EXPLORING TEACHER APPROACHES TO TEACHING A SELECTED UNIT OF STUDY IN THE NATURAL SCIENCE CURRICULUM

By

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DECLARATION

I, Maanwanthie Jerrier (Student Number: 9804251) do hereby declare that this dissertation, which is submitted to the University of KwaZulu-Natal for the degree of Master of Education, has not been previously submitted by me for a degree at any other university, and that all sources I have used or quoted have been indicated and acknowledged by means of a complete reference.

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List of Abbreviations

1. PIRLS - Progress in International Reading Literacy Study 2006
2. TIMMS - Trends in International Mathematics and Science Study
3. NS - Natural Science
4. DOE - Department of Education
5. NCES – National Curriculum Evaluation System
6. SACMEQ - Southern and Eastern African Consortium for Monitoring Education Quality
7. NCS - National Curriculum Statement
8. RPL - Recalling Prior Learning
9. OBE - Outcomes Based Education
10. NRC - National Research Council
11. RNCS - Revised National Curriculum Statement
12. H.O.D - Head of Department
13. TA - Teacher A
14. TB - Teacher B
15. TC - Teacher C
16. TD - Teacher D
17. CO2 - Carbon dioxide
18. O2 - Oxygen
19. LO - Learning Outcome
20. AS - Assessment Standard

ABSTRACT

Research indicates that conceptual knowledge and abstract thinking was deficient in South African learners (TIMMS, 1999, 2003; Gower 2008). The general poor performance of learners in Reading, Mathematics and Science has spurred the Department of Education to conduct a campaign to boost learner performances in these learning areas.

This interpretive study, using a case-study approach, is located at a public primary school in a rural area in the Chatsworth District of the Umlazi Circuit, KwaZulu-Natal, South Africa, and serves to explore how different teachers teach a selected unit of study in Natural Sciences (NS) in Grade 4. The use of constructivist approaches such as "hands-on" and "minds-on" activities, creating learner-centered environments, problem solving strategies, code switching, dialogical interactions and active participation by students in NS relate to positive academic efficiency and attitude to Science. The researcher is an educator for 24 years and this study, motivated both by both personal imperatives and research and policy imperatives, asks the following critical questions: *1) How do teachers approach the teaching of "a unit of study" in a grade four Science class? 2) Why do teachers choose these approaches to teach the unit in Science to a grade four class?*

The literature reviewed focuses on the current trends used in the teaching of Science with special emphasis on the approaches and strategies that teachers use to create, build and sustain interest in the learning area of Science, and are compared to what is advocated by the National Curriculum Statement for Natural Sciences grades 4-9 (2002). The conceptual framework of the constructivist epistemology which regards humans as generating knowledge and meaning from their experience is explained, and pedagogies and learning environments based on constructivism are discussed. The relationship between constructivism and the philosophy of the NCS NS policy document, and the use of the NCS NS Policy as analytical framework, is also explained and discussed.

In this qualitative approach the researcher uses a purposive sample, in which the strategy of video-recording lessons, semi-structured interviews, and stimulus-recall methods are utilized to elicit rich data from participants.

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Three major insights emerge, viz. that of learner centeredness in the teaching of science and how this relates to the teachers of science; the teachers' role as a mediator, and the challenge of classroom assessment. The teaching approaches that underpin the new curriculum demands that teachers use more interactive pedagogies so that continuous assessment could be supported. The study reveals that certain contextual factors, like large class sizes, as well as varying levels of understanding on the part of educators about learner-centredness, teacher as mediator and assessment, still pose difficulties for implementation and concords with Grosser and de Waal's (2008) study that reveals deficiencies regarding the understanding and application of mediated learning experiences in the classrooms. The intentions of policies are commendable but they pose many challenges for teachers in their classroom practice, viz. inadequate teacher expertise and content knowledge, limited access to relevant teaching and learning resources, poor understanding of assessment, high teacher workloads, large class sizes and the continued reliance on traditional assessment practices. It is suggested that the Department curriculum development unit will need to provide the existing teachers support on a continuous basis so that they can create and maintain an effective learner-centred environment. This should include in-service training for educators, provision of appropriate materials and support for the NS teacher presenters and Department trainers who themselves are substantially cognizant of the challenges teachers face in schools.

CHAPTER 1

Introduction: Context and Overview

1.1 Introduction

In the *Progress in International Reading Literacy Study 2006*, which measured trends in children's reading and literacy achievements in 41 countries around the world, South African learners were reported to be the worst performers. In the 1999 and 2003 *Trends in International Mathematics and Science Study (TIMMS)* South African learners also came last. Gower (2008), found that conceptual knowledge and abstract thinking was sadly lacking in South African learners. The general poor performance of learners in Reading, Mathematics and Science has spurred the Department of Education to conduct a campaign to boost learner performances in these learning areas.

My interpretive study, which is located at a public primary school in a rural area in the Chatsworth District of the Umlazi Circuit, KwaZulu-Natal, South Africa, serves to explore how different teachers teach a selected unit of study in Natural Sciences (NS) Grade 4. The use of constructivist approaches such as "hands-on" and "minds-on" activities[1], creating "learner-centered environments"[2], "problem solving strategies"[3], "code switching"[4], "dialogical interactions" and "active participation by learners"[5] in NS relate to positive academic efficiency and attitude to Science.

Dorman, Fisher & Waldrip (2006) report that teachers who provide support, demonstrate equity in the classroom, ensure that learners complete learning activities and engender student cohesion in Science classrooms are more likely to enhance their learners academic efficacy at Science and attitude to Science (Dorman, Fisher & Waldrip, 2006). Waxman & Chang (2006) add that an approach to improving classroom instruction centres on employing explicit teaching practices, especially for lower achieving learners. Waxman & Padron (2002) also support explicit practices because they have shown to improve learning as

These terms are explained in chapters 2, 4 and 5.

[1] Hands on and minds on activities, see Pollard (2005, Chapter 5).

[2] Learner-centred environments, see Gamoran, Secada and Marrett (1998, Chapter 2)

[3] Problem solving strategies, see Cobb and Bauersfeld (1995, Chapter 2)

[4] Code switching, see Probyn (2004, Chapter 2)

[5] Dialogical interactions and active participation by learners, see Lemke (1990, Chapter 2)

cognitively guided instruction, culturally responsive teaching, cooperative learning and instructional conversation in the teaching of Science (Waxman & Padron, 2002). All of these research based instructional practices, stress a student-centered model of classroom instruction that emphasizes more active student learning and teachers becoming facilitators of learning (Waxman & Chang, 2006).

The studies that I have cited relate to international initiatives that have been conducted in the quest to improve the quality of Science teaching. My electronic search for national as well as local studies in the field have revealed a dearth in the research field of NS at primary school level, as I have not been able to access such studies.

Learners in grade 4 Science were reported to perform far below the national average (TIMMS,1997, 2003, 2006). I have therefore decided to embark on a qualitative study in a primary school by making use of video recordings of teachers' approaches to teaching and conducting semi-structured interviews using a stimulus recall method to collect my data.

1.2 Focus and purpose of study

1.2.1 The Purpose of the study

The purpose of my study is to:

- Explore how educators teach a selected unit of study in Natural Sciences in a Grade 4 class.
- Describe the approaches and strategies that these educators' employ.
- Explain the teaching of the selected unit of study with regards to the teachers' choice of approaches.

By using a stimulated recall method and semi-structured interviews, I was able to get the teachers to give their own explanations, which I recorded in order to incorporate this in my narrative during my analysis. I have used this particular strategy to give the teachers their own voices, so that the omniscient voice of the researcher is obviated and also to give reliability and validity to the data revealed, as rich data is obtained using these methods and strategies.

1.2.2 Rationale

There is a growing demand for accountability and increasing importance for evaluation in all learning areas of the curriculum. The Department of Education has become seriously concerned by the general poor performance of learners in reading, Mathematics and Science. Studies conducted by Taylor and Vinjevold (1999), Fleisch (2007) and Taylor (2009) have all revealed the need for accountability in the school curriculum.

The campaign to boost learner abilities in the said areas came after South African learners were reported to be the worst performers in the *Progress in International Reading Literacy Study 2006*, which measured trends in children's reading and literacy achievements in 41 countries around the world. South African learners also came last in the 1999 and 2003 *Trends in International Mathematics and Science Study (TIMMS)*. It was also found that conceptual knowledge and abstract thinking was sadly lacking in South African learners (Gower, 2008).

According to the TIMMS (1997) report the performance of South African learners in Grade four, eight and final year of secondary school was significantly low in that South Africa had come 'stone last', with our average being far below the international average score in all of these grades in both Mathematics and Science (NCES, 1997) .

TIMMS is a fair and accurate comparison of Mathematics and Science achievement at the end of secondary schooling in the participating nations, as our general population is not being compared to more select groups in other countries (NCES, 1997). I therefore believe that there is a need for concern.

Recent studies have also revealed the poor performance of South African schools compared to those in both developed and developing countries. These have been established at primary level in Mathematics and Reading and at secondary levels in Mathematics and Science {Taylor, 2009; Taylor, Fleisch & Shindler 2007).

The *Southern and Eastern African Consortium for Monitoring Education Quality (SACMEQ*) scores for Mathematics at Grade 6 level clearly reveal that South Africa is outperformed by eight surrounding countries, many of which, including Mozambique, Kenya, Uganda and Tanzania, are much poorer, with gross domestic products ranging from one-tenth to one-sixth

of South Africa's respectively. This clearly demonstrates that although poverty is often associated with performance, many school systems are achieving higher quality with far fewer resources than South Africa has (Taylor, 2009).

Another reason for concern is the analysis of the SACMEQ scores by quintile. It has been found that even amongst the richest 20 percent of schools (quintile 5) South Africa is still outperformed by countries like Mauritius and Kenya. In all other quintiles the South African mean scores fall below those of the SACMEQ all-country means (Taylor, 2009)

We can therefore note that SACMEQ studies collaborate with both the TIMMS studies and the PIRLS report. The results in the post apartheid era have demonstrated that the school systems have been slow in transformation. Given the enormity of the task of levelling the playing fields of education which carries a legacy of 350 years of colonial selective development, I believe that we must pursue the argument that the key to improved performance lies in fostering a culture of professional responsibility and accountability at all levels of the system.

I therefore decided to situate my study within a single domain of the curriculum and focus my study on the teaching approaches that teachers use in the teaching of NS. My study therefore has also a personal imperative, as I am an educator for the past 24 years at the same school and I have taught NS. Anecdotal observations also show that the results and performances are in keeping with the trends that have already been observed. Given this scenario, I wish to concretize this quest into a personal study, as I have noted gaps in NS research at primary school level.

I have been a teacher of Science for the past 22 years and my interest and focus lies in new methods and strategies that could be employed to make the teaching of Science interesting. I have therefore chosen to explore a part of the Natural Sciences Curriculum in Grade 4. My observations and literature review therefore frame the following *critical questions* I ask in the study:

Critical questions:

1. How do teachers approach the teaching of "a unit of study" in a grade four Science class?

2. Why do teachers choose these approaches to teach the unit in Science to a grade four class?

1.2.3 Scope of the Study

My interpretive study serves to explore how different teachers teach the same unit of study ("Green plants make food") in Natural Sciences (NS) in Grade 4 classes. The study is located at a public primary school in a rural area, which falls under the Chatsworth District of the Umlazi Circuit. Four teachers from the grade four classes were selected. The pre-selected unit of study that they all taught was video-recorded. These teachers were then interviewed by the use of the stimulus-recall method and a narrative of the analysis was then presented. The unit of study comprised of two one hour lessons, therefore eight hours of video-recordings were accomplished. These lessons enabled me to observe, explore, describe and explain the approaches that the teachers used during the delivery of their NS lessons. The stimulus-recall interviews enabled the teachers to answer the questions directly as they have been reminded of their teaching at a particular point in time, "thus confronting the teachers with their recent actions, thereby minimizing superficial self presentation by the researcher" (Steele, 2003).

The institution that I have chosen is set in a rural area around which many low cost housing townships have arisen. Immediately along one side of the school fence is a large informal settlement which the children and the communities call the "mjondolos". Many learners who are from these 'mjondolos' attend the school. A vast majority of the learners come from the low socio-economic backgrounds, and are happy to be at school as they receive a hot meal on a daily basis which is provided by the Department of Education.

I had hoped that the research undertaken at this institution will provide 'rich data' and thick descriptions (Merriam, 1988, p.11). I used an "insiders approach[6]" as I am a teacher at the school and I am well known to the teachers and the learners. The principal of the school was extremely helpful and was obliging in my request to conduct the research at the school. The teacher participants were also most accommodating and helpful. The learners were eager to appear on the video-recordings and came to school well spruced up and looking forward to their lessons.

[6] Insiders approach, refer to Chapter 3, Roland and Wicks (2009), Hockey (1993).

Because I have established a good rapport with the participant educators, I was able to conduct successful interviews after inviting them to my home individually to watch the video-recordings of their lessons and then to conduct the interview using the stimulus recall method. All of the teacher participants were thrilled and amused to watch themselves on video. They soon settled down to become seriously engrossed in watching their teaching and were amazed at how they perceived themselves and their teaching using another lens.

1.2.4 Limitations

1. Methodological: video can capture only what is observable. Unspoken thoughts and feelings of a participant cannot be seen or heard on tape. The event can be experienced vicariously. Only the events occurring within the range of the camera lens can be recorded.
2. Contextual: Different teachers are trained at different levels of competency. Some teachers maybe qualified whilst others may not be qualified. All the participants come from the same school so therefore we would expect the teaching approaches of the different teacher participants to vary and differ from each other.

1.2.5 Overview of the Study

In this chapter I have summarized the rationale for undertaking this study, particularly presenting the contextual and personal imperatives that motivate my undertaking. I proposed that I wished to explore how educators teach a selected unit of study in Natural Sciences in a Grade 4 class, and describe the approaches and strategies that these educators employ in their teaching, as well as explain the teaching of the selected unit of study with regards to the teachers' choice of approaches..

In ***Chapter Two***, which constitutes my literature review, I focus on recent or current trends used in the teaching of Science with special emphasis on the approaches and strategies that teachers use to create, build and sustain interest in the learning area of Science. These approaches and strategies are explained and described and also compared to what is espoused by the National Curriculum Statement for Natural Sciences grades 4-9, (2002). The conceptual framework of the constructivist approach is explained according to its cognitive implications. Pedagogies based on constructivism and learning environments that are designed according to constructivist teaching are discussed and the

relationship between constructivism and the philosophy of the NCS NS policy document is explained. The use of the NCS NS Policy as analytical framework is also explained and discussed.

In ***Chapter Three***, I describe how the qualitative approach is used. The strategy of video-recordings of the lessons, semi-structured interviews, and the technique of the stimulus-recall method and how it is used to reveal rich data from participants is discussed. My motivation for a case-study approach within an interpretive paradigm, purposive sampling, the advantages of using video-recordings, the use of the narrative approach and ethical considerations are also discussed in this chapter.

In ***Chapter Four,*** analysis of the data is undertaken**.** The evidence on which my analysis is based is derived from a small scale descriptive study based on four teachers, each teaching the same unit of study in different grade 4 classes. Although much of the data, despite ringing true or of authenticity it may have for most rural South African schools and classrooms, will require verification before it can serve as generalisable in a firm national picture. It nevertheless illustrates the similarities and differences in the teaching approaches that different teachers employ in the teaching of the same unit of study in NS in a grade 4 class.

In ***Chapter Five,*** which describes my findings and recommendations, I respond to the data by highlighting some of the major insights and findings that have arisen. One of the major insights discussed is learner centeredness in the teaching of science and how this relates to the teachers of science. The teachers' role as a mediator is also explained and discussed. Pollard's (2005) constructivist models are used to explain how constructivist approaches in the teaching of science is envisioned and can be used. The challenge of classroom assessment has also been revealed as a major insight and the need for sustainable teacher development in this area is also discussed. Finally, some recommendations for the DOE are suggested.

CHAPTER 2

The Conceptual Framework and Literature Review

2.1. Introduction

In this chapter I describe the adopted conceptual framework of constructivism, illustrate how the philosophy of the National Curriculum Statement grade R-9 Natural Sciences Policy Document embraces the principles of constructivism and constructivist approaches, explain what cognitive constructivism is, illustrate the pedagogies based on constructivism, describes what a constructivist learning environment is all about and highlight the relationship between constructivism and the philosophy of the NCS NS (DOE, 2002) policy document.

The conceptual framework is then followed by a discussion of studies conducted nationally and internationally. These studies focus on the approaches that Science teacher's use in the teaching of Science. These approaches and strategies in NS relate to positive academic efficacy and attitude to teaching and learning of Science. The theorists I have favoured are Camill (2000) and Cliff and Curtin (2000) who support the case method as a problem solving strategy; Probyn (2004) who illustrates the need for code-switching in the South African context; Mercer, Dawes, Wegerif and Sams (2004), Lemke (1990) Driver, Asoko, Leach, Mortimer and Scott (1994), Dawes (2008), Alexander (2006) and Cobb and Bauersfeld (1995) who all advocate dialogical interactions and socially constructed discourse; Kang and Howren (2004) and Manner (2001) who support the theory of recalling prior learning (RPL) and Roberts (2009) who supports the creative transfer of ideas to carry out open-ended investigations.

I then discuss the Analytical framework. The analytical framework explains the purpose of policies in education and the making of policies in education. The views of theorists such as Ball (2006), Taylor (1999) and the National Curriculum Statement (NCS) policy for Natural Sciences (DOE, 2002) as a frame of reference for my study are discussed.

2.2. Conceptual Framework

The conceptual framework is based on the ideas that will be purported by the constructivist approach and it will show how the philosophy of the NCS curriculum policy of NS embraces these principles of constructivism.

The literature review therefore focuses on studies that have already been conducted in the teaching of Science both locally and internationally using the theories of the constructivist approach. By examining local and international trends that teachers use in their classrooms, I will be able to explore how teachers teach NS in a Grade 4 class at the selected site of study.

In my description of constructivism as a framework, I explain what cognitive constructivism is, illustrates the pedagogies based on constructivism, describes what a constructivist learning environment is all about, and highlight the relationship between constructivism and the philosophy of NSC NS policy document.

2.2.1 Background to Constructivism

Constructivism is a psychological theory of knowledge or epistemology which believes that humans generate knowledge and meaning from their experiences. The formalization of the theory of constructivism is generally attributed to Jean Piaget, who explains mechanisms by which knowledge is internalized by learners. He believes that through processes of "accommodation' and 'assimilation', individuals construct new knowledge from their experiences. When individuals assimilate, they incorporate the new experience into an already existing framework without changing the framework. This will occur when individuals' experiences are aligned with their internal representation of the world.

According to the theory, accommodation is the process of reframing one's mental representation of the external world to fit new experiences. Accommodation can therefore be understood as the mechanism by which failure leads to learning, that is, when we act on the expectation that the world operates in one way but our expectations are violated, we feel as if we have failed, but by accommodating this new experience and reframing our model of the way the world works, we learn from the experience of failure (Piaget, 1967).

