

## ***DECLARATION BY CANDIDATE***

I, hereby declare that the work contained in this dissertation is my own original work and has not previously in it's entirely or in part been submitted at any university for degree purposes.

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# ABSTRACT

Since 1994 when the new democratic government came into power many changes have taken place within the South African education system. The implementation of a new curriculum made demands on educators in terms of teaching and learning of the various Learning Areas. The purpose of the study was to explore grade four educators' experiences of teaching and how they used teaching strategies to teach Matter and Materials in the Natural Sciences Learning Area of the current curriculum, the National Curriculum Statement (NCS) for the Intermediate and Senior Phases. The research questions that drove this research are: What are educators' experiences of teaching grade four Matter and Materials in Natural Sciences? How do grade four educators use teaching strategies to teach Matter and Materials in Natural Sciences? The literature review focuses on the teaching of science and the strategies that educators use to create interest in learners. This study was based on Rogan and Grayson's (2003) Theory of Curriculum Implementation. This is an interpretive, case study of four primary school educators teaching Natural Sciences in quintile one primary schools in Camperdown, KwaZulu-Natal, South Africa. Quintile one schools are under-resourced schools. Qualitative and elements of quantitative approaches, and a convenient sampling method were used. The data collection methods were questionnaires, classroom observations and semi-structured interviews. The expectations of teachers teaching Natural Sciences Grade Four as stated in the NCS Grades 4-9(2002) were documented. Data from all the instruments was analysed deductively using Rogan and Grayson's (2003) Levels of implementation of a new curriculum. This study revealed that educators were still using traditional methods of teaching and only one educator used practical work to teach Matter and Materials. This is in contrast to the teaching strategies advocated by Curriculum 2005 (C2005), the predecessor of NCS, which suggests that educators should use more interactive strategies so that learning and assessment could be supported. Educators mainly used written and oral work to assess the learners. It is suggested that the Departmental Curriculum Development Unit should provide the educators with support on a continuous basis so that they can create and maintain an effective learner-centered environment when teaching Natural Sciences.

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## ***DEDICATION***

This work is dedicated to my husband Themba and my three children: Siphesihle, Nandipha and Simthandile.

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## LIST OF ABBREVIATIONS

Terms	Abbreviations/ Acronyms
Assessment Standard	AS
Curriculum 2005	C2005
Curriculum and Assessment Policy Systems	CAPS
Department of Education	DoE
Education Quality	EQ
Foundation Phase	FP
General Education and Training	GET
Home Language	HL
Head of Department	HOD
Intermediate Phase	IP
Integrated Quality Management Systems	IQMS
Learning Outcome	LO
Language of Learning and Teaching	LOLT
National Curriculum Evaluation System	NCES
National Curriculum Statement	NCS
National Research Council	NRC
Natural Sciences	NS
Outcomes Based Education	OBE
Pedagogical Content Knowledge	PCK
Progress in International Reading Literacy Study	PIRLS
Revised National Curriculum Statement	RNCS
Recalling Prior Learning	RPL
Recognition of Prior Knowledge	RPK
Southern and Eastern African Consortium for Monitoring	SACMEQ
Senior Phase	SP
Trends in International Mathematics and Science Study	TIMMS
Zone of Proximal Development	ZPD

# **CHAPTER 1**

## **SETTING THE SCENE - RESEARCH PROJECT**

### **INTRODUCTION**

Science teaching and learning in South Africa has undergone numerous changes since 1994, when a new democratically elected government came into power. These changes included the introduction of new education policy, a new curriculum assessment policy and training of educators for the implementation of a new curriculum. An example of these changes was in the teaching of Science which previously was portrayed as a body of knowledge that was taught for memorization for exam purposes (Kahn, 1995) to the teaching of process skills and the construction of knowledge by learners. These changes in education and the expectations of educators in terms of implementing the new curriculum came with a myriad of problems, including the preparedness of educators, lack of teaching resources and support for curriculum implementation. Science teaching and learning problems currently experienced in South Africa are not unique to this country, as many other countries, both developed and developing, have been experiencing similar problems (Mathews, 1994). These problems need to be addressed because the improvement of Science Education is perceived as a priority for any developing country to underpin the advancement of long-term economic development of the country (Rogan & Grayson, 2003). Hence, the governments of developing countries have been engaged in many initiatives in order to improve and sustain the quality and accessibility of Mathematics and Science Education (James, Naidoo & Benson, 2008). One such initiative according to James and van Laren (2008) is the in-service workshops which focus on the content of the policy documents and how to teach and assess the subjects for the enhancement of teaching and learning.

How Science is taught and learned can determine its significance for the majority of learners, not only for those planning to pursue careers in the scientific workforce but even for everyday life. Hecht (1986) and Rose (2010) are of the view that the teaching strategies that educators use and how they use them are influenced by a number of factors. These include: the educator's skill in communicating the lesson, the appropriateness of the work for the learner and the educator's classroom management. Scarlete (2010) extends the view of Rose (2010) by adding that subject matter, time, age, learning styles and special needs also influence the teaching strategies that educators use.

