improve the teaching of science in general and the learning strand planet earth and beyond in particular.

Your participation in this study is voluntary. It will involve a lesson observation and an interview of approximately 15 minutes in length to take place in a mutually agreed upon location at a time convenient to you. You may decline to answer any of the interview questions if you so wish. Furthermore, you may decide to withdraw from this study at any time without any negative consequences.

With your kind permission, the interview will be audio-recorded to facilitate collection of accurate information and later transcribed for analysis. Shortly after the transcription has been completed, I will send you a copy of the transcript to give you an opportunity to confirm the accuracy of our conversation and to add or clarify any points. All information you provide is considered completely confidential. Your name will not appear in any publication resulting from this study and any identifying information will be omitted from the report. However, with your permission, anonymous quotations may be used. Data collected during this study will be retained on a

password protected computer for 12 months in my locked office. There are no known or anticipated risks to you as a participant in this study.

If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please contact me at 0795791296 or by e-mail at 45158142@mylife.unisa.ac.za .

I look forward to speaking with you very much and thank you in advance for your assistance in this project. If you accept my invitation to participate, I will request you to sign the consent form which follows on the next page.

_____
Yours sincerely
Oyindiye Mosi Bango

CONSENT FORM

I have read the information presented in the information letter about the study of teachers' classroom practices in education. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to any questions, and add any additional details I wanted. I am aware that I have the option of allowing my interview to be audio recorded to ensure an accurate recording of my responses. I am also aware that excerpts from the interview may be included in publications to come from this research, with the understanding that the quotations will be anonymous. I was informed that I may withdraw my consent at any time without penalty by advising the researcher. With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

_____
Participant's Name (Please print):

_____
Participant's signature):

_____
Date

_____
Researcher's name (Please print

_____
Researcher's signature:

_____
Date

APPENDIX 4

LETTER TO THE PRINCIPAL

6 September 2016

Request for permission to conduct research at XXX Primary School.

Title: Exploring Senior Phase Natural Science Teachers' Classroom Practices: A focus on planet earth and beyond strand

Contact person
Prof Awelani.V. Mudau
Tel-012 429 6353
E-mail: mudauav@unisa.ac.za

Dear **Principal**

I, Oyindiye Mosi Bango am doing research with Prof Awelani. V. Mudau, a senior lecturer in the Department of Science and Technology Education towards a MEd at the University of South Africa. We have funding from UNISA Student Funding. We are inviting you to participate in a study entitled Exploring Senior Phase Natural Science Teachers' Classroom Practices: A focus on planet earth and beyond strand.

The aim of the study is to identify and understand the nature of classroom practices of natural science teachers. Your institution has been selected because it falls under the District 12 of the Gauteng Department of Education which has been earmarked for the study as it has diverse mixture of race and socio economic factors. The researcher will observe the teacher in a science lesson and will then interview the teacher.

The benefits of this study are that your school will get findings and recommendations that relate to science teachers classroom practices which are relevant to your school as it would have partaken in the research. These recommendations could be utilised by your school to improve science teaching. Potential risks to the learners and teachers as a result of the study do not exist as the researcher will not interrupt the daily routine of the class. Feedback procedure will entail availing the research findings and recommendations to your school. The complete dissertation will also be offered to your school.

Yours sincerely
Oyindiye Mosi Bango

(Researcher)

APPENDIX 5:

GDE APPROVAL LETTER

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

For administrative use:
Reference no: M2017/386

GDE RESEARCH APPROVAL LETTER

Date:	30 January 2017
Validity of Research Approval:	06 February 2017 – 29 September 2017
Name of Researcher:	Bango O.M
Address of Researcher:	1232 Mum Street
	Fleurhof
	1709
Telephone Number:	079 579 1296
Email address:	45158142@mylife.unisa.ac.za
Research Topic:	Exploring senior phase Natural Science teachers classroom practices used by science teacher, The teaching of N.S will be improved
Number and type of schools:	Three Primary Schools
District/s/HO	Johannesburg North

Re: Approval in Respect of Request to Conduct Research

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

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

02/02/2017 1

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za

1. *The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.*
2. *The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.*
3. *A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.*
4. *A letter / document that outlines the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.*
5. *The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.*
6. *Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.*
7. *Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.*
8. *Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.*
9. *It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.*
10. *The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.*
11. *The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.*
12. *On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.*
13. *The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.*
14. *Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.*

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

.....