Since the theory of constructivism suggests that learners construct knowledge out of their experiences, constructivism is therefore often associated with pedagogic approaches that promote active learning or learning by doing. The learning activities will therefore be characterized by active engagements, hands-on activities, inquiry, problem-solving, investigations, experimental design and collaboration with others (Bodner, 1998).

2.2.1.1 Cognitive Constructivism

Cognitive constructivism is based on the work of Swiss psychologist, Jean Piaget, who studied the development of thought in children. Piaget's theory of cognitive development proposes that humans cannot be given information which they immediately understand and use. He believes that, instead, humans must construct their own knowledge. They build their knowledge through experience. Experiences enable them to create schemes or mental models in their heads, where they try to organize structure and restructure their experience in light of existing schemes of thought and modify and expand their schemes (Piaget, 1967). Piaget's view of how knowledge construction occurs focuses on internally driven mental activities of the individual child, a cognitive development that is seen to proceed in stages and that which is universal and predictable (Piaget, 1967; Flavell, 1992).

Driver et al (1994), therefore propose that learning from this perspective requires a well designed practical activity that challenges learners' prior conceptions and encourages learners to reorganize their personal theories. This perspective of constructivism shows the inadequacy of the teacher – centered approach. The role of the teacher therefore is to provide a rich environment for the spontaneous exploration of the learner, a classroom filled with interesting things to explore encourages learners to become active constructors of their own knowledge through experiences that encourage assimilation and accommodation.

2.2.1.2 Pedagogies based on constructivism

There is much pedagogy that is based on the constructivist theory. Most of the approaches for example, practical work in Science stems from constructivism and support the idea that learning is achieved best by using a hands-on approach. Learners must learn by experimentation and being left to make their own inferences, discoveries and conclusions.

Learners learn new information that is presented to them by building upon knowledge that they already possess.

In most pedagogies based on constructivism, the teacher's role is to observe, as well as engage with learners while they are completing activities. They should pose questions to the learners to stimulate their ability to reason (De Vriesl, 2000). According to (Gamoran, Secada and Marrett, 1998), the student will have to play a more active role in the learning process. The emphasis must turn away from the teacher and the content and move towards the learner and his activities. Rhodes and Bellamy (1999), add that a teacher should support, give guidelines and create the environment for the student to arrive at his or her own conclusions and sustain a continuous dialogue with learners.

2.2.1.3 Social Constructivism

Social constructivism encourages the learner to arrive at his own version of the truth. This is important for the student's social interaction with knowledgeable members of society. Wertsch (1997) stresses that without the social interaction with more knowledgeable people, it is impossible to acquire social meaning of important symbol systems and how to use them. Young children develop their thinking abilities by interacting with other children, adults and the physical world. Social constructivism therefore takes into account the background and culture of the learner throughout the learning process because the responsibility of learning resides increasingly with the student (Glasersfeld, 1989). Social constructivism emphasizes the importance of the learner being actively involved in the learning process. Learners construct their own understanding and they do not simply mirror and reflect what they read. Learners must look for meaning and regularity in the order of events (Glasersfeld, 1989). According to Lorsbach and Tobin (1997) the constructivist epistemology asserts that the only tools available to a knower are their senses. It is through the use of the five senses, which are seeing, hearing, touching, smelling and tasting, that individuals interact with their environment. With the messages that they receive from their senses, they are able to build a picture of the world. Lorsbach and Tobin (1997) therefore assert that knowledge cannot be transferred intact from the head of a teacher to the heads of learners. The learners will therefore try to make sense of what is taught by trying to fit it in with their previous experiences or what is already known (that is, prior knowledge).

From a constructivist perspective, Lorsbach and Tobin (1997) agree that science is not the search for truth but rather it is a process that assists us to make sense of our world. The teaching of science therefore becomes an active, social process of making sense of experiences. Learner's prior knowledge of phenomena is an important part of how they come to understand school science. An important aspect of a constructivist oriented curriculum is the negotiation of meaning. This process involves discussion and attentive listening, making sense of the points of views of others and comparing personal meanings to those embedded within the theories of peers and by comparing similarities and differences between the theories of their peers and their own (Lorsbach and Tobin, 1997). This epistemology therefore allows learners to work successfully as members of a group and to construct knowledge socially.

2.2.1.4 How constructivism relates to the philosophy of the NCS NS Grade R- 9 (2002) Policy Document

The philosophy of the NCS grades R-9 Policy Document (DOE, 2002) is based on the principles of social transformation, democratic values, social justice and fundamental human rights. Learners are therefore encouraged to develop an understanding of the rich diversity of this country, including the cultural, religious and ethnic components of this diversity (DOE, 2002). Outcomes Based Education (OBE) encourages a learner-centered and activity based approach to education. As listed in this document, the critical outcomes to be achieved are:

1. Identifying and solving problems and making decisions using critical and creative thinking.
2. Working effectively with others as members of a team, group, organization and community.
3. Collecting, analyzing, organizing and critically evaluating information.
4. Communicating effectively using visual, symbolic and/or language skills in various modes.
5. Organise and manage themselves and their activities responsibly and effectively.
6. Use Science and technology effectively and critically, showing responsibility towards the environment and the health of others.

7. Demonstrating an understanding of the world as a set of related systems by recognizing that problem solving contexts do not exist in isolation. (DOE, 2002, p.7).

The development of higher knowledge and higher level skills is also emphasized. These are linked to progression where learners will develop more advanced skills and knowledge. These are known as process skills. These skills can be learned across the three learning outcomes. The term "process skills" refers to the learner's cognitive activity of creating meaning and structure from new information and experiences. Examples of process skills will include observing, making measurements, classifying data, making inferences and formulating questions for investigation. Process skills therefore can be seen as building blocks from which suitable Science tasks are constructed. The framework of process skills enables teachers to design questions which promote the kinds of thinking required by the Learning Outcomes. From the learning point of view, process skills are an important and necessary means by which the learner engages with the world and gains intellectual control of it through the formation of concepts (DOE, 2002). The NCS NS Grade R-9 Policy Document can be seen to strongly embrace the principles of constructivism. The document supports learner-centeredness and learner-centered activities and the creation of effective environments for learners to engage in investigative and hands-on work, inquiry and project based learning, problem solving and working as part of a team.

2.2.2 Analytical Framework

Given my intention to explore the approaches that teachers employ in the teaching of NS grade 4, I would make use of an analytical framework. The analytical framework will therefore consist of an explanation of the purpose of policies and policy making and the views of theorists such as Ball(2006), Taylor(1999) and I will use the National Curriculum Statement (NCS) policy for Natural Sciences (NS) (DoE,2002) as the frame of reference in my study. During my analysis I will compare how the school context and the participant teachers respond to the demands of the curriculum by paying particular attention to the approaches and strategies that the teachers employ in the teaching of NS.

Ball (2006) agrees that the analysis of a policy is a complex task, as it cannot be accomplished successfully by single theory explanations. He believes that "what we need in

policy analysis is a toolbox of diverse concepts and theories-an applied sociology rather than a pure one" (Ball, 2006, p.43). He therefore looks at policy from three perspectives: policy as text, policy as discourse and policy effects. In the analysis of policy as text, the "encoding" of policies are complex. It is formed via struggles, compromise, authoritative public interpretations and reinterpretations. The "decoding" of policies is just as complex as it is decoded via actor's interpretations and meanings in relation to their history, experiences, skills, resources and context. The text and the readers of the text all have histories, thus interpretations can occur according to the various lenses through which they are viewed (Ball, 2006).

Ball (2006) also looks at policy as discourse which describes what can be said, thought and also who can speak and with what authority. He believes that "we are spoken by policies; we take up the positions constructed for us within policies" (Ball, 2006, p.48). Each person may be able to conceive of the possibilities of response in and through the language, concepts and vocabulary that makes sense to them, because in our complex societies we are subjected to a variety of discordant, incoherent and contradictory discourses (Ball, 2006). The effects of policy, and in particular education policy depends largely on context of school within which it is implemented.

Taylor (2005) views curriculum policy as a key factor in setting the direction for and providing coherence in teaching and learning. He submits that a curriculum framework sets out the intention of policy makers. Its main purpose would be to guide teachers as they plan their daily classroom activities, it guides textbook writers about what materials they should provide teachers and learners with , and also informs those who construct assessment instruments for measuring what has been learnt at classroom, district, provincial or national levels. A curriculum framework also implicitly states the kinds of teachers that are required to give effects to its intentions (Taylor, 1999). Like Ball (2006), Taylor (1999) also intimates that school actors and teachers in particular always reinterpret policy effectively remaking it. A curriculum framework therefore serves as the chief instrument for aligning the work of the multiple sets of actors who deliver teaching and learning (Taylor, 1999). The Department of Education (DoE) Natural Sciences (NS) curriculum policy (2002) will be used as my framework or point of reference when analyzing the data that I elicit through my research methods.

All teachers are viewed as key contributors to the transformation of education in South Africa. The National Curriculum Statement (NCS) grades R-9 (schools) envision teachers who are qualified, competent, dedicated and caring. It is hoped that they will be able to fulfill the various roles outlined in the Norms and Standards for Educators. These will therefore include teachers being mediators of learning, interpreters and designers of Learning Programmes and materials, leaders, administrators and managers, scholars, researchers and lifelong learners, community members, citizens and pastors, assessors and learning area or phase specialists (DoE, 2002).

For this study I will make use of the National Curriculum Statement (NCS) of Natural Sciences (NS) (DoE, 2002) as the framework for my study. During my analysis I will compare how the school context responds to the policy. With the implementation of the NCS (DoE, 2002), new demands are being placed on the Science teacher. No longer are traditional methodologies such as the simple transmission of facts and "chalk and talk" valued. Environments where "experts discover, teachers tell and learners remember facts, theories or procedures" (Lapadat, 2000, p.1), have been labelled inefficient in promoting student learning. Instead, Science teaching is now viewed as learning area where Science classrooms are centered on engaging learners in investigating scientific ideas as active individuals who bring past experiences and prior knowledge to the learning task at hand (DoE, 2002). According to the (DoE, 2002) Science has been shaped by the "search to understand the natural world through observation, codifying and testing ideas, and has evolved to become part of the cultural heritage of all nations" (DoE, 2002, p.4).

In order to be accepted as Science, certain methods of inquiry are generally used. These methods promote reproducibility, attempts at objectivity, and a systematic approach to scientific inquiry (DoE, 2002). According to the National Research Council (NRC) (2000), inquiry classrooms are environments where learners observe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and report their ideas to others using claims and evidence. They also use critical thinking by considering alternative explanations in an attempt to increase their understanding of scientific knowledge through the use of reasoning and thinking skills (NRC, 2000). This is not unlike the NS learning area statement of the DoE (2002), which envisages a teaching and learning milieu which recognises that the people of South Africa operate with a variety of

learning styles as well as with culturally influenced perspectives. It operates from a premise that all learners should have access to a meaningful Science education. "Meaningful" education alludes to learner-centeredness, where learners are helped to understand not only scientific knowledge and how it is produced, but also the contextual environment and global issues that are intertwined within the learning area (DoE, 2002).

As espoused by the NCS policy, teachers can rightfully take their place as "facilitators" and learners as "learners" as the ability to reason scientifically is one of the main tools of our new policy.

2.2.3 Review of Literature

The literature reviewed indicates that there are various trends, methods and strategies that teachers employ in the teaching of Science nationally and internationally (Kang and Howren, 2004; Manner, 2001; Camill, 2000; Cliff and Curtin, 2000 and Probyn, 2004). In my analysis I shall discuss the relevance of these methods and strategies and explain how these strategies may be suitable or unsuitable in our South African context. These studies are relevant to my research as they clarify the various methods and strategies employed by teachers in the teaching of Science as well as the different contexts in which these strategies can be used.

Camill's (2000) and Cliff and Curtin's (2000) case method approach which involves problem solving strategies that could be used in the teaching of Science, Probyn's (2004) theory of 'code switching' and Kang and Howren's (2004) theory of 'recalling prior knowledge' are an integral facet of the National Curriculum Statement. It has assisted my research purpose to ascertain whether the approaches adopted by the NS teachers include these theories during the delivery of the NS lessons.

Conceptual understanding requires learners to organise facts and ideas into a meaningful concept in Science. The teacher has the task to find out learners prior conceptions, identify the misconceptions, allow them to learn through various methods that get them involved actively and allow them to evaluate themselves. Kang and Howren (2004) therefore emphasize that the success of a unit of study will depend on starting the lesson by identifying what learners know and challenge learners' ideas with various activities. The critical aspect

is when learners examine their own ideas, thus building on their conceptual understanding (Kang and Howren, 2004).

Probyn (2004) adds that in South African context 'code-switching' is a necessary process for conceptual understanding. An aspect to teaching and learning of Science through two languages, that is mother-tongue and English, is one that poses a problem to majority of South African teachers and learners. Probyn's (2004) study shows that there is a constant need for code-switching by the Science teacher, in order to get concepts across to learners. Also the concepts had to be illustrated through demonstration, analogy and practical work and consolidation on the chalkboard. It was found therefore that teacher skills needed to be developed to promote higher-order thinking and it was necessary to provide linguistic and contextual support for teachers (Probyn, 2004). This study on 'code-switching' will elicit data for the manner in which teachers approach difficulties in teaching NS in grade 4. 'Code-switching' is a necessary approach in enhancing understanding of scientific and conceptual knowledge. The observation method assisted in my research to ascertain whether it was used as an approach. Although in South Africa, the Language in Education Policy (DOE, 1997) allows for learners to choose their language of teaching and learning, there are many factors that do not allow for this ideal situation.

In order to answer my first critical question, *What approaches do teachers use in the teaching of a unit of study in a Grade 4 class,* I used the theories proposed by Kang and Howren (2004), to ascertain if teachers employed these issues in the classroom. Probyn's (2001) study proved especially useful in my research as it is a South African study and very pertinent to the context of my own study. It was interesting to observe how "code-switching" as a strategy was employed and to what extent it was employed in the teaching of NS in grade 4.

In order to answer my second critical question as to *why teachers chose the approaches that they used in their teaching of Science*, I examine Manner's (2001) theory of "re-calling prior learning". Kang and Howren (2004), Manner (2001) and Probyn (2004) provide ideas and strategies that show how to teach Science for conceptual understanding. Manner (2001) speaks of 'multiple intelligences' of children and how teachers need to take cognisance of this in their teaching. Camill (2000) and Cliff and Curtin (2000) advocate the use of the case method for the teaching of environmental issues in Science. All of the above studies have

relevance to my research because they assisted in the answering of the critical questions through my observations and interviews.

I borrowed from Kang and Howren's (2004), Probyn's (2004) and Gowers (2008) findings because of their similarities. Kang and Howren (2004) explore the teaching of conceptual understanding. They found that one of the most difficult jobs in primary school Science teaching was teaching Science for conceptual understanding.

Of significance, then, are dialogical interactions amongst learners. Mercer et al (2004) suggests that there are two distinct contexts in which language occurs in classroom environments. They are teacher-led situations and peer group interactions. Lemke (1990) adds that it is through peer group interactions that learners become fluent speakers of "Science". It is through this "language of Science" that learners make sense of their newly constructed ideas (Lemke, 1990). Driver et al (1994) also claim that it is the role of the teachers to make the tools of Science available to learners, allowing them to engage in socially constructed discourse. As teachers create opportunities for learners to use these tools in the classroom, learners' scientific reasoning skills also increase.

According to Dawes (2008) teachers of Science should aim to establish inclusive dialogue in order to promote thinking and learning. The most crucial aspect of this is the chance for learners to articulate their own ideas. Dawes (2008) explains that classroom dialogue involves speaking and listening during educational activities, with a focus on what the teacher intends the student to learn. This opportunity of participating in dialogue is a profound educational experience that a teacher can offer to learners.

However, Dawes (2008) emphasizes that dialogic teaching is distinctive in that there is a clear focus on learning coupled with openness in the process of generating understanding. Alexander (2006) identifies dialogic teaching as a *collective* – where teachers and learners work on learning tasks together; *reciprocal* – where everyone listens to each others point of view; *supportive* – where learners respect each other's ideas and know that their task is to help one another understand*; cumulative*, where the discussion gradually builds on what is said, links are made and lines of thinking are evident and purposeful. The teacher's planning ensures that the discussion is focused on learning goals (Alexander, 2006)

Learners therefore must be able to share with confidence, make suggestions and hear new ideas. Learners must also be able to retain their creative and imaginative everyday ideas along with their newly acquired Science knowledge.

Cobb and Bauersfeld (1995) agree that as student voice increases, teachers tend to give up control of discourse and begin to move from a teacher-centered style of teaching to that of a student-centered learning environment. By allowing this type of student decision making, the classroom becomes a place where richer understandings about Science ideas are able to occur.

In order to achieve learning outcomes and assessment standards successfully it is important for teachers to tap into learners learning styles and employ good methods and strategies in the teaching of Science. The next two concepts place emphasis on the following critical trends, namely 'multiple intelligences' strategies in classroom learning and the use of case study method in the teaching of environmental issues in the teaching of Science. I shall begin with Manner's (2001) critical trend that argues that learners exhibit different learning styles and multiple intelligences and only by accommodating these various abilities can instructors properly plan and conduct assignments and assess what learners have learned. Not all learners will learn best with a single instructional technique. Learners learn best through various styles. Manner's (2001) ideas tie in with what is espoused by the Department of Education's policy on assessment, where teachers are required to employ a variety of assessment methods in order to assess learner performance and not to disadvantage learners in any way. Different learning styles and multiple intelligences will have implications for the design and execution of teaching situations. The teacher will have to therefore take into consideration the student who may be able to explain well, respond emotionally, have the ability to reason deductively, have the ability to create visual representations and make things. Manner's (2001) *multiple intelligences theory* is also evident in the NS curriculum policy. During the observations of the video recordings I was able to ascertain whether teachers used these strategies in their teaching of Science.

The second critical trend is the advocacy of the case study method by Camill (2000) and Cliff and Curtin (2000). They argue that the case study method is an invaluable method in the teaching of environmental issues in Science. In both studies it was found to be especially useful when teaching content rich courses and for the successful integration of content,

process and application in ecology studies. Both studies support the use of active-learning methodologies in their classrooms because it deepens and reinforces knowledge of the subject matter and promotes the process of higher order thinking. According to Cliff and Curtin (2000) "a case method is designed primarily to enhance the learners understanding of the essential concepts of a course and secondarily to encourage critical thinking" (Cliff and Curtin, 2000, p.64).The teacher has to create a scenario using a series of newspaper articles, magazines and other resources available. This scenario should present learners with a salient problem or issue that requires them to apply their knowledge of a particular subject to its resolution by using their understanding of underlying facts and concepts (Cliff and Curtin, 2000). The case-method promotes higher order thinking skills in learners.

2.2.4 Creative Approach in Science

In popular and general usage one associates creativities with the visual arts, music, dance or design. In Science however, creativity is not just the production of a 'thing' or physical creation, but it refers to the creative use of Science ideas to solve problems. According to Roberts (2009), these problems can range from the imaginative use of scientific concepts to seeing the world in a different way, solving one's own scientific problems, to attacking a scientific issue of everyday relevance by forensically examining the evidence upon which the various and competing claims are based (Roberts, 2009).