This study explored the teaching strategies used by natural sciences educators in Grade Four, which is the first grade of the Intermediate Phase of the General Education and Training (GET) band. Learners in Grade Four study Natural Sciences as an independent Learning Area (subject) for the first time. In the Foundation Phase, from Grades R – 3, Natural Sciences is integrated into the Life Skills Learning Area, as one of six subjects. Very little time was allocated to Natural Sciences as it formed a one sixth part of the Life Skills Learning Area and it was not developed in any structured way nor was it presented very rigorously (Beni, Stears & James, 2012).

This chapter presents the background of the study, which includes a brief discussion on the historical background of the South African education system, on the teaching of Science in South Africa and describes the focus of the study. I then outline the research questions which this study sought to answer and the rationale for this study. I also provide a description of the teaching strategies and other terminology introduced by the Revised National Curriculum Statements namely: Natural Sciences Learning Area Statement (the curriculum document), learning outcomes and assessment standards and finally, I present a brief overview of the study.

## **1.1. Background of the Study**

Over the past fifteen years the South African education system has gone through extensive curriculum changes. The objective of Curriculum 2005, the first curriculum implemented after independence, was a radical shift from the traditional content-based and exam-oriented curriculum of the past to outcomes-based education. This curriculum promoted scientific literacy and the development of critical thinkers who are able to make informed decisions about Science -Technology-Society (STS) related issues in a South African cultural context (Department of Education, 2003). The following section presents the historical background of South African education with a focus on Science Education.

### **1.1.1. Historical Background of South African Education**

In South Africa, before 1994, education of the South African citizens was based on a system of racial segregation. There were numerous education departments which serviced particular race groups. The four race groups<sup>1</sup> received unequal educational provision as well. The education of black South Africans was inferior as it was greatly affected by discrimination

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<sup>1</sup> The Racial groups in South Africa are named as Whites, Coloureds, Indians and Blacks.

with unequal distribution of resources and poor teaching styles (Parker, 1994). The education that the black South African received was not, in accordance with the view of Parker (1994), one which would encourage the right mental attitude, disposition, knowledge and beliefs, and appropriate types of skills to become productive citizens.

The post-1994 changes aimed to “heal the division that was brought about by Apartheid and to promote a good quality of life for all South Africans” (Department of Education, 2006, p. 12). To achieve this, a single Department of Education was formed replacing the racially divided education departments and a new curriculum, Curriculum 2005 (C2005) was designed and implemented. It was first implemented in Grade One in 1998, Grade Two in 1999, and Grade Three in 2000 and in 2001 for Grades Four and Eight. C2005 was underpinned by the principle of Outcomes Based Education (OBE) which “encourages a learner-centered and activity-based approach to education” (Department of Education, 2003, p. 2). In implementing OBE South African educators faced the dilemma of what and how to teach; the C2005 policy was notably silent on the issue of content to be taught. One of the difficulties they faced was the dictum that “content was not important, any content could be selected at any time and at any grade level as long as outcomes were achieved” (Chisholm, 2003, p.3). OBE was implemented in primary schools where educators’ perceptions were that learners should cut and paste pictures, with no specified content but that the achievement of outcomes only was of importance (Chisholm, 2003). The confusion that educators faced led to the revision of C2005 in 2000 (Chisholm, 2003). In February 2000, the Ministerial Committee was established to review the curriculum implementation and provide recommendations for curriculum changes. The report gave:

“a wide ranging critique of the curriculum and argued that while there was overwhelming support for the principle of Outcomes-Based Education and Curriculum 2005, implementation was confounded by a skewed curriculum structure and design, a lack of alignment between curriculum and assessment policy, inadequate orientation, training and development of educators, learning support material that are variable in quality, often unavailable and insufficiently used in classrooms, policy overload and limited transfer of learning into classroom, shortages of personnel and resources to implement and support C2005 and inadequate recognition of curriculum as the core business of education departments (Chisholm, 2003, p. 3-4).

Consequently, the Revised National Curriculum Statement (RNCS) was designed and developed. This curriculum was accepted as a policy early in April 2002. It was introduced and implemented in schools in 2003, in the General Education and Training band (GET), from Grade R to Grade Nine. The GET has three phases: the Foundation, Intermediate and Senior Phases (Department of Education, 2002). The Foundation Phase is the first phase of the General Education and Training Band, which covers Grades R-3. The Intermediate Phase is the second phase, which covers Grades 4-6 and the Senior Phase is the third phase, Grades 7-9 (Department of Education, 2000).

The common aspect in the curriculum discussed above is that teaching should be learner-centered and encompass the theories and philosophies of constructivism and Outcomes-Based Education (OBE) (Department of Education, 2000). The focus on a learner-centered curriculum placed more emphasis on the learner rather than the teacher and learners were expected to be actively involved in learning as opposed to being passive receivers of knowledge, which is the case in a teacher-centered curriculum. It was believed that a learner-centered curriculum may interest learners more and motivate them to continue with Science in high school and at tertiary level (Chisholm, 2003).