Ms Faith Tshabalala
CES: Education Research and Knowledge Management

DATE: 02/02/2017

Office of the Director: Education Research and Knowledge Management
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APPENDIX 6

ETHICS CLEARANCE LETTER

UNISA university of south africa

UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2017/03/15

Ref: **2017/03/15/45158142/4/MC**
Name: Mr OM Bango
Student: 45158142

Dear Mr Bango,

Decision: Ethics Approval from 2017/03/15 to 2019/03/15

Researcher:

Name: Mr OM Bango
Email: 45158142@mylife.unisa.ac.za
Telephone: 0795791296

Supervisor:
Name: Dr AV Mudau
Email: mudsuav@unisa.ac.za
Telephone: 0124296353

Title of research:

Exploring Senior Phase Natural Science teachers' classroom practices: A focus on the Planet Earth and Beyond strand

Qualification: M Ed in Science 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 2017/03/15 to 2019/03/15.

The low risk application was reviewed by the Ethics Review Committee on 2017/03/15 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.

The proposed research may now commence with the provisions that:

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

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
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 require additional ethics clearance.
7. No field work activities may continue after the expiry date 2019/03/15. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

The reference number **2017/03/15/45158142/4/MC** *should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Kind regards,

Dr M Claassens
CHAIRPERSON: CEDU RERC

Prof V McKay
EXECUTIVE DEAN

mcdtc@netactive.co.za

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APPENDIX 7

INTERVIEW TRANSCRIPT OF MR DUBE: FEBRUARY 2017 AT MASENDU PRIMARY SCHOOL

The purpose of this schedule is to identify and understand the nature of classroom practices of some natural science teachers in the south-west of Johannesburg as they teach the learning strand Planet Earth and beyond.

Mr Dube (Pseudonym).

Underlined questions were not in the interview schedule but were asked by the researcher in order to get more clarity.

Pre interview

1. **What professional teaching qualifications do you hold?**
   Mr Dube: B.Ed in Intermediate and Senior phase

2. **What learning area did you major in?**
   Mr Dube: Technology

3. **What institution did you attain your qualifications and in what year?**
   Mr Dube: UNISA in 2008

4. **How many years have you been teaching science?**
   Mr Dube: Approximately 5 years

5. **What grades do you teach science to?**
   Mr Dube: Grade 7 only.

6. **Are you comfortable teaching science?**
   Mr Dube: Yes, and very confident

Turn Transcript

1. **Is science given equal prominence as other learning areas at your school**?
   Mr Dube: Yes

2. **If yes, how? If no, what could be done?**
   Mr Dube: It is being taught according to set time allocation according to the education policy.

3. **What makes you enjoy teaching natural science?**
   Mr Dube: I enjoy teaching natural science because it promotes understanding of the natural world, both myself the educator and the learners.

4. **How is science education essential to learners now and in later life?**
   Mr Dube: Science education helps learners to interact with their natural environment, it equips then with skills to interact with their world as well as after learning life it also helps them to get employment in the science field.

5. **Which teaching and learning methods work best for you in the science classroom/lesson**?
   Mr Dube: Mostly I prefer investigations, experiments and projects.

6. **Is there a particular routine you follow in your teaching of natural science?**
   Mr Dube: No, I don't follow any particular routine.

7. **If yes, why do you choose this routine?**
   If no, why do you choose to constantly change routines?
   Mr Dube: My routines depends mostly on the topic being taught at a time, also the grade level, the understanding of the learners, so I have to vary depending on the topic or concept being taught at a time and how the learners understand.

8. **What do you feel could improve your teaching of natural science particularly in the learning strand Planet Earth and beyond?**
   Mr Dube: I think if I could attend a lot of teacher workshops, seminars to maybe equip me more on the topic.

9. **Which natural science learning strand are you more comfortable teaching?**
   Mr Dube: I'm more comfortable teaching Life and living

10. **Why do you enjoy teaching the learning strand that you have chosen?**
    Mr Dube: I prefer teaching this strand because it deals with direct experience of learners especially their immediate

environment and the surrounding world. So they learn directly from the immediate environment, it's not abstract.

11. **What is different in your preferred learning strand to the strand Planet Earth and beyond in terms of your understanding, how you teach it and the content.**
Mr Dube: I think I prefer teaching life and living because I use direct experience with immediate environment unlike Planet Earth and beyond which is a bit more abstract. It is not very direct with learners' experience, they don't experience it on daily. I think understand Life and living better than Planets and beyond because I am also dealing with what I experience on daily basis, my immediate environment, I interact with it almost on daily basis. I'm teaching something that I'm well versed on, I'm experiencing on daily basis.

12. **Do you teach them differently?**
Mr Dube: Yes I teach them differently.
How so?
Mr Dube: Planet Earth and beyond mostly I teach it through apparatus and improvised models, then Life and living I use the immediate environment as the source of knowledge. Take children out, take them to a garden, to a pool, to a mountain, to a desert or a zoo. They learn direct as they interact with their environment.