Creativity in Science therefore includes the creative transfer of ideas to be able to carry out open-ended investigations. In order to be creative, one has to have a set of ideas available to be creative with. Creativity comes after having learned much.

In order for teachers to use creative approaches in the teaching of science, the teachers themselves have to be creative and knowledgeable about Science and Science concepts. During my observations of the lessons I was able to establish that most of the teachers used ideas directly from the text book and they did not take contextual factors into account. This therefore had implications in the delivery of certain aspects of their lessons.

2.2.5 Assessment of Learners

According to the NCS policy for NS in grades R – 9 the assessment of learners has to take place on a continuous basis. Learners have to be assessed in various forms during each unit of

study. The activities are planned and designed according to the assessment standards for the unit of study. During my observations and interviews it became evident that the planning of assessments was a problem for most teachers in the teaching of Science. The teachers found difficulty in incorporating assessment into their lessons and therefore the only form of assessment that was used was a summative test at the end of the term. I therefore discussed the need for assessment and how it can be incorporated in the Science lessons.

The assessment of framework of the National Curriculum Statement (NCS) for grade R-9 (schools) is based on the principles of outcome-based education. According to the DoE documents (2002) assessment should provide indications of learner achievements in the most effective and efficient manner, and ensure that learners integrate and apply knowledge and skills. Assessments should also help learners to make judgments about their own performance, set goals for progress and provoke further learning.

2.2.5.1 Definition of assessment

The DoE (2002) defines assessment as "a continuous, planned process of gathering information about the performance of learners measured against the Assessment Standards of the Learning Outcomes. It requires clearly – defined criteria and a variety of appropriate Strategies to enable teachers to give constructive feedback to learners and to report to parents, and other interested people."

2.2.5.2 Purposes of assessment and their uses

The main purposes of assessing learners should be to enhance individual growth and development, to monitor the progress of learners and to facilitate their learning. The uses of assessment include baseline assessment of prior learning which takes place at the beginning of a grade or phase to establish what learners already know. Diagnostic assessment which is used to find out about the nature and cause of barriers to learning experienced by the learner; Formative assessment which monitors the support and the process of learning and teaching, and is used to inform learners and teachers about learners progress so as to improve learning; Summative assessment which gives an overall picture of learners progress at a given time e.g. at the end of a term and systemic assessment which is way of monitoring the performance of

the education system, one component of which is that of learner performance in relation to national indicators (DoE, 2002)

2.2.5.3 Investigations and practical work

Teacher assessment of practical work and investigations is regarded as the most appropriate means of measuring the achievement of the learners' skills. The criterion against which learners work is measured is either with the context of an entire investigation or an isolated exercise. These skill based assessment criteria should enable the learner to achieve an outcome (Skevington, 1994).

2.2.5.6 How to manage effective assessment

According to Skevington (1994) the key to making assessments work is being able to carry it out, record the results and maintain a record of the evidence to be used for making judgment for later use (Skevington, 1994).

In order for assessment to be effective the teacher will have to organize the classroom in such a manner as to facilitate the assessment process. The teacher will have to be able to focus attention on one group of learners and at the same time be able to see what else is going on and respond to other members of the class. Learners also need to have a clear idea of the structure and pattern of their work, so that they can direct their own learning for a suitable period of tome. In order to facilitate this, resource materials will have to be organized so that learners are able to carry on with their work with a minimum of attention (Skevington, 1994).

For some groups, self study may not be possible, because the nature and abilities of the learners may not allow it. In these circumstances activities will have to be restricted or adapted. It is left to the teacher to decide on what is in the best interest for the development and learning of the learners. The outcome for the assessment must be clearly written so that learners will be able to understand what is expected of them. Formative assessment during lessons enables the learners to participate in the process.

This leads to the process of recording of the learners' achievements which is part of the curriculum policy. The teacher will have to decide at the out set as to what information will serve the purpose of the school policies and record these only.

Much of the assessment is informal and feedback is verbal or written as comments against their work. Teachers may record these assessments the same time as the assessments to reduce the time involved late. It is also more reliable and forms a permanent record of the learners work (Skevington, 1994).

2.3 Conclusion

In this chapter I examined and reviewed various theories on the conceptual framework and the analytical framework. I also examined the views of various theorists in their studies in NS. These reviews have assisted in the research design, analysis, findings and recommendations in this study.

In *Chapter Three,* I describe how the qualitative approach is used. The strategy of video-recordings of the lessons and semi-structured interviews, and the technique of the stimulus-recall method and how it is used to reveal rich data from participants is discussed. My motivation for a case-study approach within an interpretive paradigm, purposive sampling, the advantages of using video-recordings, the use of the narrative approach and ethical considerations are also discussed in this chapter.

Chapter 3

Research design and Methodology

3.1 Introduction

In this chapter I describe and explain the research design and methodology selected to generate data for the study. I justify why my study is an interpretive one, within the qualitative research paradigm. I also discuss the reasons for choosing a case study approach and the data collection methods, namely, the observations through video recordings of lessons and the use of the stimulus recall method during the semi-structured interviews. I present justification for the use of the research instruments that I have employed to give credence, validity and trustworthiness of the data gathered and the analysis thereof.

My study is an interpretive study which is conducted within a qualitative research paradigm. The main idea within the context of the interpretive paradigm is to understand the subjective world of human experience (Cohen, Manion and Morrison, 2008). According to Cohen, Manion and Morrison (2008) interpretive approaches focus on action or intentional behaviour.

My study therefore concentrates on the participant teachers and their teaching methods and strategies. Their behaviour could be viewed as intentional, because their intention is to teach using learning outcomes and assessment standards. Therefore, the data elicited from my study is "grounded" in nature as they arose from the experience and understanding of the context within which these teachers taught. The teachers, who participated in this study did so on a voluntary basis. They were selected purposively because they were Science teachers in grade 4 classes. Four teachers in the school were selected because the school has four grade four classes. In this school teachers are class-based; that is, they teach all the learning areas in their class. Preference is not given to specialist teachers in specific subjects.

According to Denzin and Lincoln (2005), the strategies of inquiry a researcher employs will put the research in particular paradigms of interpretation. These strategies also connect the researcher to specific methods of collecting data. The methods of collecting data will include direct observation, interviewing, and analysis

of artifacts, documents, cultural records, use of visual material and the use of personal experience. The researcher may also use this information in a variety of ways which include content and narrative strategies (Denzin and Lincoln, 2005).

3.2 The Qualitative approach

My research is conducted within a qualitative research paradigm. The purpose of my study is to explore, describe and explain the teaching approaches used by teachers during the teaching of a selected unit of study. In my study the unit of analysis was the topic "Green plants make food". According to Merriam (1998) the use of the qualitative or naturalistic research paradigm offered the greatest promise of making significant contributions to the knowledge base and practice of education. Merriam (1998) believes that the research should focus on discovery, insight and understanding from the perspective of those being studied..

Creswell (2008) adds that in qualitative research we identify our participants and sites based on places and people that can best help us understand our central phenomenon. According to Denzin and Lincoln (2005), "qualitative research involves an interpretive, naturalistic approach to viewing the world. They explain that qualitative researchers should study things in their natural settings, attempting to make sense of or interpret phenomena in terms of the meaning people bring to them" (Denzin and Lincoln 2005, p.3).

My study could therefore be placed within the naturalistic approach of inquiry. I carried out video recordings of the lessons that the teachers participants conducted within their day to day context. Because I could not disrupt and disturb the rest of the school activities due to the shortage of human resources at the school, I had to enlist the help of a university student who took a special interest in video-recording to assist me with my video-recordings. I observed the classroom activities at intervals whilst he attended to the technical aspects of the video filming which I was not familiar with. Enlisting his assistance left me free to observe phenomena that could not otherwise be captured on the video recorder, as only a single video camera was being used.

3.2.1 Case Study

According to Hitchcock and Hughes (1995, p.317), the case study approach has several hallmarks, which includes: its concern with rich and vivid descriptions of events relevant to the case, blending the descriptions of events with their analysis, its focus on individual actors and seeking to understand their perception of events and the researchers integral involvement in the case.

I use an in-depth case study approach in my study in order to "look at a phenomenon in its real-life context" (Robson, 2002 p. 178). Cohen, Manion and Morrison (2008 p.53) explains that case studies provide a unique example of real people in real situations, whilst Merriam (1998) explains that "a case study is an examination of a specific phenomenon such as a programme, an event, a person, a process, an institution or a social group". Yin (2002), observes that a case study design is particularly suited to situations where it is impossible to separate the phenomenon's variables from their context.

The 'case' in my study refers to the exploration, description and explanation of the approaches that teachers use in the teaching of NS in grade four. A single public primary school was chosen and the participants comprised of grade four teachers that taught NS. I purposefully or intentionally selected these participants in order to describe the phenomenon, as I was particularly interested in the approaches that teachers used at the beginning of the intermediate phase.

According to Roland and Wicks (2009), the "inside researcher" is one who is well-known to the community or institution within which the study is based. The "inside researcher" will have a good knowledge of the phenomenon that is being studied and the people or participants in the research programme. In this study I employed an 'insider research' approach. According to Roland and Wicks (2009) the "inside researcher" will be able to "enter into and maintain a cordial relationship with the participants in their community." In this research I was able to achieve this relationship with the participant teachers and the learners by using an insider research approach. Because I am an educator at the school and I am well known to the participant teachers and learners, the approach allowed me to gain a better understanding of the participant teachers approaches to the teaching of NS and of the

discourse and critique that followed during the interview process when identifying and interpreting their teaching approaches. The insider approach allowed me to establish rapport with the participants and also enabled me to analyse the extensive data of the video tapings and interview transcripts.

Robertson (1983), indicates that the "insider" will possess "intimate knowledge of the community" whilst Hockey (1993) intimates that as an insider the researcher does not have to deal with culture shock and is therefore able to measure more accurately the responses to questions and is therefore more empathetic. However, Gunasekaia (2007) warns against the "informed perspective" of the researcher as it could influence both observations and interpretations. Hellawell (2006), also warns against the potential difficulty of insider research in the aspect of over – rapport of familiarity between researcher and participants.

In this study I was able to overcome personal bias of reflecting my own beliefs and values by using the strategy of video taping the lessons and asking the participants themselves to comment on their approaches to teaching after watching themselves on video.

In my study, I explore how teachers teach Natural Sciences (NS) in a given unit of study. I pay particular attention to the approaches and strategies that teachers employ and I ask why they choose these approaches. I found that the case study approach was suitable for my research intent and purpose as the data produced from my study are "strong on reality". According to Cohen et al (2008) this strength in reality is because case studies are down-to-earth and attention-holding, in harmony with the readers own experience and this provides a natural basis for generalisation (Cohen et al, 2008, p.256).

3.2.2 Data Collection

In this study I used the strategies of observation, video-recordings, semi-structured interviews and document analysis to generate data. The first stage of my data collection consisted of the video recordings of the teachers' lessons. A unit of study which consisted of two lessons per educator was recorded for a week. Each lesson was of one hour duration. Therefore, I elicited eight hours of data altogether from four

teachers. I chose to video tape the lessons so that the unexpected and evolving aspect of teaching and learning was captured and that rich descriptions and explanations could revealed. After viewing the recordings of each teacher's lessons, I designed a semi-structured interview schedule.

I collected data in order to explore teachers' approaches to teaching a selected unit of study in Natural Sciences (NS). The unit of study that was pre-selected was "green plants make food" in NS in a grade four classes. My critical questions therefore focused on how the teachers approached the teaching of the unit of study and why they chose these approaches to teach the unit of study in a grade four class.

3.2.2.1 Video Recording

The main strategy that I employed was the video-recording of the unit of study for each teacher. The video-recordings were therefore the first stage of my data collection. Each teacher taught two lessons of an hour's duration to complete the teaching of the unit of study. I was able to elicit eight hours of data altogether from four teachers. I prudently selected Video-recording as my data collection strategy, as I could capture the unexpected and evolving aspect of teaching and learning, so that rich descriptions and explanations could be revealed.

According to Gass and Houck (1999) and Iino (1999) video recorded data can provide us with more contextual data than can audio recorded data. They can give us a more complete sense of who the people are, and acquaint us with the setting in which the people function and the types of activities they engage in. Video-recordings also enable us to accurately identify who is speaking and provides us with information about posture, gestures, types of questioning, class responses etc.

For the purpose of my study, I was able to record the approaches to teaching the teachers used and the nature of the activities done. I was able to record every word spoken during the entire lesson and the recordings provided a performance of the data. This also obviated the problem or constraints on my memory as the researcher and my inherent slower speed of writing as compared with the speaking and responses of the participants.

According to Grimshaw (1982a), an advantage of using video recording is performance, which allows us to experience an event repeatedly by playing it back with each repeated viewing; we can change our focus somewhat and see things we had not seen on previous viewings. Erickson (1992) adds that replaying the event also allows us more time to contemplate, deliberate and ponder the data before drawing conclusions. Video-taping can therefore be studied intensively.

3.2.2.2 Semi-structured Interviews

The second stage of my data collection was the semi-structured interview within which I employed the 'Stimulated recall' approach to elicit more data. I prepared a semi-structured interview schedule to interview each of the four teachers according to the data I gathered after viewing their video taped lessons. Creswell (2008) believes that in qualitative research, the interview is just as popular as observations. A qualitative interview occurs when researchers ask one or more of the participants' general, open-ended questions and recorded their answers. This data is then transcribed for analysis (Creswell, 2008). Although the one-to-one interviews were time consuming, I found it was the most prudent way of collecting data. I had to first watch the video recordings of each teacher, and design a semi-structured interview schedule according to the themes that I wished to explore. The video recordings provided rich data, but I had to prudently select that which I needed for the answering of my research questions. I designed my interview questions such that they were open-ended, so that the participants could speak freely and conversationally and it allowed me to probe or clear up misunderstandings.

The questions in the interview schedule were designed so that the data generated could be grouped into themes for the purpose of analysis. Another reason for video-recording the interviews was that the sound quality and clarity was superior to that of a Dictaphone. The same interview schedule was used for all the participants. During the stimulated recall approach I played back the video recordings of the teacher's lessons. I asked each teacher to explain why he/she had chosen to teach their lesson using a particular approach or strategy.

The second stage of my data collection was the semi-structured interview within which I employed the "stimulated recall" approach to elicit data. During the stimulated recall approach I played back the video recordings of the teacher's lessons. I asked each teacher to explain why s/he had chosen to teach the lessons using a particular approach or strategy. According to Steel (2003), "stimulated recall confronts teachers with their recent actions thereby minimizing superficial self-presentation by the researcher." The stimulated recall technique therefore uncovered the thinking and decision–making processes that went into the planning and preparation of their lessons. It also uncovered some of the thinking processes that guided their teaching approaches. This process also helped me to give the teacher participants their own voices, so that their actual responses could be in the analysis of the data.

According to Flyvbjerg (2007) case studies often contain a substantial element of narrative and good narratives approach the complexities and contradictions of real life. It is therefore not desirable to generalise and summarize data collected but to capture the rich data as it presents itself. Flyvbjerg (2007) advocates that when writing up a case study, one should demur from the role of omniscient narrator and summarizer. Instead, the story should be told in all its diversity, allowing it to unfold from the many-sided, complex and sometimes conflicting stories that the participants in the case have told. The story must be told and that readers from diverse backgrounds must be able to make interpretations, although their interpretations will of course differ. The case must be described with different facets, like life itself (Flyvbjerg, 2007). I used the narrative inquiry approach to put together my narrative of the four participants. The responses of the four teachers were video recorded during the stimulus recall interviews.

The application of narratology enabled me to "flashback" to an earlier point in the lesson and "flashing forward" enabled me to look at a moment later in chronological sequence of events. My analysis is therefore not a simple "story" of the actual chronology of events that have taken place in the classroom, but it is a "discourse" of the events. By "discourse" I mean the manipulation of the story in the presentation of a coherent narrative of the study (Prince, 1994). According to Clandinin and Connelley (2000) when narrative inquirers are in the field, they are never there as

disembodied recorders of someone else's experience. They too are having an experience, the experience of the inquiry that entails the experience they set out to explore.

According to Gergen and Gergen (2003, p.580) "a significant means of disclaiming validity is to remove the single voice of omniscience and to relativize it by including multiple voices within the research report." I have therefore chosen to give my participants their own voice in my narrative.

I constantly assured the participant teachers that the intention of the study was to build a shared understanding of the approaches they used in their teaching of Science. Because the teachers had participated on a voluntary basis, they were willing to share and speak about their classroom practice and give voice to what they felt they had learnt from the viewing of their own classroom practice and experiences on video tape.

The stimulus-recall method of interviewing dispelled the idea of power relations, where the participants try to please the interviewer. This I tried to overcome by assuring them that whatever they said would be treated with confidentiality and that they were viewed as collaborators in the research. The knowledge gained from the semi-structured interviews was used to answer my critical questions and explore the approaches that the teachers used in the teaching of NS and to determine why they used these approaches. The teachers were already knowledgeable about the NCS Policy Document Grades NS R-9 (DOE, 2002).

I hoped that in this joint inquiry, the narratives of the teachers' practices would allow me to work with the teachers in order to explain and give reasons for how they taught their lessons and why they chose certain approaches.

3.3 Ethical Considerations

I first sought ethical clearance from the university. Ethical clearance was granted by the universities ethical clearance committee. I then sought permission from the Department of Education to conduct my research. The ethical clearance was granted by the Department of Education for me to conduct research at the primary school that

I had chosen. The necessary ethical clearance forms were forwarded by the University to expedite the ethical clearance by the D.O.E. I had to seek permission from the principal of the school at which I conducted the research. The principal was most obliging and encouraged me in my progress. He granted me permission verbally and in writing. I then sought permission from the participant teachers at the school, and assured them that it was for my study purpose only. All the participant educators were most willing to oblige. Although my focus was on the participant teachers and their approaches to teaching NS, they could not do this without the presence of learners. I therefore had to obtain informed consent from both the participant teachers and the learners for the video recording of their lessons.

According to Cohen et al (2008) informed consent is the procedure in which individuals choose whether to participate in an investigation after being informed of facts that would be likely to influence their decisions.

Because learners are minors, the informed consent forms were forwarded to their parents for their perusal and subsequent signing of the forms. These forms were then collected and filed. All the learners' parents or guardians had signed the consent forms for their child to be present while the lessons were being video recorded.

I obtained informed consent for the subsequent video-recordings and interviews of the participant teachers.

3.4. Conclusion

In this chapter I discussed in detail the research methodology that was selected and the justification and rationale for my choice. This chapter unfolds with an explanation of the use of the qualitative case study approach and why I employ an insider perspective within this approach. I then explain why the strategy of video recording was prudent in my study and how the semi structured interview questions enabled me to establish themes during the analysis. I also explain the use of the narrative enquiry approach to obtain multi-voiced texts and I discuss the various forms of ethical clearance that I had to seek to continue successfully with this study.

In the next chapter I describe the video recording of the participant teachers' lessons and I analyze the semi-structured interviews of the participant teachers.

Chapter 4

Analysis of Data

4.1 Introduction

This chapter captures the response of the selected teachers to the critical questions which are:

1. "How do teachers approach the teaching of a unit of study in a grade four Science class?"
2. "Why do teachers choose these approaches to teach the unit in Science to a grade four class?"