Further curriculum changes took place in 2009 when the Minister of the Department of Basic Education (DBE) called for a review of the RNCS because educators were overloaded and demotivated; there was no uniformity in the implementation of the curriculum and the content was not demarcated for specific grades. The review panel that was set up recommended a reduction in the educators' teaching load by removing the many confusing documents and by having a single document for subjects (for Content, Assessment and Time allocation), (Curriculum News, DBE, May, 2011). Amendments were made to the curriculum document by the Department of Education and the Curriculum and Assessment Policy Statements (CAPS) replaced the then current RNCS documents. CAPS was implemented in both the Foundation Phase (Grade R-3) and Grade 10 in 2012, in the Intermediate Phase (Grade 4- 6) and Grade 11 in 2013. It was implemented in the Senior Phase (Grade 7 - 9) and Grade 12 in 2014. In Grade 4 (and all other Intermediate Phase grades), learners take six learning areas as Natural Sciences and Technology have been integrated since 2013. Although this research was conducted before the curriculum changes were implemented in 2012, and is based on the RNCS, it still has relevance for educators who are engaged in the current CAPS implementation since it concerns educators implementing a curriculum with a focus on the

teaching strategies used. Thus, the findings from this research will inform current educators with regard to the use of teaching strategies in the natural sciences classroom.

## **1.2. Science Teaching In South Africa**

In South Africa, the imperative for education in Science and Technology was noted by researchers. James, Naidoo and Benson (2008) drew attention to the national effort which is required to promote Science and Technology as a means of improving the living standards for all. According to them, “scientifically and technologically qualified individuals who are passionate about Science and Technology and will use their skills to help the country grow economically are required in South Africa” (James, Naidoo & Benson, 2008, p.16).

Research on different approaches to sustaining and developing Science Education in South Africa (Johnson, Hodges & Monk, 2000; Rogan & Grayson, 2003; World Science Forum, 2007) have highlighted a number of challenges aggravating the situation. These challenges include a large number of under-qualified educators, low teaching standards, outdated teaching practices and under-resourced classrooms. According to Rogan & Grayson (2003) some South African educators lack subject knowledge and that is a major problem. Rogan and Grayson (ibid, p. 1175) also state, “more than 60% of practicing science educators had no formal training in Science”. For schools to promote effective teaching and learning they need to have good facilities and equipment, but in some schools that is not the case (Johnson, Hodges & Monk, 2000). According to a study conducted by South Africa’s Centre for Development and Enterprise (CDE) the shortage of good educators, particularly in Mathematics and Science, “is at the root of South Africa’s under-performing education system” (Africa Science and Technology & Innovation News, 2011, p. 1). The study concluded that South Africa’s Mathematics and Science results were “at or near the bottom of the world class” and that was because educators have been badly trained, and “possibly most were underperforming” (Africa STI, 2011, p. 1).

## **1.3. Key Terms of the Study**

Teaching and teaching strategies are the key terms of the study. A brief description of them is given below together with the terms introduced by the RNCS such as Learning Area, Learning Area Statement, Learning Outcomes and Assessment Standards. Finally the term grade four educator and grade four learners are described.

### **1.3.1. Teaching Approaches and Strategies**

According to Issac, (2011) teaching is about approaches or general philosophies, strategies and methods. The philosophy involves the beliefs and principles underpinning the methods used, but does not prescribe the exact methods. Steyn, Badenhorst and Yule (1988) say approaches are about giving descriptions of why one teaches in the way one does. According to Azion (2012, p. 5) a teaching approach “refers to the way a subject or course is being taught in order to achieve long term objectives.”

A teaching strategy, according to Stone and Morris (1972, p. 34) is “a generalized plan for a lesson which includes instructional objectives and outline of planned tactics necessary to implement the strategies”. Steyn, et al., (1988), emphasize the decision making role of the educator when they define a teaching strategy as “an action of the educator with the aim of making the learners understand what is taught”. Issac (2011, p. 8) asserts that any teaching strategy is actually a “combination of different methods and its purpose is to create a conducive learning environment”. Issac (2011) further states that strategy deals with particular arrangements prepared by the educator and carried out during lesson presentation. Some strategies may be successful and some may be unsuccessful, depending on how and why a particular educator uses them and on the content taught. Azion (2012) states that the educator should be wise enough to be able to select the teaching strategies which will eventually lead to the selection of good teaching methods, techniques and even activities to achieve the teaching aims. According to Azion (2012, p. 5) strategies include “planning, organizing and implementing of teaching methods and learning activities”. Strategies differ from time to time and the differences are determined by the “age, level, needs, interest and abilities of the learners” (Issac, 2011, p. 9). Methods are more practical, they could be understood as the way an educator teaches. Teaching methods are defined by Issac (2011, p. 9) as a “planned procedure intended to achieve a specific aim or objective”. Azion (2012) also defines method as a series of systematic actions by educators in order to achieve short term teaching objectives.

According to the RNCS curriculum document, specific teaching strategies are prescribed but emphasis is on “meaningful education which has to be learner-centered” (Department of Education, 2003, p. 26). The guidelines about things that should be considered when designing lessons include “the focus on development of Natural sciences process skills,

placing investigation at the centre of all classroom activities and providing opportunities for participation of all learners” (Department of Education, 2003, p. 2).