13. **What challenges do you encounter in teaching the learning strand Planet Earth and beyond**?
Mr Dube: Normally unavailability of equipment and apparatus and teaching aids.

14. **What teaching and learning aids do you use in your teaching of science?**
Mr Dube: I normally use some improvised models made by myself or made by learners which cannot be direct representative of the actual what, Planet Earth and beyond like the globe, you have to improvise.

15. **How do these teaching and learning aids enhance your teaching?**
Mr Dube: They help me to make learners understand and to make my explanations and even my illustrations simpler.

16. **Do you think your knowledge of science, with the strand Planet Earth and beyond, is adequate?**
    Mr Dube: No

17. **Elaborate on your response.**
    Mr Dube: I feel I still have to learn more about the diversity of the planet earth especial through doing some researches, attending some seminars or even reading more. At times before I teach it I feel I must read more to prepare myself to I present it to learners.

18. **With reference to your lesson do you think you achieved your objectives looking particularly at the way you delivered the lesson**?
    Mr Dube: Ya, the methods which I used, I think I used they tried to help and explain and illustrate especially the movement of the earth and sun from rotation to revolution and the use of the model I think it helped a lot in helping learners try to understand the movement of the earth around the sun.

19. **Do you think there is anything you could have done differently in delivering the lesson that you think could have helped.**
    Mr Dube: Ya, I feel if maybe I had taken learners maybe to watch maybe a video on the movement of the sun, of the earth around the sun they could have even understood it even better

Post interview

1. **Is there anything you would like to add further?**
   Mr Dube: No, thanks.

APPENDIX 8

INTERVIEW TRANSCRIPT OF MR NYONI: FEBRUARY 2017 AT PLUMTREE JUNIOR SECONDARY SCHOOL.

The purpose of this schedule is to identify and understand the nature of classroom practices of some natural science teachers in the south-west of Johannesburg as they teach the learning strand Planet Earth and beyond.

Mr Nyoni (Pseudonym).

Underlined questions were not in the interview schedule but were asked by the researcher in order to get more clarity.

Pre interview

1. **What professional teaching qualifications do you hold?**
   Mr Nyoni: BEd

2. **What learning area did you major in?**
   Mr Nyoni: Science education.

3. **What institution did you attain your qualifications and in what year?**
   Mr Nyoni: University of Zimbabwe in 2003

4. **How many years have you been teaching science?**
   Mr Nyoni: Approximately 11 years

5. **What grades do you teach science to?**
   Mr Nyoni: Grade 7 and 8.

6. **Are you comfortable teaching science?**
   Mr Nyoni: Yes I am.

Turn Transcript

1. **Is science given equal prominence as other learning areas at your school?**
   Mr Nyoni: Yes, it is the same preference as other learning areas because we are following the CAPS policy and according to the CAPS policy it is supposed to have 3.5hrs of which that is what the school is doing.

2. **If yes, how? If no, what could be done?**
   Mr Nyoni:

3. **What makes you enjoy teaching natural science?**
   Mr Nyoni: Natural Science is a practical subject, it requires learners to get involved in experiments to also get the learners to observe the situation the trends, basically when you are teaching the Earth and beyond, acids and bases, the learners get to interact with the real objects then it motivates the learning. Then Natural Science by its nature, the environment so learners get to know how they and their environment are connected. That is the goodness of science.

4. **How is science education essential to learners now and in later life?**
   Mr Nyoni: Science education it has become a discipline on its encompassing different environmental factors like social factor, physical factor and the economical factor. What do I mean by that? Now the learners can in cooperate what they learn in class with their outside world, their communities. How so? In bringing the integration of the subject itself and the behaviour they are supposed to portray in the outside world, it is from science. Science, you are respecting the human being before respecting the dignity of the human being. The human being as a person is what we are dealing with in science. Once you master that it benefits the learners and their interactions on daily basis. So learners learn to look at all the science experiments that has been done and observe the trends.

5. **Which teaching and learning methods work best for you in the science lesson?**
   Mr Nyoni: The teaching and learning methods will vary depending what topic you are teaching. Some topics that work best in the science is group work where learners on their own they are made to discover things about whatever concept they are dealing with. They give feedback on each other than the teacher only monitors. Then also the other teaching style can employ is the lecture method whereby you are telling the learners what to do. It is an old system of teaching because it frustrates the learners. The knowledge is from you to them so you don't know or you cannot gauge how they receive it. So when they are in groups they are able to manipulate, they are able to play with concrete objects and they are able also to challenge each other

6. **Is there a particular routine you follow in your teaching of natural science?**

   Mr Nyoni: The routine that we follow is one. You follow the lesson plan. Actually they can be two, you are following the lesson plan from the CAPS document, so now the routine will be the actual method that you use. You start from the introduction, to the lesson development then to the conclusion. But now what will differ is the activities that you engage with the learners in those steps of teaching. So basically there is no specific routine. The learners themselves, the ability of the learners to master the concept drives you in a certain way to teach the lesson and the environment or the setup, whether you have got equipment or you don't have science equipment in the lab. All those are factors that contribute to the routine that one must employ.