The unit of study that was selected was "Green plants make food". The methods that I used to obtain data were the video-recording of lessons and the semi-structured interviews.

The analysis of my research was a joint construction and not a transmission of knowledge. It was characterised by negotiation, feedback and respect for the teacher participants.

After the one-to-one interviews, I had to develop transcripts of the participants. Each participant spoke for approximately 15 minutes on average. I read and re-read the transcripts in order to establish themes and patterns which had begun to emerge from the data (Miles and Huberman, 1994). It was not difficult for me to establish themes and patterns as I used the same semi-structured interview schedule for all the teacher participants. For example, the participant's responses for the first question were grouped together to give an idea of the first theme. I had asked eight questions (see Appendix E) and therefore eight themes have emerged from the data. I started to fit the data according to the relevant themes by using a manual system of cutting and pasting the data (Hammersly & Atkinson, 1990) in order to construct a conceptual scheme that allowed me to interrogate the data and start the writing of the text of the teacher's narratives. I used information that was recorded by the video-camera as well as the interview to correlate with NS grade R-9 policy document (2002) to draw comparisons. I did not always distinguish the use of these into categories, because they were used in the same manner when I conducted my analysis.

My analysis therefore resulted in what Denzin (1994, p.510) refers to as a "multi-voiced, reflexive, open-ended, emotionally based text". The text that was forthcoming used the views and responses of the teachers as the teachers shared their ideas and examples from their own practice and spoke about their personal views and beliefs based on their current practice as Science teachers. They responded about what they did specifically in the unit of study that they had taught, therefore the dialogue was of what they were actually doing. The teacher's views of Science were mainly what were espoused by NCS Policy Document and how they taught and the reasons they chose the approaches that they used.

For the ease of reference in the text I dubbed each of the participant teachers as Teacher A (TA), Teacher B (TB), Teacher C (TC), and Teacher D (TD). To maintain confidentiality, I refrained from using their names. The direct responses of the participants were used in order to add richness and authenticity to my text.

The themes that emerged out of each question were:

1. Creation of interest and motivation
2. Learning outcomes and Assessment Standards
3. Teaching Methods and Strategies
4. Changes in Approach
5. Learner Activities
6. Learner Skills
7. Assessing Learners
8. Teacher Reflections

The data for each of the themes listed was interrogated in order for me to be able to write up the text of the teachers' narrative.

4.2. Observation of the video-tapes and description of the lessons

In order to answer my first critical question i.e. what approaches do teachers use in the teachings of their lessons, I had to watch the video-tapes and describe how the teachers approached the teaching of the unit of study. I started first with teacher A.

4.2.1 Description of Teacher A (TA)

Lesson 1

Teacher A is the only Science teacher in the grade who is not classed based. She is a foundation phase teacher who teachers NS in the grade 4 class to relieve the class teacher who happens to be the H.O.D of the Senior Primary Department.

Teacher A entered the class promptly at nine o'clock. She greeted the class. The entire class stood up to sing a greeting to her and very noisily sat down. She explained to the class that she was going to teach them something new. The class waited expectantly. She asked for a piece of chalk and a learner gave her a piece of chalk. TA wrote the topic on the chalkboard. The topic: plants make their own food. The class was asked to open to page two of their textbook.

TA used a questioning technique to lead the discussion on how we as people made food. The learners responded with various answers from plants – animals etc. The response that TA sought was that we bought and prepared our food. She then explained that plants make their own food by using natural resources e.g. water, soil, sunlight. She drew comparisons between people and plants.

A learner was asked to read the textbook; while the others followed in the textbook. Other learners looked around and lost interest. The teacher then explained about carbon dioxide and the interdependence of people on plants for oxygen and plants on people for carbon dioxide. She explained the term "photosynthesis". The analogy of cooking food by people and the making of food by plants was used. The word photosynthesis was broken up into 'photo' + 'synthesis'. 'Photo' meant light and 'synthesis' meant to make. This translated into "using light to make food".

The teachers then gave the learners a chalkboard summary of what had been taught thus far. The learners busied themselves with note taking. The learners were seated in groups of two, all facing the chalkboard. While the children copied their notes, the teacher explained to the learners about what they were going to do in the next Science lesson. She asked the learners whether they had all understood the process of photosynthesis. All answered in the affirmative. She explained that they would understand better in the lesson to follow. The

teacher then walked around and in between the rows and checked whether the learners were copying their notes. The teacher then proceeded to mark the learners' books.

Some of the learners became restless and paid attention to the camera man. The teacher then asked the learners to read Activity One in the textbook and if they were finished and to see whether they understood it. The teacher asked learners whether they had finished and already read the activity. The learners answered in the affirmative. She asked them what they had understood about the activity i.e. what did they need to carry out the activity. The children were quiet. The teacher then began to read the activity and explain to the learners the proceeding of the activity.

The activity required that learners carry out an experiment to show what will happen if one of the variables for good plant growth is removed. Learners had to have the containers i.e. margarine tubs, cotton wool and water. The cotton wool had to be moistened. A soaked bean seed had to be placed in between the moistened cotton wool and this container had to be labeled A, and placed in a dark cupboard. For the next bean seed, the same procedure had to be followed, but this time the container had to be labelled B and placed on the window sill and the third bean seed had to be placed between dry cotton wool and the container had to be labeled C. This container had to be also left on the window sill.

Teacher A asked the learners to bring in their containers, bean seeds and cotton wool. She asked the learners to think about what was going to happen – that is predict what would happen in each container after having learnt the first lesson.

The learners shuffled, fidgeted, wrote, looked around and some appeared restless. The teacher then asked the learners to read the chalkboard summary aloud. They all spelt the word 'photosynthesis'. The teacher once again reminded the learners about the requirements for the next lesson and asked the learners in charge to collect the textbooks which were once again kept away in the cupboard.

Lesson 2

Lesson 2 was held in the afternoon. The learners were eager for the lesson to proceed and quickly settled down to listen to the teacher. The teacher recapitulated the previous lesson by using the questioning technique in her discussion.

The teacher then proceeded with the discussion of the requirements of the experiment. TA explained why they had to use three containers. The teacher used the approach of a teacher demonstration to show the children what was required. Some of the children paid attention while others were pre-occupied with other activities of their own.

The teacher reiterated what she had explained the previous day. The three containers were marked in the following way: “no light”, “no water” and “water + light”. The one marked “water + light” was left on the window sill, the one marked “no water” was also left on the window sill and the last one marked “no light” was left in the cupboard. The teacher quickly demonstrated the proceedings and explained that they would look at the results after three days. TA asked learners once again to predict what will happen. The learners were all eager to have their predictions heard and began to shout out responses. The teacher asked them to be orderly and to raise their hands. Most of the learners had correctly predicted that the seeds receiving water and light will be the one to grow. The demonstration was thus over. The teacher proceeded to the lesson that she had planned for the day.

The lesson planned included the activity where the learners had to see that the potato contained starch and the apple contained sugar. The teacher cut pieces of potato and pieces of apple. She asked learners to volunteer in the testing for starch and sugar. Two learners were selected to come forward. They were given the pieces of potato to rub onto their arm. The whitish residue that was left on their arm, the teacher explained that, that was starch.

The next two learners that were selected were to test the apple for sugar, much to their glee. Each tasted the piece of apple. The first one reported that the apple was sweet. The second learner reported that the apple was sour. The teacher explained that both the potato and apple came from plants. They therefore concluded that plants made food.

TA asked a learner to read the textbook. She then explained how we are fortunate to be able to eat certain parts of the plants as food. She explained that we eat certain parts of a plant e.g.

roots, stem, leaves, fruits etc. She used a chart showing the different vegetables which represented the different parts of a plant e.g. in a cabbage and lettuce we are eating the leaves. A carrot was a root because it grew under ground. It was explained that the potato was called a bulb.

The teacher then gave the learners an activity while she wrote up a chalkboard exercise. The activity was that learners had to write up the proceeding of the bean plant experiment as to the procedure that was followed. Some of the learners busied themselves with the work while others chattered and became slightly noisy and restless.

The teacher quickly wrote up the chalkboard summary and walked around the classroom to observe whether the learners were engaging in the activities. The learners, who did not know what to do, fidgeted, looked around and some disturbed others who were busy. The teacher continued to complete the chalkboard summary.

The activity that the teacher designed was a table where the learners were asked to fill in examples from the chart whether the vegetable was a root, stem, leaf, fruit, flower or seed. Learners had to sort and categorize these according to the table. Learners busied themselves with this activity.

While they were busy with this, the teacher asked learners to stand up and read their summaries. One learner was asked to read his response. The teacher continued to pace around the class and check on the learners work. A considerable amount of time was utilized in the task of note taking and completing the activity of the table. The learners did not engage in any hands-on or practical activity of their own. The teacher had proceeded to have teacher demonstrations instead.

It was evident that many learners were bored and restless at the end of the lesson. Because learners were bored they became aware of the camera-man and proceeded to make faces and perform in order to be conspicuous on the video-recording. It was commendable though that they displayed a great amount of control and did not become completely rowdy.

TA then proceeded to complete the table and correct the learners' response. She affirmed the correct responses and negated the wrong responses. Learners were asked to correct their work

and those who did not complete their work were asked to copy the correct responses. The textbooks were collected once again at the end of the lesson.

4.2.2 Description of Teacher B's Lesson

Lesson 1

Teacher B began the lesson by asking learners to open their text books and have their exercise books on the desk. They had turned to the topic "plants make their own food" A teacher led discussion was held about where the learners got their energy from. It was finally established that they got their energy from food because when they do not eat enough food they felt lethargic and weak. In the same way plants also needed food. Plants however, did not eat food, but they make their own food.

TB explained that plants needed water, sunlight, soil and carbon dioxide to make food. By a question and answer session she was able to explain that plants used up carbon dioxide from the air to make food and release oxygen into the air which we require to give us energy or to breathe. This was a cyclic process.

She further explained the photosynthetic process by explaining the significance of chlorophyll in plants, the function of roots and leaves. The new words were listed on the chalkboard and the learners were asked to spell the words out aloud in a chorus.

The learners looked at the textbook at the diagram in particular; the diagram depicted the process of photosynthesis. The teacher proceeded to read the textbook for the learners while they followed in their text. The word photosynthesis was broken up and the meaning was revealed i.e. 'photo' means light and 'synthesis' means to put together. The boys in the class were asked to read the paragraph from the text. The girls had their turn to read thereafter.

The teacher proceeded with the experiment. The children were grouped quickly into groups of four in an orderly manner. The teacher cautioned the learners to keep the textbooks far away from the water. The requirements for the experiment were distributed quickly to the groups. The teacher used a teacher directed method to demonstrate the planting of the bean seeds. The learners followed the steps as directed by the teacher to plant the bean seeds. She assisted the different groups with the procedure. The learners in the group were instructed to mark the three containers in the following manner: "no water"; "no light" and "water plus

light". The reason for this experiment was to show that plants needed air, water and sunlight to grow. The learners were asked to predict what would happen to each of the plants on the three containers.

The learners were asked to resume their original seating arrangements where they all faced the chalkboard. They continued with the lesson and looked at the textbook again. The example of the apple and the potato was used. The learners looked at the diagram of the text. The class read together. The teacher asked the learners if they all understood the process of photosynthesis. The class affirmed that they did. The teacher then explained the activity in the textbook. The teacher gave the learners a chalkboard summary which they copied into their exercise books. The rest of the lesson was taken up by the learners copying the notes from the chalkboard.

Lesson 2

The teacher corrected the previous day's activity. The teacher discussed and wrote the answers on the chalkboard. The learners were then asked to turn the page to the next lesson. Learners were asked to recall the activity of the previous day's work. The teacher read the textbook while the learners followed in the textbook. They discussed the different parts of the plants that we eat e.g. roots, stems, leaves and flowers. A colourful chart was used to explain the edible parts of plants that stored food. The difference between the roots and tubes were explained. The learners found the discussion interesting as they responded well to the teachers questioning technique. The examples that were depicted on the chart were familiar to the learners. The boys had their turn to read the text to consolidate what they had learnt followed by the girls.

The teacher discussed the processed plant foods. Such as sugar and wheat plant from where we get flour. The maize plant was also discussed and that cornflakes were processed from maize.

The learners were asked to copy the chalkboard summary and thereafter they completed the activity. The learners completed the activity until the lesson ended.

4.2.3 Description of Teacher C (TC)

Lesson 1

Teacher C began the lesson by taking his learners out of the class to the school jungle-gym. He had the learners seated in an orderly manner in the jungle gym. He explained to the class that the lesson that he was going to teach required for them to use their five senses. He asked the learners to tell him what the five senses were. The learners were able to respond. Different learners answered that "we see with our eyes; we hear with our ears; we feel with our hands; we taste with our tongue and we smell with our nose.

He told learners that they had to use their senses to observe the plants that were growing in the environment. He asked learners what the plants required to grow. Learners responded that plants needed sunlight, water, air, soil. Teacher C explained that the plants purified the air. Plants took in the 'bad air' we breathed out and gave of oxygen that we breathe in. the teacher pointed out the lemons that were growing on the lemon tree. He asked the learners how the lemons grew on the lemon tree.

TC then spoke of the leaves and the green colour of the leaves. He explained that this colouring matter was called chlorophyll and that chlorophyll was used by the plant to trap sunlight and together with food from the soil the leaves were able to manufacture food.

TC used a practical method by using the resources of the context of the school to show and explain to the learners the different things that plants needed to grow. He then introduced the concept of photosynthesis. He explained that photo means light and synthesis means building up. He explained the role function of all the parts of the plant and their role in the making of food.

He recapitulated the new words: chlorophyll, photosynthesis, halitosis etc. He stressed once more the use of the senses.

He then asked the learners if they could make their own food. They responded no they did not have leaves to make their own food. He explained that plants went through all their processes but did not cause harm, but people were destructive when they lived in the environment. He asked the learners to stand and quietly walk back to the classroom.

Back in the class, TC recapitulated the new vocabulary which he recorded on the chalkboard. Back in the classroom the children were once again seated neatly in rows that faced the chalkboard. TC adorned the walls of the class with skillfully made charts, pictures, drawings and booklets, which were all made up by him. He has a special interest in the visual arts and displays his talent colourfully in and around the classroom and on the walls outside the blocks.

TC introduced a variegated colour-leaved plant. The leaves of the plant were red and yellow predominantly with streaks of green. He asked them how that leaf made food. He explained that these leaves also contain chlorophyll.

He then went on to explain the parasitic plant called the 'dodder'. He called them a special plant – it did not have chlorophyll but it got its food from the host plant. As TC proceeded, he built up a list of vocabulary on the chalkboard with their functions or meanings. TC explained that we could not observe the fine points of the photosynthetic process but we know that plants are growing

The learners established that carbon dioxide helped the plants in making food. TC explained that oxygen was a byproduct of photosynthesis.

TC then proceeded to ask learners what type of food we get from plants. He explained to the learners the proceeding for the next day's lesson. He explained that they would use a potato and prove that the potato had starch.

The activity that the class did was to draw the different aspects that were required for the photosynthetic process. They were to depict the tree, ground, roots, sun and water. The learners proceeded to draw and annotate their drawings. They were asked to use materials such as pencils, crayons, roll ups or colour pencils. The learners got themselves busy with this activity. After using the teacher directed method or lecture and discussion method, the learners activities allowed the learner to engage in an activity that required themselves to use their senses. TC went around the class and encouraged learners to use their colour pencils to depict their drawings.

TC stopped the learners and showed them on the chalkboard how to label their drawings by using the vocabulary on the chalkboard. He explained CO_2 as bad air and O_2 as good air. TC

went around and supervised and marked learners' books. TC had good class control. The children enjoyed a good rapport with him but they knew that he was firm and assertive. The rest of the lesson was utilized to complete the drawing. TC asked learners to bring in an apple and a potato for the next days lesson.

Lesson 2

The children were excited to continue with the Science lesson on the next day. They were ready and waiting with their desks already protected by newspaper. They enthusiastically sang their greeting to the teacher and were amused when he replied that he was still fat and available in response to their "and how are you sir". This set a tone of enthusiasm for the lesson. The teacher quickly recapitulated the previous day's lesson. The learners were able to answer enthusiastically. Most of the learners had remembered the lesson.

The teacher then went on to discuss the different parts of the plant that stored food. The teacher explained that he was going to begin with the lesson for the day. He inquired whether they had brought in the potatoes and apples as they had promised. Majority of the learners did not bring in their items. The teacher had anticipated this, and brought in the items. The learners were grouped in two. The teacher cut up the apples into pieces first and distributed these to the groups. He then cut the potatoes into pieces. Each group received a piece of potato and apple. After the learners had received their specimens they settled down to continue the lesson. TC told the learners that they were going to use their senses of taste to explore- sweet, sour, bitter, salty and spicy. The children were eager to taste the apple. They did not want to taste the potato. They said that the potato tasted good when it was cooked. The teacher called the potato 'marzumbaan'- isiZulu word for potato. It was the only form of 'code-switching' that was used in all the lessons that I watched.

The teacher then proceeded to explain how he would use iodine on the apple and potato to determine whether they contained starch. Some of the learners had already eaten their pieces of apple. This caused a bit of commotion as other learners laughed at them. The teacher then decided that he would use the potato only. He showed the class that iodine was of an orange colour, but in the presence of starch it turned purplish-black. He demonstrated this on a one piece of potato. He used a piece of apple to conduct the same experiment. On the apple the iodine did not change colour. The class became rowdy and began to shout out answers. TC told that it was okay for them to sing together but not speak together. The learners quickly

settled down once more in an orderly manner. The teacher and the learners discussed the experiment. While the teacher was busy explaining to the one group of learners, other learners became restless and fidgety. The teacher once again recapitulated the proceedings of the experiment. The learners were able to answer properly.

The activity for the learners was for them to summarise briefly the experiment of the starch test that was conducted. The paragraph was to consist of about four sentences explaining what happened to the potato when the iodine was poured onto it and what happened to the apple when iodine was poured on it. The conclusion had to be written as well.

While the learners were busy with the activity, TC proceeded to mark the previous days work. He called learners two at a time. He then walks around observing the learners doing their work. The children became interested in the camera man.

TC then marked the paragraphs. He read aloud the good efforts, to demonstrate what was expected of them in the summary. The lesson terminated.

4.2.4 Description of Teacher D's lessons (TD)

Lesson 1

Teacher D (TD) begins her lessons promptly. The learners were ready to start with their relevant books already taken out and on top of their desks. TD starts of by telling the class that they will compile a list of new vocabulary as the lesson proceeds. She turns the learners' attention to a relevant worksheet on "How plants make their own food". They proceed to read this information together. They look at the requirements for good plant growth. The need for water is established. Plants require more water than people. Plants needed sunlight, water and air. The components of air are oxygen and carbon dioxide was explained, where oxygen was needed by people and carbon dioxide was needed by plants for the manufacturing of food. The teacher also explained that whilst we got our energy from food, the plants attained their energy from the sun.