### **1.3.2. Educators’ Experiences**

Educators’ experiences according to Marton and Booth (1997) could include their understanding, approaches and their contexts. For this study educators’ experiences also included various aspects such as their qualifications and teaching experiences, as well as their perception of their practices.

### **1.3.3. Learning Areas and Learning Area Statements**

A Learning Area is a “field of knowledge, skills and values which has unique features as well as connections with other fields of knowledge and Learning Areas” (Department of Education, 2002, pp. 9-10). The RNCS distinguished these eight Learning Areas, which are: Languages; Mathematics; Life Orientation; Natural sciences; Technology, Social Sciences; Arts and Culture and Economics and Management Sciences (Department of Education, 2002, p. 9).

Each Learning Area has its own Learning Area Statement stipulating what is expected of learners in each grade. The statement identifies the goals, expectations and outcomes to be achieved through related Learning Outcomes and Assessment Standards. It indicates the content but does not specify exactly what should be taught in each grade and which methodologies should be to be used (Department of Education, 2002).

### **1.3.4. Learning Outcomes and Assessment Standards**

The Learning Outcomes are “operations which the learner must be able to do in relation to a certain range of scientific knowledge” (Department of Education, 2002, p. 7). Learning Outcomes describe “what learners should know, demonstrate and be able to do at the end of the grade, phase or band. This includes skills, knowledge and values (Department of Education, 2002, p. 7). The Learning Outcomes are derived from the Critical and Developmental Outcomes (Van de Horst & McDonald, 2003). They do not “prescribe content or method but are intended to ensure integration and progression in the development of concepts, skills and values through the Assessment Standards” (Department of Education, 2002, p. 14). Assessment Standards define “the levels at which the learner operates in an outcome” (Department of Education, 2002, p. 7). They describe the level at which learners

should demonstrate their achievement of Learning Outcomes and the depth and breadth at which their achievement is demonstrated. “Assessment Standards are grade specific and show how conceptual progression should occur in a Learning Area” (Department of Education, 2002, p. 14). The Learning Outcomes in most cases “remain the same from grade to grade while Assessment Standards change as learner’s progress through different grades” (Department of Education, 2002, p. 14).

### **1.3.5. Grade Four Educators**

For the purpose of this study, a grade four educator (teacher) is someone who is involved in the education of learners in Grade Four and who fulfills the requirements as envisaged by the RNCS. In most of the cases any educator in a primary school can be a grade four educator but not necessarily a natural sciences specialist as well. In the RNCS educators are viewed as key contributors to the transformation of education and have a particularly important role to play in this process. The RNCS envisage educators:

“who are qualified, competent, dedicated, caring and able to fulfill roles that include being a mediator of learning, interpreter and designer of learning programmes and materials, leader, administrator and manager, scholar, researcher and lifelong learner, community members, citizens and pastors, assessors and learning area or phase specialists” (Department of Education, 2002, p. 3).

### **1.3.6. Grade Four Learners**

Grade four is one of 12 grade levels that make up the General and Further Education and Training bands in the education system in South Africa (Department of Education, 2005, p. 3). It is at Grade Four where the Intermediate Phase of the General Education and Training (GET) band starts. For the purpose of this study, a grade four learner is a child who is in the fourth grade of formal schooling. The age range of these learners could be from the age 9-11 years.

## **1.4. The Focus and the Purpose of the Study**

This study focused on grade four educators teaching Matter and Materials in Natural Sciences and the teaching strategies that they used. Natural Sciences, in the context of the South African school curriculum, is a term that refers to the combination of Life Sciences, Physics, Chemistry, Earth Science, and Space Science. It is divided into four content areas or themes namely; Life and Living, Energy and Change, Planet Earth and Beyond, and Matter and

Materials. These themes and their sub-sections will be described later in section 1.6. The purpose of this study is to explore how grade four educators teach the section on Properties and uses of Materials and Structures which is one of the sub-sections of Matter and Materials in Natural Sciences. This research is about curriculum implementation but focuses on describing the teaching strategies used by educators when teaching Natural Sciences in Grade 4 and how they use these strategies.

The potential value of this study is that if there is a clear understanding of educators' experiences in teaching this section and they can attempt to provide learners with the basics of Matter and Materials in Grade Four, then learners would be in a better position to improve their performance and that will also create and instill interest and love for Science and this needs to be developed and nurtured. This may be achieved at a high level if educators use appropriate teaching strategies to teach Science.

### **1.5. Research Questions**

Taking into account the purpose of the study, these questions were designed and used to drive the research:

1. What are educators' experiences of teaching grade four Matter and Materials in Natural Sciences?
2. How do grade four educators use teaching strategies to teach Matter and Materials in Natural Sciences?

For this study, educators' experiences in research question one includes various aspects namely, their qualifications, teaching experiences, attitudes, feelings and their understanding of the knowledge of Natural Sciences as well as their practices. This study aimed to explore the educators, their experiences and use of certain teaching strategies within the framework prescribed by the then relevant curriculum documents.