7. **What's the advantage of changing routines as you have just stated?**

   Mr Nyoni: When you are changing routines you are doing that to accommodate every learner. When I'm one style type of person, which means the learner is understanding out of 40 learners, then I have killed the 40 learners in the class. Then they will go home or where ever they are going without mastering the concept. But to change the routine you are trying to be diverse in order to accommodate every learner, all the abilities of the learners you are trying to in cooperate them.

8. **If yes, why do you choose this routine?**
   If no, why do you choose to constantly change routines?
   Mr Nyoni:

9. **What do you feel could improve your teaching of natural science particularly in the learning strand Planet Earth and beyond**?

   Mr Nyoni: Now when I'm teaching this strand Planet Earth and beyond, one thing that can help teachers is to be workshopped thoroughly on that area and be given materials of Earth and beyond in terms of more depth in order to demonstrate like when you are talking of the solar system, learners only see the solar system in their text books, but if you have got a model of that, that you can demonstrate the learners will understand it better because it bring it into simplicity. At the same time we need the model of the earth and sun as practical models that you can demonstrate, this is the sun, this is the earth and then

this is the relationship that we talk about because earth and beyond is built on two things, the sun and the earth. The relationship, how does the sun relate to the earth? Remember when we talk about the earth we are talking about the biosphere where there is life, and then now what is it that the sun does to this biosphere where there is life? So human beings have got life and then also have got plants, all these are living things. So it is not for learners to understand from a theoretical part but they need practical things that they can work with, for example we have the skeletal model, the learners will see that this is the skull, so the brain is inside the skull unlike when you are telling them and also at the same time I spoke of workshops. Teachers need to be workshopped with expert teachers in the area so that they understand the nitty gritties of the planet earth because at the end you find out that you also have to talk of the spheres and lines of axis. So teachers have to understand then it makes it easy for learners to also grasp.

10. **Which natural science learning strand are you more comfortable teaching?**

Mr Nyoni: I think I have two strengths, Life and living and Matter and Materials, actually all. Energy and change, Planet Earth and beyond. Now the good part about matter and materials we are dealing with things that learners will see. When you are talking about Life and living, because learners enjoy about plants and the life processes that living things undergo. Now the challenge lies in whereby we are now explaining about the cells. The learners don't see it, it is abstract. When you are talking about Matter and Materials you are talking about heat transference, conduction, learners I will bring a spoon, we switch on our candle and then we can demonstrate practically its movement of particles from one part to another through vibration in metals and then when you are teaching about space which is radiation, going outside and demonstrating. You don't require materials that you need to buy. Things that you have in the vicinity. So that is the easy about it. But when you are talking about Planet Earth and beyond, it becomes abstract for the learners and the teacher because many schools are faced with the challenge of lack of resources. The textbook has seized to be the only means of information. You have to google, maybe the school doesn't have internet and the schools have to undergo what we call twining.

11. **Why do you enjoy teaching the learning strand that you have chosen?**

    Mr Nyoni:

12. **What is different in your preferred learning strand to the strand Planet Earth and beyond in terms of your understanding, how you teach it and the content.**

    Mr Nyoni: The difference to start with is in the terminology that we use. Science uses scientific terms, so when you are looking at Planet earth and beyond compared Matter and Materials we are talking of simple terms. Planet Earth and beyond you are talking about Mars. Not even the teacher has been to Mars. It's something that you are supposed to read and comprehend and as a teacher you are unable to comprehend and as a teacher you are supposed to give direction to the learners. The teacher might not understand the topic, what more for the learners. The planet Earth and beyond has not been given enough attention in terms of material supply so that teachers are fully equipped to deliver it to learners. In Matter and Materials learners can even go and experiment at home with different surfaces. The strands become easier according to how available the material is. I have more knowledge on Matter and Materials.

13. **What challenges do you encounter in teaching the learning strand Planet Earth and beyond?**

    Mr Nyoni: The dissemination of known information. How do I break it to the level of the learners? It is an abstract topic. There is a big gap in what is in the textbook and what scientists continually discover. While I'm teaching at A, a learner has identified something at E, so how do I bridge that gap because while we are here the learner has read about discoveries at Mars while the teacher is unaware of those. It's a problem with the teachers, how equipped are we? The strand deals with technology about the internet, about googling but here I'm with technology challenge. The teacher becomes frustrated with the learners who keep asking questions that I have no answer to.