The word 'photosynthesis' was explained. The concept was explained by using the analogy of the camera and photographs. The learners established through their discussion that 'photo' meant light and 'synthesis' meant to put together. The teacher then directed the learners' attention to a pot plant that was placed on the table in front of the classroom there are two pot

plants that are on the table. One appears to have a lush growth. The other plant looks stunted and dry. The teacher explains that she had left the smaller plant in the cupboard for a day. The cupboard is dark; therefore the plant did not receive any light. The plant was a 'thyme plant'. The learners were asked to compare the two plants. Learners responded that the 'thyme plant' looked dry and that it was not growing well. They then deduced that plants needed sunlight for growth. They also established that plants needed water to grow. The concept of drought was also explained. The learners were able to respond that sunlight was also required for good plant growth. This was illustrated by the lush leaves that were found on the plant that was the control.

It was established that 'photosynthesis' was a process during which the plant made food. The list of words that were written on the chalkboard had to be taken down in the learners NS notebooks. They used their dictionaries to find the meaning of words. The teacher quickly summerised the meaning of the word 'photosynthesis' on the chalkboard. Learners copied the words and notes in their notebooks. The teacher encouraged them to proceed with the work quickly. The vocabulary had to be completed as homework.

Once again the learners were asked to put their pens down and become attentive. The teacher explained how the experiment was to be conducted. The process was to describe. The learners had to get beans seeds, three margarine tubs/other containers, polystyrene cups with holes (to allow the excess water to drain out) so that the plant won't be water logged , cotton wool. The word moist was explained. Each learner had to have 3 containers. In each container learners were asked to plant 4-6 seeds. The learners' chorus read the worksheet. The meaning of 'sprout' was explained. They had to use damp cotton wool. When the seeds started to sprout they would see tiny leaves. The three tubs will be labelled; one will be labelled no light- placed in a dark cupboard. The next tub will be labelled water and light and placed on the window sill and the third container will be labelled no water and also placed on the window sill. The teacher explained that plant growth will be stunted if it did not receive light. All instructions were explained step by step.

The teacher explained to the learners how to go about recording their work. The plant growth was going to take about three-five days to occur. The learners were asked to bring their seeds, containers and cotton wool to school to plant their seeds. The learners were excited about the activity. The teacher then asked the learners to chorus read the paragraph had been discussed already. The teacher asked the learners whether they understood what they read. All the

learners affirmed that they understood what they read. The learners were asked to copy the summary from the chalkboard, while the teacher walked about and supervised the learners work. Ten minutes of the lesson was used to copy the summary and the last five minutes of the lesson was given to the learners to start their homework which was the vocabulary and meaning of the words using a dictionary.

Lesson 2

Lesson two of teacher D started off with great excitement because of the activity that they were anticipating. The learners were grouped in fours by turning their desks and chairs around. The teacher noticed that only two children in the class had brought in their requirements for the experiments. The teacher then decided that she was going to use a teacher directed method for those who had their requirements, while those who did not have their requirements could watch and observe so that they could conduct their own experiments at home successfully.

The teacher then proceeded to recapitulate the previous day's lessons, using the questioning and answering method. Another vocabulary list was built up on the chalkboard. The word 'chlorophyll' was explained as the green pigment found in leaves.

After the explanation, one learner from each group was called to receive the bean seeds. The entire procedure was recapitulated to refresh the learners' minds. The teacher then proceeded to use a teacher-directed method to explain step by step the planting of the bean seeds. A few learners at the back of the class had lost interest and the teacher had to re-direct their attention back to the work on hand. She demonstrated clearly and concisely the procedures that had to be followed. The learners in the groups assumed roles and busied themselves with the activity. The teacher had to eventually supply the non-compliant groups with the requirements for the experiments as many learners did not bring in the items. The teacher walked around from group to group and tried to mediate the activity. The learners then placed their containers on a table at the back of the class.

The teacher then asked the learners to produce their homework. None of the learners had done their homework. The learners were threatened that they would have to for go their lunch break if they did not do their homework. The teacher then proceeded to read all the variables

or requirements that were needed for good plant growth. She explained the interdependence of plants and animals on each other.

They then proceeded to discuss how plants made sugar or starch. The learners were asked to chorus read the paragraph about plants making foods. The teacher used the potato to demonstrate to the learners that the potato contained starch. She explained that the potato turned black because it contained starch. Also, the teacher explained to the learners that starch came out of the potato when it was cut and left in the water. This was evident because the water became whitish. The teacher volunteers to taste the pieces of the potato. They responded that the potato tasted salty. She then asked volunteers to taste the apple. They responded that apple was sweet and sour. The teacher explained that the granny-smith apples were sour. The red skinned apples were sweet.

The children responded that the potato had starch and that the apple had sugar. The teacher explained that apples could remain white if you added lemon juice to it after it was cut up into pieces. The learners were asked to read the last paragraph of their worksheet. The teacher explained that plants were like food factories. The teacher used all the different variables that the activities involved, and brought them together in order to explain the concepts of photosynthesis. The teacher explained the importance of carbon dioxide for plants in the photosynthesis process. She also explained the everyday uses of carbon dioxide to people e.g. they are contained in fizzy coldrinks that the learners enjoyed.

The teacher explained the activity in the worksheet. The learners were able to respond well during the discussion. This demonstrated that they had grasped the ideas and concepts very well.

The teacher then proceeded to explain the different parts of a plant that stored food. The teacher explained that the potato was a tuber which was an underground stem. She explained that when the potatoes are ready to be harvested the soil around the plant cracks and the potato plant flowered when they were ready to be harvested. A variety of food storage organs of the plant was discussed.

The learners were asked to seat themselves down, back in two rows so they therefore re-arranged the furniture to the normal seating arrangements. The learners resumed the activity from the worksheet. The teacher asked the learners to complete their work.

4.3 Semi-Structured Interviews

During the semi-structured interviews (See Annexure D), I asked all the teachers the same questions. I asked eight questions to each teacher. I grouped the response to the same question of each teacher, in order to see what kind of themes or patterns emerged from this data.

4.3.1 Theme 1: Creation of Interest - Motivation

The first theme that emerged was that of Creation of Interest or motivation from the request: "Please explain your approach to introducing the lessons." Three teachers of the four that were interviewed used the approach of tapping into the children's prior knowledge. They used their questioning skills to elicit responses which will enable to educators to gauge how much prior knowledge on the given topic they already possessed. This I gathered from their responses.

TA "*I sort of broke it up into different parts so that they could understand what plants need to live, how they need to survive, basically building up from there and get them to try and understand the process*"

TB "*I thought that I would use our own experiences*"

TD "*I focused best on the learners prior knowledge of the activity we were going to do and from there I judged how much they know.*"

The gauging of prior knowledge and building upon of new knowledge is synonymous with the constructivist approach to learning Science.

Teacher D took a different approach to introducing the topic. This teacher took the learners outside in order to observe. He asked them to use their senses. He also used the approach or skill of first gauging how much of prior knowledge the children already possessed. The change in the environment captured their attention, as they could see for themselves, the environment that was conducive to good growth of plants. He was able to point out the different parts of the plant and their location. He did not mention this in his interview, but this is clearly evident in the video-recording.

TD says "*I do try to arrange for ice-breakers, I try to make them talk, I get learners to speak, I get into a rapport."*

In his fifteen minute introduction to the lesson, he was able to introduce a variety of concepts that learners would have otherwise failed to visualize. He was thus able to gain the interest of the learners and sustain this interest for most of the learners.

Motivation

Palmer (2008) defines motivation as "any process that initiates and maintains learning behaviour" (Palmer, 2008, p.147). He therefore believes that it is important because learners will have difficulty in learning unless they are motivated. He uses the support of constructivist theory as cited in Driver (1989) to explain that learning is viewed as an active process which requires effort on the part of the learner. According to constructivist theory, if learners are not motivated, then no meaningful learning can occur. Motivation is therefore required initially to make learners want to participate in learning and throughout the whole process to sustain the whole learning process (Palmer, 2008).

The Science teacher can play a pivotal role in influencing student motivation. Interest is generally considered to be an effective motivator. According to Pintrich & Schunk (1996), interest is related to increased memory, greater comprehension, deeper cognitive engagement and thinking. In Mitchell's (1993) study of situational interest, he found that there were two main sources of interest, namely, "meaningfulness" and "involvement". He explains that 'meaningfulness' occurs when learners perceive activities as being relevant to their present lives and that 'involvement' referred to the degree to which learners are active participants in the learning process (Mitchell 1993).

In Zoharik's (1996) study, where Science teachers were asked to write essays on how they created interest, it was found that most teachers believed that the hands-on activities were the primary source (Zoharik, 1996).

Palmer (2004), in his study, identified what created interest in a Science method course for elementary teacher education learners. It was reported that interest had been aroused by factors such as learning how to teach Science, learning Science concept, hands-on activities,

novelty, surprise, group work and personal anecdotes. He found, however, that this study focused only on college level learners (Palmer, 2004).

From the studies that I have cited, it is evident that creating an interest in a unit of study as motivating learners is an integral part in the teaching of Science. From this theme we are able to gauge that the different teachers motivated the unit of study in different ways. Their approaches might have been similar, but the types of responses they received differed.

4.3.2 Theme 2: LO's and AS's

The response to my second open-ended question revealed the next theme of how teachers achieved the Learning Outcomes and Assessment Standards that are stipulated by the NCS (DOE, 2002).
My question was: This unit of study is an interesting one. Tell me what were you intending to achieve during the lessons?

The unit of study, 'green plants make food' falls under the core knowledge and concepts of Life and Living. The NS learning area comprises of a wide variety of fields of inquiry. The NCS has therefore been divided into four main content areas. The content area under which this unit of study fell is the Life and Living aspect. The 'Life and Living' aspect focuses on life processes and healthy living, on understanding balance and change in the environments and on the importance of biodiversity. (DOE, 2002)

Grade 4 is the beginning level of the Intermediate phase. The core knowledge and concepts of this unit of study is to be taught by focusing on the learning outcomes and assessment standards. The core knowledge and concepts for this unit would therefore focus on "how green plants produce their own food and grow by using water and substances from the air and soil. Energy from light is needed to change these simple substances into food and plant material. Green plants are the only organism that can produce food in their own bodies. (DOE, 2002, p.62).

At the grade 4 level the learner begins a major advance in thinking. This advance is in the increasing ability to do things in thought before doing them in action. The learner must therefore think through a series of steps mentally, in order to put in a plan or procedure for an investigation. This ability to consider a connected series of events allows the learner to see

and describe simple associations between events that have already been worked with (DOE, 2002).

In the chosen unit of study all three of the learning outcomes could have been covered with appropriate assessment standards for each learning outcome, as the unit of study lends itself to this.

LO1 (Scientific Investigations): The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.
In order to achieve this LO, the teacher would have to use assessment standards (AS's). All the teacher participants chose to cover all of the AS's of LO1.
AS1: Plans investigations: Contributes ideas of familiar situations, needs or materials, and identifies interesting aspects which could lead to investigations.
AS2: Conducts investigations and collects data: Explores the possibilities in available materials, findings: Talks about observations and suggests possible connection to other situations.

LO2 was also covered with the two assessment standards for Grade 4 level.
LO2: Constructing Science Knowledge: The learner will know and be able to interpret, and apply scientific, technological and environmental knowledge.
The Assessment Standards covered were:

1. Recalls meaningful information: At the minimum, uses own most fluent language to name and describe objects, materials and organisms.
2. Categorises information: Sorts objects and organisms by a visible property.

In order to achieve LO1, three of the teacher participants used the growing of bean seeds to illustrate the need for various factors in the growth of plants of which the basic factors are air, water and sunlight. They planned investigations by using the experiment and control method. The learners in two classes brought in the bean seeds as requested by the teachers. In these classes the teacher used a teacher directed method by grouping learners into groups of four, then asking them to label the three containers A, B, C. The bean seeds were planted. The control was left on the windowsill to receive air, water and sunlight. This was labeled Pot A. The other two were the experiments i.e. Pot B and Pot C. Pot B received water and

was put into a dark cupboard so that the sunlight was removed. Pot C received air and sunlight but no water. It was interesting to note that margarine tubs and yogurt tubs used to double up as pots as the learners did not have proper plant pots. The teachers who conducted the experiments were TA, TB and TD. Teacher C had omitted this experiment. In teacher A's class the learners did not bring in the required items such as cotton wool, pots and bean seeds. The teacher had to then revise her plan and carry out a demonstration which the class concentrated on. She explained the procedure, step by step. The learners observed and answered questions which she posed to them.

Question 2 of the interview was answered differently by all four teacher participants. Teacher A, B and C did not at any point make reference to the learning outcomes and assessment standards. They reverted to the traditional ideas of teaching as to the achievement in the lessons.

Eg. 1) TA: ... *For learners to achieve an understanding of it.*

> TB: *I wanted the children to understand that plants make their own food in order for them to survive.*
>
> TC: The *approach of relevant previous knowledge.. eh.. bit different to get relevant previous knowledge with learners nowadays, we don't have the type of learners that we used to have.*

The above comments are revealing of the fact that although the teacher participants had prepared their lessons and with much collaboration between three of the educators, two of the educators did not seen to understand why they had written LO's and AS's. However they did have the lesson preparations in front of them, which they used in their teaching.

The response of teacher D was however different. She showed a good understanding of the unit of study, what was required of the LO's and how she was going to use the AS's to achieve the LO's 1 and 2. She was able to explain the development and processes of her lessons by referring to the different LO's and assessment standard that were used to achieve this.

TD: "*The Natural Sciences LO's and AS's ... LO1 which is the investigation and the collection of data. We brought in the bean seeds and we did the experiment in class, and they*

all had to record all the data… how the bean seeds were growing at different stages…. They were instructed on how to carry out the experiment… the procedure to follow, steps to follow… they analysed what their findings were… they brought in their observations as well."

Teacher D indicated that the learners had achieved the LO's because they were able to satisfy all the requirements of the AS's of LO1.

4.3.3 Theme 3: The choice of Approach?

Teaching Methods and strategies

From my observations of the teachers' lessons, I was able to learn that much of the lesson was taken up by teacher led question and answer method, teacher demonstration, and teacher-directed activities. The learners followed the instructions given by the teachers. The teacher led questions were answered promptly by learners or at times they guessed, or when prompted by their teachers in the form of clues. Learners themselves did not ask questions about concepts, phenomena and the meaning of words.

> TA: *I tried to make them understand in the simplest way by first introducing it, then explaining it, the process of photosynthesis.*

TC: *I'm coming back to the idea, that it must be an approach that is simple for me … And it must be an approach that learners must be able to speak to.*

Because the teachers felt that the learners were young at grade 4 level and would not have sufficient knowledge to themselves formulate hypothesis and plan experiments or investigations on their own, they thought of simple ways in which to make the learners understand. The ideas and language used had to be within the experience of the learners. This can also be noted from Teacher D's comments:

TD: *Okay my learners are only in grade 4, so they won't know much about observations and practical observations; and how to follow it through. So that I followed the approach, where I directed most of the activities, by explaining what has to be done and by demonstrating most of the activities in the classroom… because they are so small, the activities had to be short and simple, there are steps that needed to be done as well.*

Although the teachers seem to underestimate the potential of grade 4 learners, they nevertheless planned activities in accordance with NCS NS Policy Document. The activities that are expected to enable learners to achieve are do-able activities e.g. when learners suggest actions to try with the materials; talks about personal experiences highlighting aspects which relate to Science, notes and remarks as obvious changes or interesting details, tries own idea of how the material might respond perseveres or repeats the activity in different ways thus experiencing the phenomenon in other ways (DOE, 2002). Many activities could have been planned for learners to achieve in order to cover learning outcomes 1 at grade 4 level. The unit of study chosen lends itself to the planning of a variety of activities in order to achieve the assessment standards successfully.

However, the teacher participants seem to be of the belief that their learners are not coming to the grade with sufficient prior knowledge which could be recalled as suggested by Kang and Howren (2004) and they do not possess a sound conceptual understanding as suggested by Kang & Howren (2004), Gower (2008) & Probyn (2004).

Teacher D also suggests the strategy of grouping the learners in order for the entire group to be successful.

TD: *Another way that I approached it is by putting them into groups so that in that way learners that are more mature, and more able to handle things, helping the weaker learners and we get their input as well. Also, the shy learners will be able to participate in the group. They will get success with whatever they do.*

Teacher D caters for learners who may be slow or shy. Teacher D groups these learners with other learners who are confident. In this way peer learning and teaching can take place. This strategy is useful when taking into account the individual needs of learners as emphasized by Parker & Rennie (2002) who state that a supportive learning environment which emphasizes communication, interpersonal negotiation, interaction amongst all participants, harassment free discussions, active participation by learners and drawing on contexts that are familiar to all learners are considered. The pedagogy should take account of all diverse ways of knowing viewing and describing the world (Parker & Rennie, 2002).

Teacher D made sure that all learners participated actively by making sure that the learners were grouped appropriately where they supported each other. This is also a good strategy when teaching a large class size.

All the participant teachers had set out to cover the same Learning outcomes and assessment standards. This was evident in their lesson preparations and their work schedules. They all covered LO1 which involved scientific investigations with the corresponding assessment standards. They also covered LO2 and the corresponding assessment standards for that outcome.

The teachers' approaches of using first hand practical activities were essential in order for them to achieve LO2 and the corresponding activities of the LO. The activities were teacher initiated activities that were intended to focus the learners' attention on particular concepts. These ideas proved fruitful as most of the learners were interested in the lesson and well able to carry out the activities and complete the activities successfully. Jarvis (1991), supports the idea of work based on first-hand experiences as it makes Science stimulating and relevant, and enables a wide range of skills to be developed. She also believes that observing and using real things enables the children to use all their senses (Jarvis, 1991). This aspect of observation was also stressed by teacher C.

When learners carried out the simple experiments for themselves, their experiences were more lasting and the concepts involved were more clearly understood, rather than when secondary sources were used, because it was easier for the teacher to recognize when a concept was misunderstood or the wrong idea was communicated because they could correct the misunderstanding or idea further.

Children at primary school level need opportunities to 'play' with materials. The novelty of having pieces of apple and potato placed in front of them as a tasting exercise proved to be fruitful. They did not like the taste of raw potato but they most certainly realized the sweet taste of the apples. This enabled learners, as supported by Jarvis (1991), to participate more effectively in the discussion that followed, by learners suggesting properties that they had already discovered.

The three teachers who carried out the bean planting experiment to show learners that plants needed air, water and sunlight for growth, were not confident enough that their learners had

their own ingenuity or imagination and therefore gave the learners a 'recipe' for the activity and investigation. Jarvis (1991) suggests that "learners are more likely to learn how to set up a fair experiment, raise their own questions and suggest hypothesis and interpret data if they are involved in the decision-making process." (Jarvis, 1991, p.2).

Jarvis's (1991) suggestions have implications for the Science teachers own knowledge and understanding and enthusiasm for Science. Parkinson (2002) outlines that a good Science teacher must be enthusiastic about Science, so that these can rub-off on their learners. They themselves must show interest in the Science that is taught in order to provide a positive role model of scientific curiosity, competence and creativity. They must be confident to learn alongside the learners that they teach. He also stresses that good teachers are thoroughly knowledgeable about the Science that they teach, by thoroughly understanding the scientific concepts that they are going to teach themselves. They must be able to deal with learner's questions and provide background information, anecdotes and further examples in order to promote further interest and inquiry (Parkinson, 2002). The different Science teachers showed a good understanding of the unit of study and were therefore able to discuss and explain to the learners the various concepts that were being taught.