### **1.6. Rationale**

Science Education in South African schools has been in a crisis in the past decades, with the Science results achieved in the matriculation examinations at the national level over the past few years in dire straits (Chisholm, 2005). Kadt (2010) argued that the return on investment in primary and secondary schools has been unacceptable and that the output remained

worryingly low in comparison with international ones.

South Africa regularly participates in comparative international studies in Natural Sciences and Mathematics known as the Trends of International Mathematics and Science Study (TIMMS, 1997, 2003, 2011). South African learners taking Natural Sciences in Grade Four were reported to perform far below the international average (Martin, Mullis & Stanco, 2012). According to TIMMS reports performance of South African learners in Grades Four and Eight was far below the international average score in these grades in both Mathematics and Science (NCES, 1997). When the study was conducted in 2011 (TIMMS, 2011) the results of grade four learners in other countries had improved compared to those of the previous years (Martin, Mullis & Stanco, 2012) but unfortunately South African grade four learners did not participate; only grade nine learners participated. This study revealed that South African grade nine learners, together with many other countries, demonstrated relative strengths in knowing Science compared to applying science knowledge or reasoning (Martin, Mullis & Stanco, 2012).

The link between literacy and proficiency in Science cannot be ignored (Zimmerman, Howie & du Toit, 2009) and consequently South Africa has also participated in the Progress in International Reading Literacy Study (PIRLS); (2006 & 2011). This focuses on “two dimensions: (1) a content dimension specifying the purpose for reading and, (2) a cognitive dimension specifying the cognitive or thinking process” (Martin, Mullis & Stanco, 2012, p. 9). In 2006 in the Republic of South Africa (RSA), “testing of grade four and grade five learners receiving instruction in English or Afrikaans was undertaken” (Martin, Mullis. & Stanco, 2012, p. 10). The South African score was the lowest one in the study of 40 countries. There is evidence that South African learners in grade four and five did not have the literacy competencies required for a successful transition required in Mathematics and Natural Sciences in the Intermediate Phase (Zimmerman, Howie & du Toit, 2009). Reading Literacy tests were administered again in 2011, and South African learners did not participate. When comparing the results from 2006 and 2011 studies, they revealed that among those countries that participated, the average reading score increased in 10 countries (including the United States) and decreased in 7 countries. In the rest of the countries that participated in PIRLS in both years, there was no measurable change in the average grade four reading scores between 2006 and 2011 (National Curriculum Evaluation System, 2013, p. 7). The indications are that grade four learners are not performing well in reading and that could affect their performance

in other subjects when English is the medium of instruction (National Curriculum Evaluation System, 2013).

The discussions above indicate that more attention should be paid to Science Education research. Even at school level Grade Four is perceived as a problematic grade in terms of performance in Natural Sciences and other content subjects. I have heard grade four educators complaining about learners' performance. Educator colleagues at school have voiced that "Teaching Grade Four is not easy; grade fours are like grade ones. They have difficulties in understanding English; how much more about Science as it has a language different from everyday language." Another grade four educator commented on the difference in performance in different content areas:

"what I have experienced is that they are doing better in Life and Living; maybe this is because most of the content covered in this area is familiar to them e.g. if you are talking about the plant everyone knows it and it can be brought to the class. But with other content areas that is difficult, most content is abstract" (Grade four educator, 2012).

At one stage when we were at a natural science workshop for intermediate phase educators, the issue of learners' performance was raised. What came out from that discussion is that in schools everyone was pointing a finger at someone else. One of the grade six educators commented "I think for the learners to perform well in Grade Six they should have a good foundation from Grade Four where they began learning Natural Sciences in English." Grade four educators were also complaining about the language barrier and the increased content that learners have to know compared to the one that was covered in the Foundation Phase. Another educator commented about the time factor saying, "the problem is that you have to take more time on the topic to make sure that they understand and end up not touching some areas". As a grade five natural sciences educator I have also realized that learners are not doing well in Natural Sciences, particularly in the Matter and Materials theme.

These discussions helped to formulate the rationale for this study. For me they raised questions about how Natural Sciences is taught in Grade Four, the implications of this and how things could be improved. My concern is with the educators' experiences of teaching Matter and Materials in this grade and particularly the teaching strategies they use to teach learners who were previously taught in their home language in the Foundation Phase but now

are instructed in English. Learners who are taught by educators speaking the same home language as theirs are at an advantage because when the educator sees they do not understand she/he will tell them in their home language. Learners find it difficult to understand many of the words in English as evidenced by the fact that if they are asked the questions in English they will not raise their hands but as soon as it is explained in isiZulu they will raise their hands.

I am teaching in a rural school and I have seen many learners opting out from Science when they reach the FET Phase. I had an interest in the Matter and Materials content because learners find it particularly difficult to understand it, even in Grades Five and Six. For example, if you are talking about particles of liquids and their behavior, this is very abstract for young learners.

The Natural Sciences Learning Area must be able to provide a foundation on which learners can build their knowledge throughout life (Department of Education, 2002). The Natural Sciences Learning Area Statement “envisages a teaching and learning milieu that will enable all learners to have access to a meaningful Science Education which is learner-centered” (Department of Education, 2002, p. 5). The grade four learners still have difficulty in remembering events in sequence. They can recall the first and last things that happened, but often they cannot recall events in between (Department of Education, 2002, p. 29). My concern is how they could be taught to understand all the processes and have a complete picture and understanding of what was taught and how educators enable the development of this skill in learners by using different teaching strategies.