14. **What teaching and learning aids do you use in your teaching of science?**

    Mr Nyoni: In my teaching of science the first learning aid that I use is the environment, then I prepare the flashcards. My learning aids they vary depending on the concept that I'm teaching. Planet Earth and beyond, I use the globe. I can use

other teachers as a teaching aid. It can be a science teacher to come and give an explanation about a particular topic.

15. **How do these teaching and learning aids enhance your teaching?**
    Mr Nyoni: The learning aids enhance my teaching, when we go back to the old system, the learners learn best when they see and they are able to manipulate than what they learn.

16. **Do you think your knowledge of science, with the strand Planet Earth and beyond, is adequate?**
    Mr Nyoni: It is adequate

17. **Elaborate on your response.**
    Mr Nyoni: I can integrate the knowledge that I have and also connect and integrate the policy and the textbook, then then information becomes adequate.

18. **What teaching methods do you think enhanced learning in the lesson that you demonstrated**.
    Mr Nyoni: The teaching methods that enhanced learning was the group work whereby we carried out experiments. The learners were required to come as a group and one learner was required to come to the centre as the sun. Other learners were put as planets, which planet is next to the sun? The learner comes and stands, which planet is next to this one and comes and stands. By so doing, I wanted to demonstrate that the learners in their positions as they move rotate around the sun. Remember the sun is stationery but the planets are the ones that move around the orbit. So as the learners were put in those positions to represent the planets as they moved they never bumped each other. So that I was trying to cement the understanding that no matter how the planets move they will never rub against each other. Hence in one of my examples I used the railway line. That the train moved in its railway line and it stays in railway line, same applies to planets. It stays in its railway in the form of an orbit.

19. **If you had an opportunity what would you do differently to ensure understanding of the concept in your lesson**?
    Mr Nyoni: There are so many things that I could have done. First of all I should have planned my lesson prior to teaching it and find a venue like Sci-bono. So if I had already talked with

sci-bono facilitators that I am coming with a group of learners of grade 7, particularly for Planet Earth and beyond, then the learners were going to go deep. Then sci-bono is designed in such a way that they have planets inside sci-bono. So they would receive the models of planets, how they are and they also see the sizes because they are designed like real planets. So in that way I would have enhanced the understanding of the learners. And another alternative, I would have gone to the planetarium in Bidvest. They also have the equipment unlike using my feeble knowledge about the concept. If I had planned well in advance I would have taken the learners there.

20. If you had that opportunity would you present the lesson before or after the excursion?

Mr Nyoni: After the excursion you now come and do what you call post learning. I would make follow up questions on what the learners were taught. Now, in so doing I am achieving my lesson objective that would have been difficult if I was the one who was to start the lesson from scratch so it would be a follow up question trying to find out from the learners how they understood and I can even do that in the form of a test.

APPENDIX 9:

INTERVIEW TRANSCRIPT OF MS LANGA: FEBRUARY 2017 AT JUBA PRIMARY SCHOOL.

The purpose of this schedule is to identify and understand the nature of classroom practices of some natural science teachers in the south-west of Johannesburg as they teach the learning strand Planet Earth and beyond.

Ms Langa (Pseudonym).

Underlined questions were not in the interview schedule but were asked by the researcher in order to get more clarity.

Pre interview

1. **What professional teaching qualifications do you hold?**
   Ms Langa: BEd in Intermediate and Senior phase

2. **What learning area did you major in?**
   Ms Langa: English

3. **What institution did you attain your qualifications and in what year**?
   Ms Langa: UNISA in 2012

4. **How many years have you been teaching science?**
   Ms Langa: Approximately 3 years

5. **What grades do you teach science to?**
   Ms Langa: Grade 7 only.

6. **Are you comfortable teaching science?**
   Ms Langa: Yes I am.

Turn Transcript

1. **Is science given equal prominence as other learning areas at your school?**
   Ms Langa: Yes

2. **If yes, how? If no, what could be done?**

Ms Langa: Our school buys the teaching and the learning aids for teaching Natural Science and the use of the time table and time allocation according to CAPS.

3. **What makes you enjoy teaching natural science?**
   Ms Langa: Science is more challenging and you don't get bored when teaching Natural Science and opens minds for the learners also.

4. **How is science education essential to learners now and in later life?**
   Ms Langa: Now it's understanding the world around them and at a later stage it helps the learners get more jobs easily because there are many vacancies in the science field.

5. **Which teaching and learning methods work best for you in the science lesson?**
   Ms Langa: Observations, experimentation, demonstration, research and field trips

6. **Is there a particular routine you follow in your teaching of natural science?**
   Ms Langa: No, not exactly.