Practical work and oral work means that learners will need to work in groups. When learners are put into small groups they are better able to share ideas and participate fully, as all the learners in the group will be able to assume a role function in the group according to what s/he may be good at. Group work also assists less able learners to be assisted and supported by others in the group and in this way their self-image would be improved and they would become effective members of a team (Jarvis, 1991). This aspect of group work was also emphasized by Teacher D.

It was good to note also that all the teacher participants made use of everyday materials and tools that were easily accessible and available e.g. margarine/yogurt containers, sugar bean seeds, potatoes and apples, cotton wool. The items that they used were easily available within the context of the school. They did not make the excuses of being under-resourced, no laboratories, no equipment, etc. The study unit itself did not call for the use of sophisticated scientific equipment. The approaches that the teachers used were appropriate and their lessons were a success.

4.3.4 Theme 4: Changes in Approach

In response to the question: What did you want to achieve by changing your approach, a fourth theme emerged as to why teachers change their approach to teaching or use a variety of styles and strategies in the teaching of a unit of study.

By reading of the responses of the teachers to the above question, emerged the ideas that most nine-year olds, i.e. grade 4 learners do not seem to have a long attention span, therefore the approaches in the lessons had to be varied in order to keep the learners attentive and also to accomplish the activities of the unit of study.

Teacher A explains: *Okay, in the lesson, instead of involving the learners in an experiment, I used a chart rather, to show them the different parts of the plant. Pictures eh.. normally make a lesson more interesting… this age group of learners are generally more interested when they see colourful pictures. So by using the chart, I wanted them to get a better understanding…*

From the above excerpt, it is evident that learners constantly need new and exciting tasks in order to keep their attention going and make them interested. Teacher A used the approach of the use of a chart depicting the various edible vegetable that learners were familiar with. She had taught them the lesson on food storage organs in plants to show them the various parts of the plants that could store food in the form of starch or sugar. The assessment standard that was to be accomplished was identifying and classifying the food storage as either a root, stem, leaf, flower, seed. The learners had to give an example of their own as well in addition to what appeared on the chart. This was chalkboard activity which engaged the learners into using their thinking and reasoning skills while they identified and classified these food storage organs.

TB: *… The children were getting anxious now; they didn't want to take down notes from the board.*

It is evident from the above excerpt that Teacher B had to change her approach because it was obvious that her learners had lost interest in the written task.
According to Parkinson (2002), learners see writing as a chore and something to be avoided at all costs in Science lessons. He, however stresses that learners can learn a great deal of

Science through writing activities and by varying the type of activity. Learners will have to be motivated by the teacher bringing in elements of fun from time to time. He believes that it is part of the job of Science teachers to raise learners' level of literacy and help them to use language to clarify their understanding of Science concepts (Parkinson, 2002).

Teacher C's response is in concordance with Parkinson's (2002) ideas of integrating Science with language or other aspects.

TC: *There is an integration that takes place… Powers of observation is absolutely necessary, scientific observation … The child can now put to paper what he has observed.*

Teacher C seemed to be focused, with keeping the learners attention on the activity and tasks at hand.

TC: *I always like my lessons to be vibrant. I like my lessons to be active… and I think my lessons show quite a few changes.*

Teacher C believes that learners must be able to see or observe what was happening as Science required evidence. He believed that Science had a certain level of truth or honesty, so the evidence had to be one that could be observed as one that could be touched as 'tangible'. In this way he believed that he could achieve the learners' retentive capacities, because they would be able to remember.

TC: *They must be able to open memory banks and say 'you know what, I remember this.' I believe that in the context in which I taught the lesson and the way in which I took them through the lesson, I am happy I wasn't monotonous.*

Teacher C believes that a lesson should not take the form of a 'church service', it must be 'vibrant' and 'inspire-thought' and have 'variety'. These were the reasons for Teacher C using a variety of approaches in his lessons. This approach collaborates with Kang and Howren (2004) and Roberts (2009) creative approaches to the teaching of Science.

Teacher D also concurs with Teacher B.

TD: *The learners attention span was, is quiet short, being as small as they are, so the next day I decided not to have so much of instruction placed on them… I thought it was more beneficial by allowing them to do their experiment.*

She had changed her approach in order to keep the interest of the learners in the unit of study.

From the analysis of this theme, we can take note that it is essential for Science teachers to change their approaches in order to uphold the interest of their learners and also for more effective learning to take place and ultimately for the learning outcomes to be achieved.

4.3.5 Theme 5: Learner Activities

The teacher participants had planned a variety of activities of a practical nature for the learners to participate in. The theme of learner activities emerged from my question: Why did you engage the learners in these activities.

In order for the teachers of Science to be clear about what they are going to teach in a unit of study, they have to have a clear idea of the LO's of the unit of study to be covered and what assessment standards they are to use to achieve this LO. Therefore the activities that the teacher plans are important in order for the assessment standard to be achieved. Therefore a clear plan of carefully timed activities will need to be planned. The outcome of the activities must be carefully communicated to the learners in order for them to know what is expected of them, whether they are practical activities of written activities.

The teacher participants had planned their activities for similar reasons. This was revealed in this theme from their responses.

TA: *Many of the learners, most of the time, they not generally interested in something that's new to them… And the activity basically is to find out whether they understand what is being taught to them.*

From the above excerpt it is evident that teacher A is using her activities to assess or gauge whether her learners have grasped the concepts that she has taught theoretically. The activities have provided her with an indication of whether the learners have understood the concepts.

Teacher B also concurs with teacher A as to her reasons for planning activities.

TB: *I wanted to see whether they can adapt from doing things practically and to doing written work. I wanted to assess them as well to see how they performed in written work and in practical work.*

Teacher B also used the activities to assess her teaching methods and approaches.

Teacher C: *You have to… You can't just teach theory. You teach theory and you don't have practical aspects – you lost it – you not going to get the outcome. Teaching theory, theory, theory – reminds me of the book 'Hard Times' and Gradgrind.*

Teacher C planned activities in order for him to achieve the outcomes of the unit of study. This is in keeping with the NCS Policy Document for NS (DOE, 2002) requirements. Teacher C however regarded learner activities to mean practical work mainly. He believes that learners must engage in written activities, theory and practical work in order for the LO to be achieved. He believes that in this way 'true learning takes place'.

Teacher D: *I engaged them because practical work and experimentation is important.*

Teacher D felt that activities of a practical nature such as experiments were important for the development of thinking and reasoning skills in the learners. These ideas are in accordance with Jarvis (1991) idea where children need opportunities to make their ideas explicit and to raise their own scientific questions. By discussing with their teachers and other learners they are able to build on their experience that they already possess. This process also assists the teacher to take into account the development of the learners' concepts and evaluate their ideas (Jarvis, 1999).

From my analysis of this theme, emerges the idea that learner activities both written and practical in Science should be planned for the purposes of attaining the intended outcomes and the building of conceptual knowledge through the processes of thinking and reasoning. These approaches are also advocated by the NCS Policy Document for NS Grades R-9.

4.3.6 Theme 6: Learner Skills

Process Skills

The term 'process skills' refers to the learners' cognitive activity of creating meaning and structure from new information and experiences. Examples of process skills that could be used in NS include observing, making measurements, classifying data, making inferences and formulating questions for investigation (DOE, 2002).
The process skills used may be applicable for all three Learning Outcome, but I will concentrate on LO1 for the purposes of this study, as the unit of study (green plants make food), concentrate on LO1 and AS 1,2,3 and LO2 and AS 1,2.

From a teaching point of view, process skills can be as building blocks from which suitable Science tasks are constructed. From the learning point of view, process skills are an important and necessary means by which the learner engages with the world and gains intellectual control of it through the formation and concepts (DOE, 2002).

The process skills used by the teacher participants for the unit of study include observing and comparing, recording information, sorting and classifying, interpreting information predicting, conducting investigations and communicating Science information.

Observing and comparing may involve the learners in noting detail about organisms, objects and events with or without prompting by the teacher, noting similarities and differences and describing them in general terms.

I shall use excerpts from the interviews to illustrate the use of process skills by the different teachers.

TC: *Lets take the activity there by the lemon tree. Activity –observation skills… they see colour, the see plants, but they just hone in to one particular aspect – their observation skills are now further focused.*

We therefore note that TC uses observation skills to enhance his teaching. He uses this skill in both his lessons. He also uses observation skills when he does the starch test in the potato.

TC: *The skill of identifying starch with what chemicals were going to be used to identify starch. It is through observation skills that the learners were able to explain that in the*

presence of starch iodine will turn blue/black and because the slice of potato contained starch, and that starch was produced by the potato plant and starch is the modified stem which is a tuber by making comparison between the two specimens which were the apple and potato.

Teachers A, B & C were not able to carry out the starch test using the chemical iodine, as they did not have the chemical. They therefore used the tasting method using the potato and apple. The conclusion their learners were able to come to was that the apple contained sugar, because it was sweet and the potato contained starch because it was not sweet. They observed the taste of the two food storage organs of two different plants. They were also able to compare the taste of the apple and potato.

Teachers A, B & D also taught the skills of planning and conducting investigations. The learners planned and conducted the investigations in the form of experiments, they became aware of the controlling variables for good plant growth such as air, sunlight and water, they were also able to record these findings and report their findings,

TD: *They will learn practical work, how to conduct en experiment, how to do a recording, the LO conducting of experiments, collecting of data, the recording of data, investigation-that would all come in, their thinking and reasoning skills as well.*

TB: *Eh… collecting and sorting… data handling.*

The skill of sorting and classifying may involve the learner using a given rule to sort items in a table. Learners were given a table of edible parts of the plant and food storage organs that we eat. Learners were able to sort out the food storage organs according to the different parts of the plant that they represented. Example, leaves, stems. roots, fruit and flowers, seeds. The learners were able to accomplish a variety of skills where they were directly involved. As Lemke (1990) adds that it is through peer group interactions that learners become fluent speakers of 'Science'. It is through the 'language of Science' that learners make sense of their newly constructed ideas (Lemke, 1990). Driver et al (2000) claim that it is the role of the teacher to make the tools of Science available to learners, allowing them to engage in socially constructed discourse. In this way scientific reasoning skills also increase (Driver et al, 2000). This is also keeping with Bodner's (1998) views on constructivism, where learners construct knowledge out of their experiences. Constructivism is therefore often associated

with pedagogic approaches that promote active learning or learning by doing. Learner activities must therefore be characterized by active engagements, hands-on activities, inquiry problems, investigation and experimental design (Bodner, 1998).

From my analysis of the process skills that teachers teach it has become evident that they are using the constructivist approaches to teach skills. These approaches are also strongly supported by the NCS Grade R-9 Policy Document (2002).

4.3.7 Theme 7: Assessment of Learners

"Assessment in the NCS for grades R-9 (schools) is a continuous planned process of gathering information about the performance of learner's measurement against the Assessment Standards of the learning outcomes. It requires clearly-defined criteria and a variety of appropriate strategies to enable teachers to give constructive feedback to learners and to report to parents" (DOE, 2002 p.77)

Continuous assessment is the chief method by which assessment takes place in the NCS. It covers all the outcomes-based education assessment principals and ensures that assessment takes place over a period of time and is ongoing; supports the growth and development of learners; provides feedback from learning and teaching; allows for the integrated assessment; uses strategies that cater for a variety of learner needs (including that of barriers to learning) and allows for summative assessment (DOE, 2002)

The assessment strategies that teachers choose to use is a subjective one and is unique to each teacher, or the grade or the school and it will depend on the teacher's professional judgement. The availability of space and resources influences this decision. Even though the resources may be the same or similar, teacher's choices may differ (DOE, 2002).
Delandshare & Jones (1999), concur that if learning is thought of as a process of constant development enhanced by structured, purposeful and educational experiences then assessment is more likely to be seen as providing documentation and feedback. Wilson (1994) adds that it is necessary for the teacher to gather evidence from multiple sources.

It is against this backdrop that I would analyze the teacher participant's views on assessment and continuous assessment in particular, paying particular attention to the strategies that they employed when assessing learners in this unit of study.

The conceptual framework that guided this study emerged from my recordings of constructivism and how constructivism relates to the philosophy of the NCS NS grade R-9 Policy Document. According to Hodson (1998), Constructivist theories of learning suggest that learners come to Science lessons with concepts and ideas about Science that they have developed from their everyday learning experiences. They then rethink and reconstruct their ideas and views to fit in with scientific explanations of phenomena (Hodson, 1998). Chetcuti (2009) adds that, opportunities are created for learners to make their own ideas explicit, share them with others, subject them to critical scrutiny and test their robustness by observation and experimentation. This knowledge construction within the Science classroom is not only scientific in nature, e.g. The chosen unit of study "Green plants make food" or photosynthesis, but knowledge construction is developed about what is expected of them as learners. They are therefore developing their own views and expectations (Chetcuti, 2009).

In response to my question: How do you assess the learners' levels of achievement in your lesson? Each of the teacher participants responded with different assessment strategies which include tests, questioning, observations, discussions, integration, written activities, practical work, assignments and the mandatory test which is expected by the school policy at the end of each unit of study.

Teacher A and B speak of the oral assessment.

TA: "*Assessment was done orally, by learner discussions. I was able to pick out how much the learners really knew, or remembered. In our school we do have very weak learners, so sometimes in written work some of them do not perform as much as they would have performed in practical work…. Orally they do perform better."*

The assessment practices that are encouraged through the NCS for grades R-9 (schools) are continuous, planned and integrated processes. It is stressed that assessment planning should include the assessment of learners who experience barriers to learning, as it is likely that in every classroom there would be some learners who experience barriers to learning. These barriers to learning will include factors such as lack of resources as the context factor and in the learners themselves i.e. sensory, physical, intellectual disabilities or disease or illness. Barriers to learning can also arise from the social context i.e. poverty, violence or difficult home conditions (DOE, 2003).

Teacher A and B have identified the barriers to learning experienced by learners in the classrooms, with regard to written work and written instruction and therefore conducted some of their assessments orally by conducting learner discussions to determine and gauge the kind of learning that has taken place. The finding in Chetcuti's (2009) study also collaborates with these teachers' findings as it agrees that the teachers who participated were very strong in their view that there were many differences among the learners whom they taught. This difference indicates a complexity in the nature of the factors that influence assessment and achievement (Chetcuti 2009).

Another assessment strategy that teachers employed was observation. The teacher observes the learners while they perform their tasks and conducted their experiments which was teacher directed.

Teacher C was also the only participant who used the strategy of integrating knowledge from other learning areas to build or construct upon.

TC: "*We have now integrated English paragraph writing …. in a Science lesson. We are …honing into the integrated aspect of the lesson. We are just not looking at it scientifically, but we need other building blocks e.g. paragraph writing, e.g. vocabulary… If we integrate, I see everything comes together."*

According to DOE (2003), integrated learning is central to OBE, the key being the balance between integration and conceptual progression. This means that integration must support conceptual development rather than being introduced for the sake of it. Teachers will therefore have to be aware and look for opportunities for integration both with the learning area and across the learning areas (DOE, 2003).

Teacher C asked learners to write a short piece or paragraph about how green plants made food. He had built up a list of vocabulary on the chalkboard during the course of his lesson; these words were to be used to write the paragraph depicting the process of photosynthesis. , He also went a step further to concretize this concept by asking learners to draw a simple picture of the process depicting a plant in the environment, clearly showing the different parts of the plant (roots, stems, leaves), making sure that the root was to be depicted below the ground. Learners were to annotate the diagram using the words from the vocabulary listed on the chalkboard. From my observations I was able to deduce that most of the learners had

succeeded in doing a pictorial representation of the concept of photosynthesis and explain how 'green plants made food'. Teacher C found that this form of assessment i.e. integrating language (English), Science and Visual Art helped him to achieve the learning outcome.

Teacher C believes that for a successful lesson the integrated approach was most useful.

TC: "*Just going into a lesson, just like that, without attending to paragraph writing, without attending to vocabulary, without attending to the meaning of the words, we are going to have problems. If we integrate, I see everything comes together. The child understands an integrated approach, you know, he is able to explain himself."*

Teacher C was able to achieve the LO and the assessment standards while the children wrote up their paragraphs and produced their picture depictions, he walked around the class, marked their books, commended the learners who had completed their work to his satisfaction and displayed the best works for others to observe. He also read the paragraphs that were written well, i.e. with coherence and understanding of the concepts aloud, so the slower children were able to learn from their peers.
Teacher C's assessment strategies is in keeping with Bancroft's (2002) suggestion, where we need to use multi-sensory teaching strategies and multi-sensory assessment tools.

He suggests that this can be done through practical, oral, drama, creative writing and Information and Communications Technology use. This ensures that all the different talents and the ways of learning of learners are taken into consideration, because assessment does not stand outside teaching and learning but stands in dynamic interaction with it (Bancroft, 2002).

4.3.8 Theme 8: Teacher Reflections

The theme of teacher reflections emerged from my last question which was: can you please share some thoughts, feelings and reflections on your lessons? It could be anything that you feel is important but was not covered earlier during the interview.

When the last question was asked, it was the first time during the interview that all of the teacher participants became quiet as if in true reflection. I thought that they were uncomfortable to answer this question because they have answered all the other questions with promptness and they were at complete ease. The last question seems to have taken them

by surprise or a raw nerve had been hit. I then realized that in the history of their teaching, none of the teacher participants had been confronted by their own teaching practices as starkly as this. The Integrated Quality Management System (IQMS) has been in operation in an attempt to monitor teacher practices with the aim to constantly improve teacher practices in a cyclic and systematic fashion, paying particular attention to the various performance standards and the areas that needed to be developed. Teachers are therefore accustomed to management members and their peers arriving in their classrooms after having given them prior notice of their visits. Teachers are then given reports by their school mentors about their shortcomings. These reports are duly signed by the teacher participants and filed away in their IQMS files which are then housed in the office, only to be handed out again in the next cycle of IQMS. Anecdotal reports from teachers at other schools also confirm the farcical nature of these procedures.

So when teachers were confronted with their own teaching where they could see for themselves, what they looked like, how they spoke, how they handled their lessons and how they managed their classes, it became a turning point in their practice as Science teachers. Sikes, Measer & Woods (2001) view these as critical phases or incidents in our teaching careers. Critical incidents in teachers' lives will therefore provoke them into selecting particular kinds of actions, which lead in particular directions. Critical incidents have been found to have forced decisions on people that had had profound effects upon career development (Sikes, Measer & Woods, 2001).

The critical incident in these teacher participants' lives have been their reflection on their own teaching practices. I call this a critical incident because this has caused them to rethink their practices and consider changing certain aspects of their teaching in Science.