The findings of this research have the potential to have a positive impact on Science Education as sound understanding of the basics of Matter and Materials will provide a solid foundation for the development of new knowledge, process skills development, as well as appropriate positive attitudes to further science studies. The research will contribute by identifying the teaching strategies that are suitable for the set of grade four learners who come from a rural setting and are taught Natural Sciences in English for the first time, including the factors influencing the choice of teaching strategies by educators. As the findings will be submitted to the Department of Education KZN province, they can be used to prepare relevant workshops to address the issues which are problematic or to affirm the useful ones. Educators showing excellent performance under unfavorable conditions in the schools which participated may also be used as leader educators in the ward or even in the circuit to assist other grade four

educators. It would be easier for educators to be assisted by someone familiar with the context rather than someone from outside the circuit.

### **1.7. Components of the Natural Sciences Curriculum**

According to the Department of Education (DoE, 2002) the Natural Sciences Curriculum which is implemented at grade four level is a combination of various sciences. These sciences are reflected in the following themes that are dealt with within the curriculum (DoE, 2002, p. 61).

Life and Living focuses on life processes and healthy living, on understanding balance and change within environments and on the importance of biodiversity. Energy and change, focuses on the way energy is transferred in both physical and biological systems and on the consequences of needs and water for energy resources. Planet Earth and Beyond focuses on the structure of the planets and the way in which the earth changes over time, as well as on understanding why and how the water changes, and on the earth as a small planet within a vast universe. Lastly, Matter and Materials focuses on the properties and uses of materials and on understanding the structural changes and reaction of materials in order to promote the changes which are desired (Department of Education, 2002, p. 64).

### **1.8. Overview of the Study**

Chapter one discusses the background and context of the study; its significance and why the topic was chosen. The purpose and the research questions are presented and the key terms are described. Chapter Two deals with a review of literature relevant to this study. It first discusses the different views about teaching and teaching strategies, both international and South African with emphasis on science teaching in primary schools. The theoretical framework informing the study is discussed in detail and explanatory tables are provided. The modifications done to the original framework are also justified. Chapter Three explains the way in which the research was conducted in terms of the research design, including the paradigm, strategy and approach used. Selection of participants used in the study is also discussed, including the justification for the choices made. All the data collection methods and instruments used to collect the data are clearly described and justified. The process of data collection and analysis is clearly explained.

In Chapter Four, the data that were collected from grade four educators are presented,

analyzed and discussed. This chapter presents the context of the study and a full description of the data for each of the educators, as a case. The composite analysis of data, integrating the data from all the cases is presented. Finally in Chapter Five the threads are drawn together and interpretations and suggestions for further research offered. The limitations encountered in the research are explicitly stated.

## **1.9 Concluding Remarks**

This chapter discusses the background and context of the study, its significance and why the topic was chosen. The purpose and the research questions are presented and the key terms are described. In the next chapter the literature relevant to this study is critically reviewed in relation to the aims of this study. It also compares and contrasts the views of different authors about teaching and learning. The theoretical framework informing the study is discussed.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **INTRODUCTION**

Chapter Two seeks to review literature on the meaning of teaching strategies and the educators' use of them in teaching Science. Chapter Two starts with a discussion on relevant studies conducted on teaching Natural Sciences in South African primary schools, and then examines the key practices of the study, specifically the meanings of teaching and teaching strategies. Educators and experiences that include attitude and understanding will be discussed. The second part of Chapter Two discusses the theoretical framework underpinning this study, specifically, Rogan and Grayson's (2003) Theory of Curriculum Implementation. An adapted framework was developed from the work of Rogan and Grayson. This theoretical framework is used as an analytical tool for this study.

#### **2.1. Teaching, Approaches, Strategies and Methods**

This section will present different meanings of teaching and of teaching practices since an understanding of what is meant by teaching and teaching strategies is of importance to this study. Teaching and teaching strategies are practices used in teaching Natural Sciences and other subjects.

Various meanings of teaching have been presented which focus on different aspects. Teaching can be defined as a part of a "bigger whole that comprises the teacher, the learner, the disciplinary content, the teaching/learning process, and the evaluation of both the teacher and the learner" (National Research Council, 1997, p. 2). According to Morrow (2007) teaching can be "characterized as the practice of organizing systematic learning, and relocate it at the heart of how we think about, plan and organize the education system" (p. 14). Gabela (2004) on the other hand, regards teaching as a "simple process of relaying, imparting or transmitting information where the desired outcome is learning. It involves explaining some part of an organized body of knowledge" (p. 55). Polland and Tann (1993) are of the view that quality teaching involves well-informed educators with adequate knowledge and skills needed for effective classroom management, pupil assessment, subject teaching, and those who are lifelong learners. Also Van't Hoof (2005) argues that quality teaching includes activating prior knowledge, hands-on learning, and continuous reflection. Quality teaching basically, is a:

“process that helps educators to focus on the educational improvement of learners through the integration of adequate knowledge of the curriculum content areas, functional pedagogic skills, critical reflective teaching, empathy and commitment to the educational process, and the acquisition of managerial competencies within and outside the school context” (Organization Economic Co-operational Development, 1994, p. 35).