7. **If yes, why do you choose this routine?**
   If no, why do you choose to constantly change routines?
   Ms Langa: Because science has different topics and those topics they require different approaches.

8. **What do you feel could improve your teaching of natural science particularly in the learning strand Planet Earth and beyond?**
   Ms Langa: Oh, if we could have more teaching aids and learning aids for the learners so they can interact more and have better understanding in what they are learning.

9. **Which natural science learning strand are you more comfortable teaching?**
   Ms Langa: I enjoy teaching Matter and Materials better.

10. **Why do you enjoy teaching the learning strand that you have chosen?**
    Ms Langa: Because it talks about things or concepts that we can easily see in our everyday lives.

11. **What is different in your preferred learning strand to the strand Planet Earth and beyond in terms of your understanding, how you teach it and the content.**
    Ms Langa: It's different because it is difficult to teach Planet Earth and beyond because learners come with misconceptions that the teacher has to erase in their minds before teaching the correct concept. For example the learners think that the sun is moving around the earth whereas it is easier, it is the other way round whereby the earth rotates and revolves around the sun.

12. **What challenges do you encounter in teaching the learning strand Planet Earth and beyond?**
    Ms Langa: The challenges are that you cannot bring the concrete examples in the classroom like bringing the earth so that learners the earth and learners see the sun, that's why it's so difficult, you have to use the globe for demonstration of the earth.

13. **What teaching and learning aids do you use in your teaching of science?**
    Ms Langa: In science we using projectors, computers, charts and models

14. **How do these teaching and learning aids enhance your teaching?**
    Ms Langa: It helps the learners understand the concept much better than seeing it.

15. **Do you think your knowledge of science, with the strand Planet Earth and beyond, is adequate?**
    Ms Langa: Oh yes it is adequate.

16. **Elaborate on your response**.
    Ms Langa: However it could be improved through learning approaches, teaching differently, example planet Pluto was downgraded from a planet to being a dwarf planet. You need to keep up with new things happening in science.

17. **Having done the lesson and having reflected on it, what do you think could have been done differently if you had the opportunity?**
    Ms Langa: Yes if I could have done differently by probing for feedback from the learners as the lesson progressed, for example not to be too fast from some parts of the lesson, for

example when I was demonstrating the tilting of the earth with that apple, using the apple, I noticed that I was so fast so I should have just slowed down and get some feedback from the learners. Watching a video could have enhanced understanding of the concept better that could have assisted the learners to understand everything that I was talking about.

APPENDIX 10:

OBSERVATION OF MR DUBE: FEBRUARY 2017 AT MASENDU PRIMARY SCHOOL IN THE GRADE 7 NATURAL SCIENCE CLASSROOM

1. **Does the teacher demonstrate adequate content knowledge of the learning area natural science to teach it?**

   Remarks:
   Adequate knowledge of the content in Natural Science seems evident as evidenced by the relevant terms used and the development of the lesson from the known to the unknown

2. **Has the teacher made deliberate attempts to grasp and maintain learners' attention?**

   Remarks:
   The teacher has to an extent made attempts to grasp and maintain learners' attention through probing questions as the lesson progresses.

3. **Do learners seem to be taking active part in the lesson?**

   Remarks:
   Learners' participation has been through taking part in the question and answer session as well as through the demonstrations.

4. **Does the teacher employ a variety of teaching and learning methods in the lesson?**

   Remarks:
   The teacher is using oral questioning, explanations and demonstrations.

5. **Are there a variety of teaching and learning aids used to help learners understand the content?**
   Remarks:
   The teaching and learning aids are not varied enough as only the globe has been used.

6. How often does the teacher check if learners are understanding?

Remarks:
The teacher is frequently checking for learner's understanding mostly after explaining to them what may be new knowledge to them.

7. How does the teacher check if learners are understanding?

Remarks:
- By answering orally if they understand the point being made.
- By posing questions related to what has been learnt.

8. What reference material, if any, does the teacher refer to during the lesson?

Remarks:
The model of the earth (globe) is referred to.

9 Does the sequence of activities in the lesson seem to be planned for and scientific?

Remarks:
The activities do seem to be planned for, however progression over the main aspect of the lesson, rotation and revolution of the earth, could have been dealt with more comprehensively in the demonstration as this was the point at which meaningful learning was to take place.

APPENDIX 11

OBSERVATION OF MR NYONI: FEBRUARY 2017 AT PLUMTREE JUNIOR SECONDARY SCHOOL IN THE GRADE 7 NATURAL SCIENCE CLASSROOM.