TA: *I think that I explained to the best of my ability, but I also feel that certain parts could have been improved, them being, learner involvement, especially the weak learners, who seem to shy away from answering questions. I feel that I should have involved them more in the discussions and question and answer sessions.*

Teacher A had reflected and shared some of my own sentiments on the lessons as well. I found that the discussions and questioning techniques employed by the teachers did not reveal the dialogical interactions that are expected in a Science lesson. The major parts of the interactions were teacher led situations as pointed out by Mercer et al (2004). Lemke (1990)

also adds that it is through peer group interactions that learners become fluent speakers of "Science". It is through this "language of Science" that learners make sense of their newly constructed ideas (Lemke, 1990).

Taking Mercer, Dawes, Wegerif and Sams (2004), and Lemke's (1990) views into consideration, it became evident that the dialogical interactions were mainly teacher dominated and controlled. Learners did not seem to have much opportunity to engage in socially constructed discourse. Their interactions were mainly single word answers that were directed to the teacher and from this we can conclude that much of the teaching that still occurs is teacher centered and in keeping with the old curriculum . Teachers have not broken away from this tradition.

Teacher B reflected that she would also like to improve on her teaching, but she did not elaborate on which aspects.

TC: *I can see now as I teach I may be facing one group of children, other children were doing some other things on camera. That was interesting. There are some limitations when you are in the class and speeding ahead with the lesson, there are other children that get distracted, the concern there now is … there are children that are just not interested in the lesson…. I look at some of the learners that were running amok, whiling their time. Their attention span eh seems that there is a problem. I need to try and work ways in which to er …. I need to attend to that.*

I found teacher C's reflections quite amusing as he is well known as the disciplinarian of the school who deals with troublesome learners from the different classes. He was rudely awakened to the fact that children from his own class "were also running amok, whiling their time." He reflected that he needs to attend to that without further elaboration. . Teacher C's class is not unique in this type of behaviour. Given large class sizes and children of "multiple intelligences" as described by Manner (2001) and different cognitive levels as proposed by Pollard (2005) it is not uncommon to experience situations of this nature. In this school in particular it is a common phenomenon where we have a few learners in every class that are easily bored and distracted.

It was also found that the teachers were not adverse to the experience of their lessons having being video-taped. When I had initially prepared myself , with some trepidation , to approach

them as I had expected to be encountered with reluctance on their part, I was surprised that after I had assured them of confidentiality and the chance for them to view themselves individually on video that they had willingly agreed to participate. This is evident in their responses during their interviews.

TB: *It was quite an experience ….. I really enjoyed the experience.*

TC: *I am chuffed with the idea, that I saw myself on screen ….. It's like a bonus - for being a part of this research.*

TD: *You know it was such an experience to see myself on screen. I just want to say that its been a very big learning experience for me. I would like to have more of this kind of activity in the future so that I would know where my short-comings are and I would like to improve on that. Improve my strengths as well as improve on the limitations that I have and move from there, so that I could deliver better quality of education in the classroom. So what this has taught me is that I can do better.*

I as the researcher also became quite delighted that the teacher participants had warmed to the idea of the research to such an extent that they had requested for more activities of this nature in the future. It became quite clear that the exercise was quite a fruitful one and of mutual benefit. I was able to write up my research dissertation while the teacher participants received feedback on their teaching approaches and strategies. My work was also made easier, as they were able to critique their own teaching by watching themselves teaching on video. This was done in a collaborative manner.

I had to explain to the teacher participants that this practice required time, effort, proper, planning and finance. There were also many issues that had to be considered as this was not common practice in South African schools as an approach to educational evaluation, as it is in other countries, and that in other countries it was known as "Reflective Teaching". I explained that I had merely copied the methodology in order to facilitate my research. I also explained that it was regrettable that we could not continue with this type of exploration as there were many ethical issues that needed to be addressed and much red-tape that had to be adhered to.

4.4 Conclusion

This chapter has presented the data that had been generated by the video-taping of the unit of study in Natural Sciences of the four teacher participants and the data that had been generated by the semi-structured interviews using the stimulus-recall method. The data has been presented in eight themes. The first theme that had emerged was creating of interest and motivation in lessons and how this aspect was handled by the teacher. The second theme was that of Learning Outcomes and Assessment Standards and how teachers went about achieving these. The third theme was that of teaching methods and strategies and what methods and strategies teachers used in their lessons. The fourth theme dealt with the approaches that the teacher employed and their explanation for these changes. The fifth theme discussed the skills that learners would have learned and how teachers taught these skills. The sixth theme was that of learner activities and described the types of activities learners engaged were in. The seventh theme discusses how teachers assess learners on a continuous basis and some of the ways in which this can be accomplished within a lesson. The eighth and last theme dealt with teacher reflections on their practices and in particular the unit of study in question.

It became evident from my observation that the lessons that teachers employed mainly teacher directed approaches and therefore their lessons were mainly teacher centred rather than learner centred. The learners had few opportunities to engage directly in practical activities and they did not have opportunities to plan and carry out their own investigations. The ideas of learner centred approaches will therefore be discussed in chapter 5.

Chapter 5

Findings and Insights

5.1. Introduction

This study sought to explore the teachers' approaches to teaching a selected unit of study in Natural Sciences. The unit of study that was selected was "green plants make food" in grade 4 classes. This chapter focuses on crystallizing and amalgamating the findings based on the data that has been presented in the previous chapter. The themes that have emerged from the analysis have provided an understanding and explanation for the teachers' approaches that were used in their teaching of Natural Sciences. I will make use of the conceptual framework of constructivist approaches and the analytical framework of the NCS policy document for Natural Sciences grades R-9 2002 to present my findings.

This chapter captures the responses to the two critical questions of my study, namely:

1. What approaches do teachers use in the teaching of NS in grade 4
2. Why do teachers choose to use these approaches?

The responses will not be divided into separate sections for the two critical questions but it will be presented as themes or major insights that have arisen out of this thesis. A presentation of the findings and possible reasons will be furnished.

Some of the major insights arising out of this thesis are:

1. How teachers look at learners centeredness in their teaching of science.
2. The teacher as a mediator.
3. Assessing learners.

5.2. Insights

5.2.1 How educators' view learner-centeredness in their teaching of science.

One of the ideals of Outcomes- Based Education indicated in the National Curriculum Statement (NCS) for Natural Sciences (NS) (DOE, 2002) Grades R-9 is to instill thinking abilities among all learners. One of the implications that arise from this is that teachers have to base their teaching in constructivists principles that will provide learners with the

opportunity to develop as thinkers. This has had implications for the teachers to transform from the traditional role of transmitters of knowledge and to and adapt to a mediative approach to teaching and learning. This approach aims at helping learners to construct their own knowledge, solve problems on their own and to understand their own thinking process (Fraser, 2006).

This approach ties in with the vision of the NCS for learners and teachers. From my study I was able to conclude that teachers are employing the traditional methods as well as the new methods to their teaching. They believe that their approaches are learner centered and hands on. They have assimilated in their own minds that they are teaching according to the tenets of the NCS policy document for NS grades R – 9 (DoE, 2002).

I shall make use of two constructivist's models of Pollard (2005) which depicts the "constructivist's model of roles in the teaching – learning process" and "a social constructivists model of roles in the teaching – learning process.

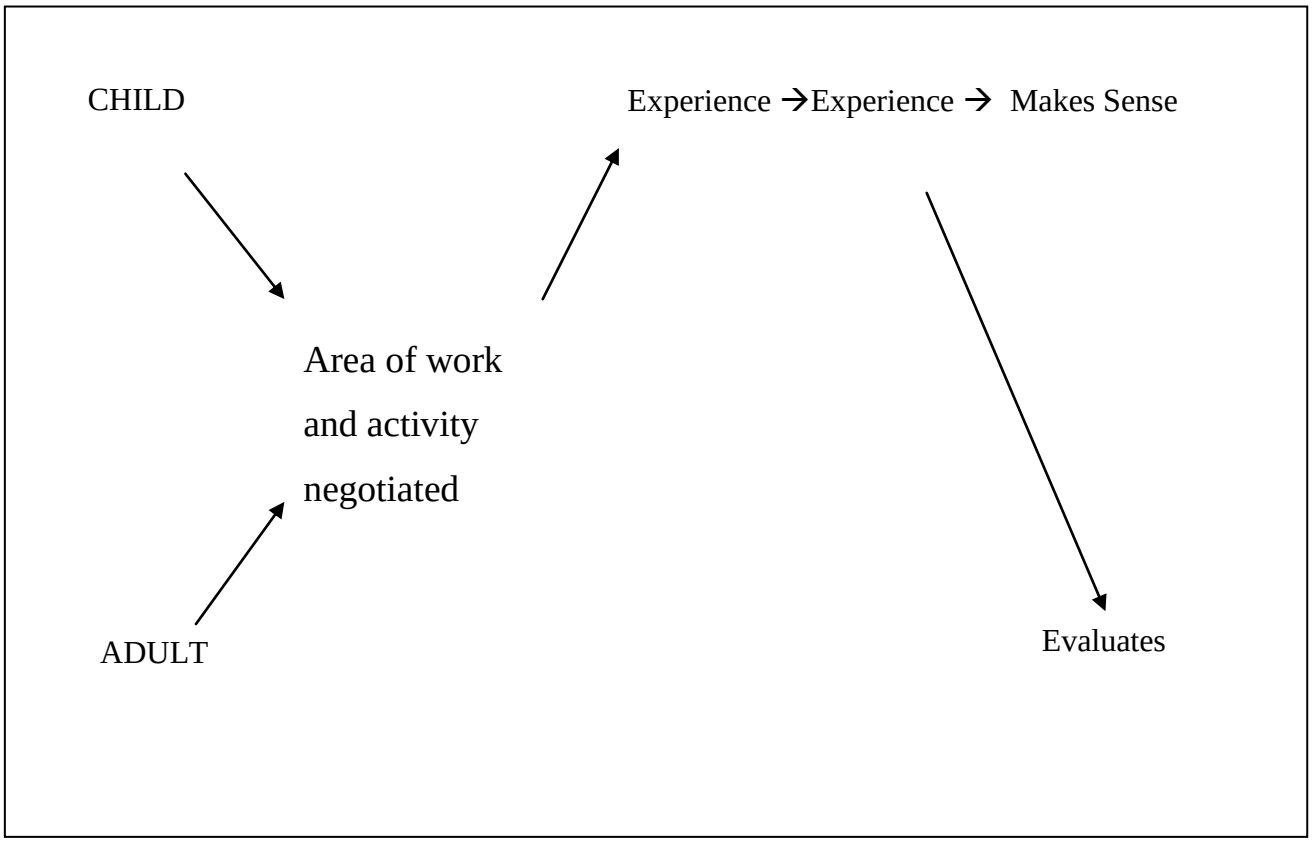

Fig. 1: A constructivist model of roles in the teaching – learning process

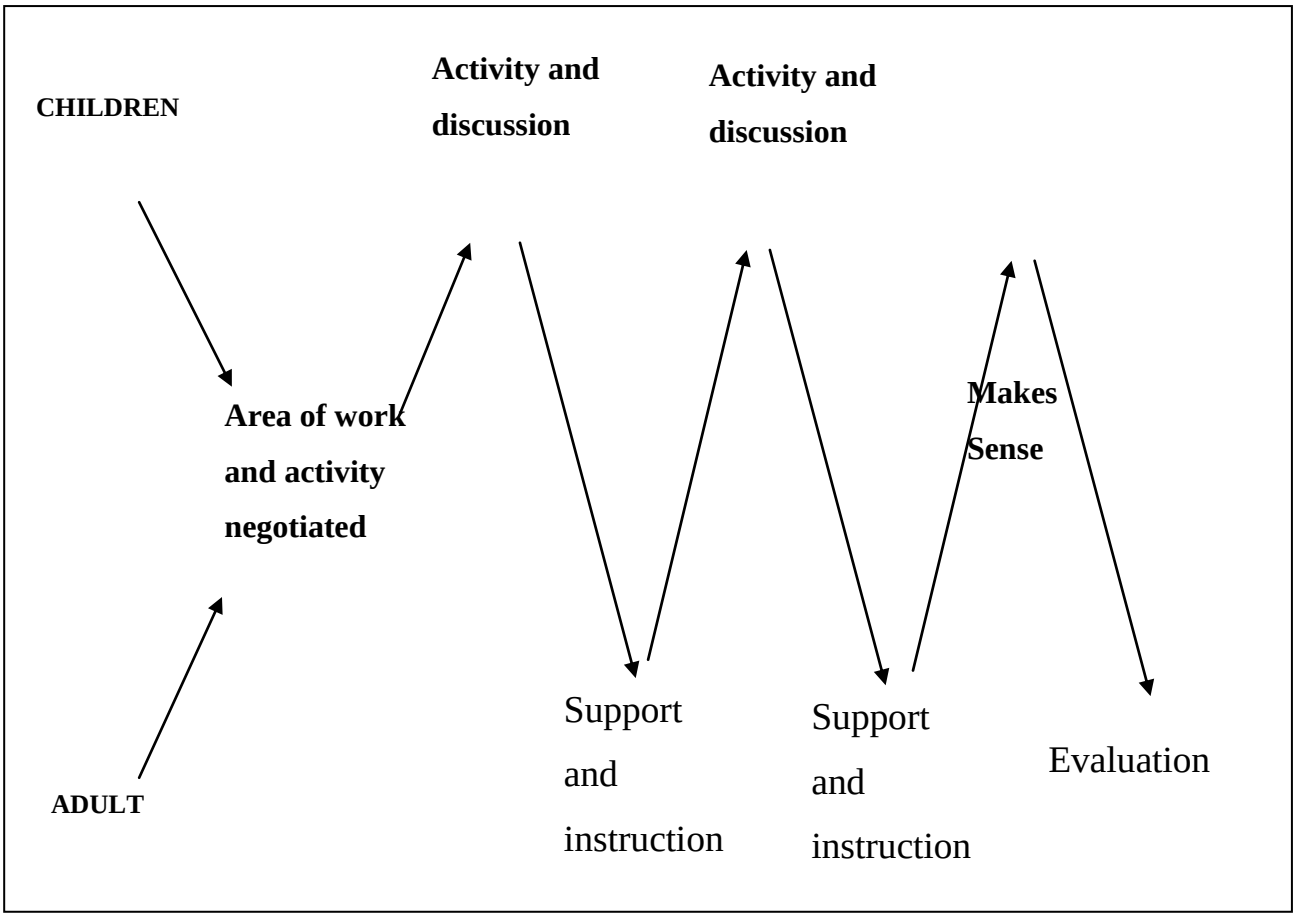

Fig. 2: A social constructivist model of roles in the teaching – learning process

The teacher participants taught learners who were within the "concrete operations stage", as they were in grade 4 and the average age of grade 4 learners is 9 years. The "concrete operations stage" ranges from 7-12 years. At this stage of development the learners' direct experience is deemed to be crucial. Children are believed to behave like "active-scientists", enquiring, exploring and discovering as their curiosity and interest lead them to successive experiences (Pollard, 2005).

The teachers who use constructivists principles in their teaching had to provide rich and varied activities that were stimulating, hands-on, and inquiry-based and stimulate thinking (Pollard, 2005). According to Pollard (2005) in social constructivists approaches teachers will have to engage with children's existing cultural and conceptual understandings first, before planning activities for the class as a group or for smaller groups within a class. The role of the teacher then is to provide support and instruction. This intervention must

connect with the understandings and purposes of the learners so that their thinking is extended (Pollard, 2005).

Looking at the Pollards (2005) model (see Fig.1) of social constructivism in the roles of the teaching – learning process, it is clear that the science teacher will have to plan and prepare many different types of activities in which the learner must be actively involved, both cognitively and physically or hands-on, in order for learning to take place. It is through a series of activities in a group that learners can engage in the 'dialogue of science' to make sense of the concepts that are being taught. In this way the activities are more learner-centred. These forms of social constructivist learning are supported by Bodner (1998), Mercer et al (2004) and Pollard (2005).

5.2.2. The Teacher as Mediator

In this study it was found that teachers were using a mixture of the traditionalists approaches of lecture method or teacher directed activities where children followed a recipe for the activities as devised by the teacher and they then interspersed the lesson with some ideas from the new curriculum where they grouped learners for activities in the guise of following the new approaches.

Teachers found that they had less control of the class when they instructed groups on the activities and moved around to different groups. In the process of mediating within one group, other groups became unproductive and noisy. As one teacher (TC) expresses "*there are other children that get distracted , the concern there now is … that there are children that are just not interested in the lesson…. some of the learners were running amok".*

This illustrates that teachers have difficulty in controlling large class sizes in physically small classrooms when they used approaches that were synonymous with constructivist approaches. Teachers change their approaches in order to avoid learners from being bored, restless and anxious. My findings concurs with findings by Grosser and de Waal (2008) who claim that there was no evidence of research on how South African classrooms understood and translated the principles of mediation to their teaching prior to their own study. Their study also reveals deficiencies regarding the understanding and application of mediated learning experiences in the classrooms (Grosser and de Waal, 2008.)

The teacher participants justified their intervention of taking over and directing all activities in the classroom by expressing their own views that learners were not at an age to carry out

experiments on their own or plan their own enquiries. They also stressed in their interviews that when learners come to them from the Foundation Phase, they lacked appropriate experiences in science skills and they also lacked in conceptual knowledge and the ability to read and understand simple instructions.

These findings are also supported by studies conducted by Taylor (2009), Fleisch (2007), Taylor and Vinjevold (1999) and Harley and Wedekind (2000). The learners therefore were able to perform at a much lower cognitive ability range.

In spite of the hurdles mentioned, the teachers were able to achieve the learning outcomes by using mainly the teacher-directed and content-centered approaches in their lessons. They felt that they had more control over their lessons and that learners were able to achieve more during the activities by planning their lessons in this way. These ideas are also supported by international initiatives carried out by Grossen (1998) and Moellar (1994) in achievement in academic performance, cognitive skills and self-esteem. These studies showed that "the teacher-directed methods came out on top and wholly learner-centered methods at the bottom.

5.2.3. Assessment of learners

Another major insight that was revealed was the challenge of classroom assessment. According to Kanjee (2009) the primary purpose of assessment at classroom level is to assist teachers and learners to determine, monitor and improve performance. If classroom assessment was used effectively it could assist teachers in identifying learner strengths and weaknesses and provide teachers with ideas for relevant interventions. It would also allow teachers to evaluate their teaching approaches (Kanjee, 2009).

In this study it was evident that the teachers did not have the appropriate assessment skills to enable them to effectively apply and develop appropriate assessment tools to assess the learners on the spot, during the lessons. Although the teachers had planned varied activities for the lessons taught, they did not assess the learners either individually, group work or peer assessment strategies were not used. The tasks that were planned did not determine the learners knowledge and understanding to a large extent. This may have implications on the teachers own experience and understanding of assessment. My findings are also supported by Pryor and Lubisi (2002) and Vandeyar and Killen (2007) who found that in South African schools, many teachers have limited experience and understanding of assessment.

5.3. Conclusion and Recommendations

This study has revealed, that although it is approximately a decade after the implementation of the post-apartheid curriculum of the NCS NS grade R-9 policy (2002), teachers are still finding difficulty in effectively using these policies and their requirements during the approaches to teaching of the NS lessons in their classrooms. It is evident that the successful implementations of policy will depend on the science teachers as there are ultimately responsible for fulfilling the expectations of this document in their classrooms. It therefore is imperative that teachers of science will require sustainable teacher development, support and guidance and a better understanding in the practice of continuous assessments.