Teaching involves approaches, strategies and methods. In this section a brief clarity of these terms is given, starting with approach. Approaches refer to general philosophies of teaching. They involve the beliefs and principles underlying the choice of strategies and methods but not focusing on their prescription. Approaches are about giving explanations as to why one teaches the way you do (Steyn, Badenhorst & Yule, 1988). Teaching approaches may be learner- centered or educator- centered. This is determined by the teaching strategies used.

According to Issac (2011) strategy is the “art and science of directing and controlling the movements and activities in the army” (p. 9). Issac (2011) and Anil (2011) relate the teaching strategy to that of an army, where you have to use the best and appropriate method of attacking opponents in order to obtain victory (Issac, 2011, p. 9) (Anill, 2011). Comparing teaching strategy to strategies employed by an army, Issac (2011) and Anil (2011) state that in teaching, strategies are the processes and methods by which the aims of teaching are recognized in the class (p. 5). Anil (2011) also added that teaching strategy is very important to promote the curriculum. According to Strasser (1964), teaching strategies “includes structure, desired behavior of learners in terms of goals of instruction and outline of tactics necessary to implement the strategy” (p. 46). Issac (2011) and Anil (2011) both assert that the teaching strategy depends on the demands of the learning situation that can include stage, level, needs, interest, and abilities of the learners. (Steyn, et al., 1988) define a teaching strategy as an action of the educator with the aim of making the learners understand what is taught. Some strategies may be successful and some may be unsuccessful depending on how and why a particular educator uses these strategies and the method in which the content is taught.

Methods are practical and are concerned with the ways in which we teach different subjects. A teaching method may be defined as a:

“Planned procedure intended to achieve a specific aim or objective. In the school context, it is defined as the various classroom activities planned by the teacher which

must always take the main components of the didactic situation (learner, educator, content) into consideration” (Fraser, Loubser, Van Rooy,1992, p.153).

Gawe (2004), states that “a teaching method is a particular technique a teacher uses to help learners gain the knowledge which they need to achieve a desired outcome” (p. 175). According to Sururi (2013) a teaching method is a way of “presenting instructional materials or conducting instructional activities” (p. 2). Furthermore, these methods depend on the knowledge and skills being taught. Table 2.1. outlines the relationship between the terms discussed above.

**Table 2. 1 Relationship between teaching strategy and teaching method**

Teaching strategy	Teaching method
It is a macro approach.	It is micro approach.
Combination of methods.	Falls under the strategy.
Teaching is well-thought-out as science.	Teaching is well-thought-out as art.
When attempting to attain the aims of the lesson, it turns out to be a strategy.	It is kept within the subject presentation.
It is about creating conducive learning environments. Concern about the behavior of learners and educators and their mutual relationship.	It is about effective presentation of subject matter.

Source: (Issac, 2011, p. 9)

For this study teaching strategy is defined as the combination of methods used to achieve the aims of the lesson. When combining these methods, the strengths and weaknesses of all methods are clearly visible. It is essential that methods be combined so that the weaknesses of one method are well covered by the strengths of the other. This use of different strategies will have very limited weaknesses as compared to the weaknesses of any one of them (Jacobs, 2004).

## **2.2. Research on Teaching Natural Sciences in South Africa**

Research studies on teaching Natural Sciences in primary schools in South Africa focus on different aspects of teaching. Bosman (2006) conducted a study to establish whether Foundation Phase schooling promotes scientific literacy. The participants of the study were educators teaching in the Foundation Phase (Grade R-3). The survey was conducted in Tshwane-North and Tshwane-South district of the Gauteng Department of Education. The study reveals that scientific literacy was not a priority in the Foundation Phase, mainly due to the time allocation and lack of applicable learning outcomes. Another finding was that there were important shortcomings that required attention before natural sciences teaching in the Foundation Phase can be claimed to provide the required basis for promoting scientific literacy (Bosman, 2006). This raises a concern whether there is a proper scientific literacy foundation in learners from the Foundation Phase going into Grade Four. The question is; what scientific literacy do these learners have and can the educators use this foundation to construct a solid scientific base and how could this be developed?

A study conducted by Beni, Stears and James (2012) explored foundation phase educators' understanding of the natural sciences curriculum within the Life Skills Learning Programme. The research was conducted in an urban school in greater Durban. The findings of the study show that educators are confident enough to teach content which they have been teaching for a long time but tend to be reluctant to introduce new science topics or new methods of instruction.

A study by Ambross (2011) seeking to evaluate the implementation and development of basic skills (process skills) by grade 4-7 educators, showed that implementation and development of science process skills are strongly influenced by educators' understanding of these concepts. Other influences were the educators' beliefs about their role and how their learners learn, as well as the presence of quality support and effective training programmes combined with continuous professional development (Ambross, 2011). The relevance of the Ambross study was that the participants were also grade four educators teaching Natural Sciences and the issue of process skills has been touched on in this study.