1. **Does the teacher demonstrate adequate content knowledge of the learning area natural science to teach it?**

   Remarks:
   The teacher does demonstrate adequate content knowledge of what is being taught.

2. **Has the teacher made deliberate attempts to grasp and maintain learners' attention?**

   Remarks:
   The teacher does attempt to grab learners' attention through the questioning method. He also prompts learners to complete statements, although in a chorus manner which does not seem suitable for learners at this grade.

3. **Do learners seem to be taking active part in the lesson?**

   Remarks:
   At the onset of the lesson when the teacher introduces the lesson and explains some concepts the learners do not show much enthusiasm. When demonstration of the planets' orbits in the solar system commence they all liven up and want to contribute to the discussions or volunteer for the demonstrations.

4. **Does the teacher employ a variety of teaching and learning methods in the lesson?**

   Remarks:
   In the teaching, the lecture method, question and answer as well as the demonstration method are evident.

5. **Are there a variety of teaching and learning aids used to help learners understand the content?**

   Remarks:

The teacher did not utilise many teaching and learning aids. The white board was used for jotting main points and illustrating relationships of earth to the sun. The learners where then used to demonstrate the orbits followed by the planets around the sun.

6. **How often does the teacher check if learners are understanding?**

   Remarks:

   The teacher frequently checks for learners' understanding. This is done before moving on to the next point.

7. **How does the teacher check if learners are understanding?**

   Remarks:

   Learners are asked to complete the statements that the teacher begins.

8. **What reference material, if any, does the teacher refer to during the lesson?**

   Remarks:

   The teacher regularly refers to the textbook as the lesson progresses.

9. **Does the sequence of activities in the lesson seem to be planned for and scientific?**

   Remarks:

   The lesson does not unfold in a scientific way. The main purpose of the lesson is not made clear from the onset. Although the teacher is knowledgeable on the content he did not focus on the concept he set out to teach and eventually did not go in-depth in the concept for the day. There is not a clear link between the learners previous knowledge to what was being taught on the day. There also seems to be some improvisation as the lesson progresses. This is observed in the lack of adequate space for the demonstration of the planets around the sun in the classroom resulting in an ineffective demonstration.

APPENDIX 12

OBSERVATION OF MS LANGA: FEBRUARY 2017 AT JUBA PRIMARY SCHOOL IN THE GRADE 7 NATURAL SCIENCE CLASSROOM

1. **Does the teacher demonstrate adequate content knowledge of the learning area natural science to teach it?**

   Remarks:
   Although the teacher possesses knowledge on the learning strand Planet Earth and beyond, it does not seem to be sufficient for the grade level (Grade 7) to which she is delivering her lesson to.

2. **Has the teacher made deliberate attempts to grasp and maintain learners' attention?**

   Remarks:
   There is evidence through-out the lesson by the teacher of trying to grab and maintain the learners' attention. However the same means of achieving this, questioning technique, could have been varied with other means of gaining learners' attention.

3. **Do learners seem to be taking active part in the lesson?**

   Remarks:
   Active participation is noted through learners responding to teachers' questions, not however through their own initiatives.

4. **Does the teacher employ a variety of teaching and learning methods in the lesson?**

   Remarks:
   The teacher is employing to a large extent the question and answer method. The lecture method is also evident in the lesson delivery. Demonstration is also being used by the teacher in an attempt to bring understanding to the learners.

5. **Are there a variety of teaching and learning aids used to help learners understand the content?**

Remarks:
Adequate teaching and learning aids for the lesson are utilised such as a globe of the earth and an apple and a pencil to demonstrate the tilt of the earth along its axis.

6. **How often does the teacher check if learners are understanding?**

Remarks:
The teacher is periodically checking for learners understanding especially after explaining or the demonstration of a particular concept.

7. **How does the teacher check if learners are understanding?**

Remarks:
- Learners are responding to teacher's questions.
- Learners are requested to demonstrate learnt concepts such as the rotation and revolution of the earth.
- Requesting learners to summarise covered aspects of the lesson.

8. **What reference material, if any, does the teacher refer to during the lesson?**