Sustainable teacher development and support is required so that teachers can successfully make the transition from teacher centred approaches to learner centred approaches of teaching especially in the Natural Sciences curriculum. For this successful, intensive and in-depth training courses must be held over longer periods of time, so that teachers will gain maximum benefit. The courses could be held as 'in-service' training programmes for teachers of Natural Sciences. Those who conduct these programmes should be knowledgeable and possess adequate expertise in the content knowledge and policy requirements of the learning area. They must also be fully aware of the challenges teachers face in schools. These challenges include inadequate teacher expertise and content knowledge, limited access to relevant teaching and learning resources, poor understanding of assessment, high teacher workloads, large class sizes and the continued reliance on traditional assessment practices. All of the factors mentioned affect teachers creating a learner-centred environment in the teaching of science.

It is evident that the Department of Education has limited human resources to monitor schools adequately and assist science teachers with the NS curriculum, as the subject advisor in the field seldom or never visit schools to monitor the learning area of NS. The school, at which this case study was conducted, has not had a subject advisor for NS visit them in the last 24 years.

I therefore strongly recommend that it is necessary for the Department of Education to set up websites for the teachers of science to access appropriate materials and support so that teachers could enhance their classroom practices. Teacher support could be in the form of appropriate learning programmes, work schedules and lesson preparations and assessment

strategies that are suitable for various contexts. It is unrealistic to expect teachers from disadvantaged schools to develop high quality teaching programmes given their limited resources. It is therefore the responsibility of the Department of Education to provide appropriate materials and support for the NS teacher so that the appropriate approaches in the teaching and learning of NS can be adopted.

The intent of policies are commendable but they pose many challenges for teachers in their classroom practice. In particular, one of the major insights that have emerged is that of classroom assessment. The teaching approaches that underpin the new curriculum demands that teachers use more interactive pedagogies so that continuous assessment could be supported. This would require appropriate assessment tasks to determine the learners' knowledge and understanding. The Curriculum development unit will need to provide the existing teachers support on a continuous basis so that they can create and maintain an effective learner-centred environment.

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APPENDICES

Appendix A

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3605

15 July 2009

The Science Teacher
Shallcross Primary School

For Attention: _____

REQUEST FOR PERMISSION TO VIDEO-RECORD SCIENCE LESSONS FOR MY RESEARCH PROJECT:

Project Title

EXPLORING TEACHERS' APPROACHES TO TEACHING A SELECTED UNIT OF STUDY IN NATURAL SCIENCE.

I am currently pursuing a Master's Degree in Education at the University of KwaZulu-Natal. My details are as follows:

1.1. Full Name & Surname		Maanwathie Jerrier
1.2. Title		Mrs.
1.3. Student Number		9804251
1.4. Discipline		Curriculum
1.5. School		Education & Development
1.6. Faculty		Education
1.7. Campus		Edgewood
1.8. Existing Qualification		B. Ed. (Educational Technology)
1.9. Proposed Qualification for Project		M.Ed.
2. CONTACT DETAILS		
2.1. Home Telephone Number		031 409 6408
2.2. Cell Number.		076 7145437
2.3. e-Mail		rjerrier@hotmail.com
NAME	**Tel.**	**E-Mail**
3.1. Prof. Reshma Sookrajh	0784517764	sookrajhre@ukzn.ac.za

The purpose of my study is to explore, describe and explain the teaching of a selected unit of study in natural science in grade four. The study seeks to explore the various approaches that teachers use in the teaching of science and the choices they make with regards to the methods and strategies that they employ. There is a growing demand for accountability and increasing importance for evaluation in all learning areas of the curriculum.

My study will be an interpretive study which will be conducted within a qualitative research paradigm. The study will concentrate on participant teachers and their teaching methods and strategies. The teachers who participate in this study will do so, on a voluntary basis and they will be selected purposively because they are science teachers in a grade 4 class. I will select four teachers in the school because the school has four grade four classes.

The first stage of my data collection will consist of the video recordings of the teachers' lessons. Three lessons per teacher will be recorded for a week. I have chosen to video tape the lessons so that the unexpected and evolving aspects of teaching and learning will be captured and that rich descriptions and explanations can be revealed. After viewing the recordings of each teacher's lessons, I will design a semi-structured interview schedule.

The second stage of my data collection will therefore be the semi-structured interview within which I will employ the "stimulated recall" approach to elicit data.

The data will be stored in a secure place during data collection and upon submission of the thesis will be stored in the School of Education, UKZN for a period of five years after which it will be disposed of.

The confidentiality of the participants will be guaranteed and respected. A copy of the findings will be lodged with the Regional Senior manager on completion of my studies. No individual will be forced to participate and all ethical considerations governing research will be strictly adhered to by the researcher and the respondents.

I hereby request permission to video-record three of your science lessons during a week.

I thank you in anticipation of a favorable response.

Yours faithfully

_____ _____

Researcher: M. Jerrier Date

Appendix B

M. Jerrier
Student No. 9804251
University of KwaZulu-Natal
Edgewood Campus
Private Bag x03
Ashwood
3605

15 July 2009

The Research Officer
KZN Department of Education
RESEARCH, STRATEGY, POLICY DEVELOPMENT AND ECMIS DIRECTORATE
Metropolitan Building, PIETERMARITZBURG, 3200

REQUEST FOR PERMISSION TO CONDUCT RESEARCH: SHALLCROSS PRIMARY SCHOOL

Project Title

EXPLORING TEACHERS' APPROACHES TO TEACHING A SELECTED UNIT OF STUDY IN NATURAL SCIENCE.

I am currently pursuing a Masters Degree in Education at the University of KwaZulu-Natal. My details are as follows:

1.1. Full Name & Surname		Maanwathie Jerrier
1.2. Title		Mrs.
1.3. Student Number		9804251
1.4. Discipline		Curriculum
1.5. School		Education & Development
1.6. Faculty		Education
1.7. Campus		Edgewood
1.8. Existing Qualification		B. Ed. (Educational Technology)
1.9. Proposed Qualification for Project		M.Ed.
2. CONTACT DETAILS		
2.1. Home Telephone Number		031 409 6408
2.2. Cell Number.		076 7145437
2.3. e-Mail		rjerrier@hotmail.com
NAME	**Tel.**	**E-Mail**
3.1. Prof. Reshma Sookrajh	0784517764	sookrajhre@ukzn.ac.za

The purpose of my study is to explore, describe and explain the teaching of a selected unit of study in natural science in grade four. The study seeks to explore the various approaches that teachers use in the teaching of science and the choices they make with regards to the methods and strategies that they employ. There is a growing demand for accountability and increasing importance for evaluation in all learning areas of the curriculum.

My study will be an interpretive study which will be conducted within a qualitative research paradigm. The study will concentrate on participant teachers and their teaching methods and strategies. The teachers who participate in this study will do so, on a voluntary basis and they will be selected purposively because they are science teachers in a grade 4 class. I will select four teachers in the school because the school has four grade four classes.

The first stage of my data collection will consist of the video recordings of the teachers' lessons. Three lessons per teacher will be recorded for a week. I have chosen to video tape the lessons so that the unexpected and evolving aspects of teaching and learning will be captured and that rich descriptions and explanations can be revealed. After viewing the recordings of each teacher's lessons, I will design a semi – structured interview schedule.

The second stage of my data collection will therefore be the semi – structured interview within which I will employ the "stimulated recall" approach to elicit data.

The data will be stored in a secure place during data collection and upon submission of the thesis will be stored in the School of Education, UKZN for a period of five years after which it will be disposed of.

The confidentiality of the participants will be guaranteed and respected. A copy of the findings will be lodged with the Regional Senior manager on completion of my studies. No individual will be forced to participate and all ethical considerations governing research will be strictly adhered to by the researcher and the respondents.

I hereby apply for permission to conduct the research.

I thank you in anticipation of a favorable response.

Yours faithfully

_____ _____

Researcher: M. Jerrier Date

Appendix C

M. Jerrier
Student No. 9804251
University of KwaZulu-Natal
Edgewood Campus
Private Bag x03
Ashwood
3605

15 July 2009

The Principal
Shallcross Primary School
For Attention: Mr. R. M. Pillay

REQUEST FOR PERMISSION TO CONDUCT RESEARCH: SHALLCROSS PRIMARY SCHOOL

Project Title

EXPLORING TEACHERS' APPROACHES TO TEACHING A SELECTED UNIT OF STUDY IN NATURAL SCIENCE.

I am currently pursuing a master's degree at the University of KwaZulu-Natal. My details are as follows:

1.1. Full Name & Surname		Maanwathie Jerrier
1.2. Title		Mrs.
1.3. Student Number		9804251
1.4. Discipline		Curriculum
1.5. School		Education & Development
1.6. Faculty		Education
1.7. Campus		Edgewood
1.8. Existing Qualification		B. Ed. (Educational Technology)
1.9. Proposed Qualification for Project		M.Ed.
2. CONTACT DETAILS		
2.1. Home Telephone Number		031 409 6408
2.2. Cell Number.		076 7145437
2.3. e-Mail		rjerrier@hotmail.com
NAME	**Tel.**	**E-Mail**
3.1. Prof. Reshma Sookrajh	0784517764	sookrajhre@ukzn.ac.za

The purpose of my study is to explore, describe and explain the teaching of a selected unit of study in natural science in grade four. The study seeks to explore the various approaches that teachers use in the teaching of science and the choices they make with regards to the methods and strategies that they employ. There is a growing demand for accountability and increasing importance for evaluation in all learning areas of the curriculum.

My study will be an interpretive study which will be conducted within a qualitative research paradigm. The study will concentrate on participant teachers and their teaching methods and strategies. The teachers who participate in this study will do so, on a voluntary basis and they will be selected purposively because they are science teachers in a grade 4 class. I will select four teachers in the school because the school has four grade four classes.

The first stage of my data collection will consist of the video recordings of the teachers' lessons. Three lessons per teacher will be recorded for a week. I have chosen to video tape the lessons so that the unexpected and evolving aspects of teaching and learning will be captured and that rich descriptions and explanations can be revealed. After viewing the recordings of each teacher's lessons, I will design a semi – structured interview schedule.

The second stage of my data collection will therefore be the semi – structured interview within which I will employ the "stimulated recall" approach to elicit data.

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The confidentiality of the participants will be guaranteed and respected. A copy of the findings will be lodged with the Regional Senior manager on completion of my studies. No individual will be forced to participate and all ethical considerations governing research will be strictly adhered to by the researcher and the respondents.

I hereby apply for permission to conduct the research.

I thank you in anticipation of a favorable response.

Yours faithfully

_____ _____

Researcher: M. Jerrier Date

Appendix D

M. Jerrier
Student No. 9804251
University of KwaZulu-Natal
Edgewood Campus
Private Bag x03
Ashwood
3605

15 July 2009

Date: _____

Dear Parent / Guardian: _____Parent / Guardian of _____

REQUEST FOR PARENTAL CONSENT:

Project Title

EXPLORING TEACHERS' APPROACHES TO TEACHING A SELECTED UNIT OF STUDY IN NATURAL SCIENCE.

I am an educator at Shallcross Primary School. I am also presently pursuing a Master's Degree at the University of KwaZulu-Natal. This requires me to conduct research.

The research that I will be undertaking, involves video-recording Natural Science lessons in the grade 4 classes. Your child may appear in the video-recording. The purpose of the video-recordings is to:

1. Explore how teachers teach particular lessons.
2. The methods they use to teach.
3. To later view the recordings in order to analyze the lessons.

The focus of the video-recording is not your child, but the teacher's lessons. The data will be stored in a secure place during data collection and upon submission of the thesis will be stored in the School of Education, UKZN for a period of five years after which it will be disposed of.

The confidentiality of the participants will be guaranteed and respected. A copy of the findings will be lodged with the Regional Senior manager on completion of my studies. No individual will be forced to participate and all ethical considerations governing research will be strictly adhered to by the researcher and the respondents.

Yours faithfully

_____ _____

Researcher: M. Jerrier Date

Appendix E
Semi-structured Interview Schedule

Good afternoon_____

I would like to thank you for consenting to be interviewed and for signing the request for permission i.e. Annexure E.

I would also like to thank you for your cooperation during the recording of your lessons.

I have viewed the recordings but I wish to seek further insights into your teaching of the lessons.

For the purposes of this interview, we would use the stimulus-recall method i.e. we will view the recordings together but at certain points I would stop the recording and ask you questions and explanations about your teaching methods used and your approach.

Also, feel free to stop the recording and comment on something that comes to mind at that point.

Are you comfortable with this approach?

Please note that you are free to withdraw from the process at any time.

May we proceed?

For the record please provide me with the following details:

1. Your name and surname:_____
2. I.D No:_____
3. Date of birth:_____
4. School at which you teach:_____
5. Contact details: Cell:_____

   Home:_____

Thank you

Let us view the first part of your lesson.

1. **Please explain your approach to introducing the lesson.**

2. **This unit of study is an interesting one. Tell me what were you intending to achieve during these lessons?**

   Viewing part of the methods e.g. explaining, demonstrating, questioning

   (Briefly describe what they were doing)

3. **There are many approaches to the teaching of the same unit of study. This is also evident in the way other teachers in this school have approached the same unit. Please explain the choice of your approach.**

4. **I notice that you have changed your approach in you next lesson.**
    1. **What did you want to achieve by this change in approach?**
    2. **Why did you engage the learners in this activity?**
    3. **So, what skills do you think they would have acquired?**

In your lessons you have used many approaches. There are many skills, knowledge, attitudes and values that the learners would have been exposed to.

5. **How do you assess the learner's level of achievement in a lesson?**

   Thank You

Can you please share some thoughts, reflections, feelings on your lessons? It could be any thing that you feel is important but was not covered during the interview.

Appendix F

PROVINCE OF KWAZULU-NATAL
ISIFUNDAZWE SAKWAZULU-NATALI

DEPARTMENT OF EDUCATION
UMNYANGO WEMFUNDO

Tel: 0333418610
Fax: 033 3418612
Private Bag X9137
Pietermaritzburg
3200

228 Pietermaritz Street
P IET ERMARITZ BURG

INHLOKOHOVISI
Imibuzo:
Enquiries: Sibusiso Alwar

PIETERMARITZBURG
Reference:
Inkomba: *0061/2009*

HEAD OFFICE
Date:
Usuku: 29 September 2009

MRS M JERRIER
UNIVERSITY OF KWAZULU NATAL
EDGEWOOD CAMPUS
PRIVATE BAG
ASHWOOD
3605

RESEARCH PROPOSAL: EXPLORING TEACHER'S APPROACHES TO TEACHING A SELECTED UNIT OF STUDY IN NATURAL SCIENCE

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

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educator programmes are not to be interrupted.
5. The investigation is to be conducted from 29 September 2009 to 29 September 2010.
6. Should you wish to extend the period of your survey at the school(s) please contact Mr Sibusiso Alwar at the contact numbers above.
7. A photocopy of this letter is submitted to the principal of the school where the intended research is to be conducted.
8. Your research will be limited to the schools submitted.
9. A brief summary of the content, findings and recommendations is provided to the Director: Resource Planning.

10. The Department receives a copy of the completed report/dissertation/thesis addressed to

The Director: Resource Planning
Private Bag X9137
Pietermaritzburg
3200

We wish you success in your research.

Kind regards

R. Cassius Lubisi (PhD)
Superintendent-General

PROVINCE OF KWAZULU-NATAL
ISIFUNDAZWE SAKW AZULU-NAT ALI

DEPARTMENT OF EDUCATION
UMNYANGO WEMFUNDO

Tel: 0333418610
Fax: 0333418612
Private Bag X9137
Pietermaritzburg
3200

228 Pietermaritz Street
PIETERMARITZBURG

INHLOKOHOVISI
Imibuzo:
Enquiries: Sibusiso Alwar

PIETERMARITZBURG
Reference:
Inkomba: *0061/2009*

HEAD OFFICE
Date:
Usuku: 29 September 2009

MRS M JERRIER
UNIVERSITY OF KWAZULU NATAL
EDGEWOOD CAMPUS
PRIVATE BAG
ASHWOOD
3605

PERMISSION TO INTERVIEW LEARNERS AND EDUCATORS

The above matter refers.

Permission is hereby granted to interview Departmental Officials, learners and educators in
selected schools of the Province of KwaZulu-Natal subject to the following conditions:

1. You make all the arrangements concerning your interviews.
2. Educators' programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, educators and schools are not identifiable in any way from the results of the interviews.
5. Your interviews are limited only to targeted schools.
6. A brief summary of the interview content, findings and recommendations is provided to my office.
7. A copy of this letter is submitted to District Managers and principals of schools where the intended interviews are to be conducted.

The KZN Department of education fully supports your commitment to research:
Exploring
teacher's approaches to teaching a selected unit of study in natural science

It is hoped that you will find the above in order.

Best Wishes

R Cassius Lubisi,
(PhD)
Superintendent-
General

PROVINCE OF KWAZULU-NATAL
ISIFUNDAZWE SAKWAZULU-NATALI

DEPARTMENT OF EDUCATION
UMNYANGO WEMFUNDO

Tel: 0333418610
Fax: 033 341 8612
Private Bag X9137
Pietermaritzburg
3200

228 Pietermaritz Street
PIET ERMARITZ BURG

INHLOKOHOVISI
Imibuzo:
Enquiries: Sibusiso Alwar

PIETERMARITZBURG
Reference:
Inkomba: *0061/2009*

HEAD OFFICE
Date:
Usuku: 29 September 2009

MRS M JERRIER
UNIVERSITY OF KWAZULU NATAL
EDGEWOOD CAMPUS
PRIVATE BAG
ASHWOOD
3605

LIST OF SCHOOLS

1. Shallcross Primary School

Kind regards

R Cassius Lubisi, (PhD)
Superintendent-General

UNIVERSITY OF
KWAZULU-NATAL

08 October 2009

Faculty Research Committee
Faculty of Education
Edgewood Campus
University of KwaZulu-Natal

Dear Prof R Sookrajh,

Consideration of Ethical Clearance for student:

Jerrier, Maanwathie - 9804251

Your student's ethical clearance application has met with approval in terms of the internal review process of the Faculty of Education.

Approval has been obtained from the Faculty Research Committee, and the application will be forwarded for ratification (MEd) or recommended in the case of PhD and Staff applications, to the Ethics Sub-Committee of the University of KwaZulu-Natal. All Masters applications approved by Faculty Research Committe may commence with research.

Both you and the student will be advised as to whether ethical clearance has been granted for the research thesis (Ph D), once the Ethics Sub-Committee has reviewed the application. An ethical clearance certificate will be issued which you should retain with your records. The student should include the ethical clearance certificate in the final dissertation (appendixes).

Should you have any queries please contact Rishandhoni (.;owmnp-r thp. Fot:lllty Research Officer on (031) 260 3440 or on the email govender3@ukzn.ac.za

Yours faithfully

pp

UNIVERSITY OF KWAZULU-NATAL
EDUCATION
2009 -10- 09
FACULTY RESEARCH OFFICE

Professor D.Bhana
Deputy Dean Postgraduate Studies and Research