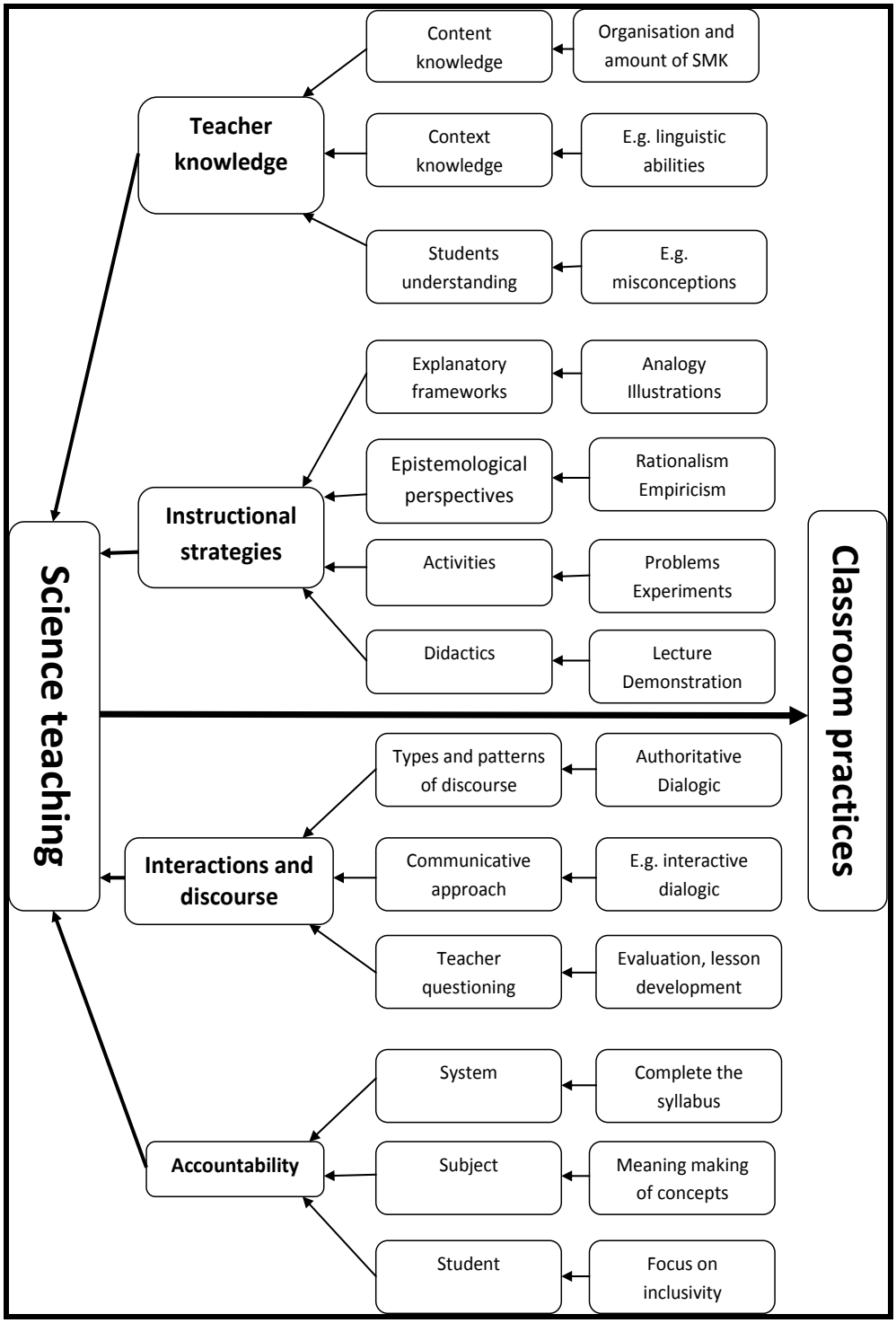
Remarks:
The teacher is regularly referring to the textbook and instructing learners to look at diagrams and illustrations related to what is being discussed in the lesson.

9. **Does the sequence of activities in the lesson seem to be planned for and scientific?**

Remarks:
The activities do seem to be planned for scientifically, however the teacher does allow for too much digression as observed by the lesson going off track as too much attention was now being paid to the seasons.

APPENDIX 13

THE EXPANDED CPDF.



APPENDIX 14:

TURNITIN ORIGINALITY REPORT

Exploring Senior Phase Natural Science Teacher's Classroom Practices: A Focus on Planet Earth and Beyond Strand

ORIGINALITY REPORT

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APPENDIX 15:

EDITING CERTIFICATE

Vhutali Leadership and Management Institute

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24 October 2017

Contacts: 27763881622 Email: drmafukata@gmail.com

Dear Sir/Madam

Re; Dissertation: **"Exploring Senior Phase Natural Science Teachers' Classroom Practices: A focus on Planet Earth and Beyond Strand"**

1. This serves to inform you that the above-mentioned dissertation has been edited and proofread by me. Dissertation details:

Candidate: Oyindiye Mosi Bango
Student number: 45158142
University: University of South Africa
Degree: M.ED IN NATURAL SCIENCE EDUCATION
Supervisor: Professor AV Mudau

2. This is to confirm that the dissertation in its current form is examinable

I hope you find this in order

Regards

Dr MA MAFUKATA