Jerrier (2009) explored educators' approaches to teaching a selected unit of study in the natural sciences curriculum. From this study three major understandings emerged: firstly,

learner centeredness in the teaching of Science; secondly, how this relates to the educators of Science and thirdly, the challenge of classroom assessment (Jerrier, 2009). The study revealed that there were contextual influences like large class sizes, as well as different levels of understanding on the part of educators about learner-centeredness, the educator as mediator and finally assessment. Consequently, due to the mentioned influences, difficulties for implementation were experienced. Although the above discussed studies do not exactly relate to the teaching strategies used in Grade Four, they are related to this study in one way or another, hence certain aspects of this study are included, such as teaching approach, assessment and educator's understanding and basic skills.

### **2.3. Science Teaching Approaches**

Teaching Science involves “the use of different approaches and teaching strategies which are the combination of teaching methods, assessment relationship with learners, the language for teaching and learning, time allocated in the lesson and resources used in teaching Science” (Department of Education, 2002, p. 11).

Approaches to teaching may be categorised as either an educator-centered approach or a learner-centered approach (Hofstein & Giddings, 1995). An educator-centered approach is often referred to as the *traditional approach* to teaching and most of the learning activities are initiated and dominated by the educator. The educator is the learners' source of information, meaning that she/he “transmits all the information and learning content to the learners, with the help of the textbook” (Lasley & Matczynski, 2005, p. 240). Educator-centered strategies include lectures, demonstration and questioning (Hofstein & Giddings, 1995).

The Transmission approach is an example of the educator-centered approach. In this approach a heavy emphasis is placed on the transmission of scientific knowledge and not the process itself. The transmission view of teaching and learning sees educators as passing on their knowledge to the learners. This view is strongly linked to expository teaching, the educator is in control of presenting the subject matter and directs learners through the lesson (Bennett, 2003). This approach has a number of limitations. It promotes rote learning as it tends to focus on factual knowledge at the expense of practical skills and social skills (Bennett, 2003). However it can be an effective approach to teaching but this depends on the educator's creativity. This means that all instructions should be clearly stated. Exposition should only be used when it is appropriate and in combination with other approaches.

The fundamental challenge for educators using this approach is to “select and modify science content suitable for learners, and the most important learner outcome sought in the transmission approach is that of scientific knowledge; its facts, concepts, theories and laws rather than learning of practical skills”(Fleer & Hardy, 2001, p.134.). There is an assumption that learners’ pre-existing knowledge is deficient or almost non-existent (Fleer & Hardy, 2001).

The transmission approach is criticized by Fleer and Hardy (2001) as this method is sometimes used by educators who lack confidence in teaching Science; resulting in a high level of control over children’s learning abilities (Fleer & Hardy, 2001). However, according to Fleer and Hardy (2001), transmission may be justified in the following situations: “teaching particular science topics that necessary depend to a large degree on transmission; helping children make connections between new knowledge and the child’s existing knowledge and developing the use of scientific language in a more detailed manner” (Fleer & Hardy, 2001, p. 137-138).

Learner-centered teaching is an approach to teaching that is increasingly encouraged as it favours self-activity like group or class discussion, problem solving and co-operative learning methods. A learner-centered approach “allows very high learner participation and the learners would determine the progress of their learning according to how they understand” (Nash, 2009, p. xiv-xv). Therefore, this approach allows learners to be “active participants in their learning” (Nash, 2009, p. xiv), meaning that they do things themselves, such as to discover information. In addition learners own their learning. Educators using this approach should not employ a single teaching method as it emphasizes a variety of different types of methods that shifts the role of the educator being givers of information to facilitating learning (Plumberg, 2008). This means that educators should plan activities that will encourage learners to find information by themselves and provide learners with opportunities to engage in hands-on activities.

Discovery learning is an example of a learner-centered approach. In this approach, the learner engages in complete autonomous activities that involve prediction, questioning, observing, classifying and measuring, in order to figure out solutions (Fleer & Hardy, 2001). Discovery learning in Science placed “a strong emphasis on practical work organized in such a way that observations looked for patterns and come up with possible explanation for these patterns” (Bennett, 2003 p 4). According to Fleer and Hardy (2001) the discovery approach to teaching

has changed the role of the educator from one of delivering facts to one of organizing learning so that children are empowered to retrieve knowledge and skills from a range of resources. The discovery approach may be characterized by the following: it de-emphasizes the educators' role as demonstrator in the science classroom. It also means that the educator will provide learners with opportunities to investigate and find things by themselves. Discovery learning also involves placing materials in the children's environment and allowing them to use the materials as they wish. Learners are allowed to make suggestions of how to solve science problems using the range of equipment provided by the educator (Fleer & Hardy, 2001).

Another approach to teaching Science is the process skills teaching approach. This is a method of teaching skills and processes in Science not necessarily focused on teaching learners how to work in a scientific manner. "The great value has been placed on processes of Science and not necessarily the content" (Fleer & Hardy, 2001, p.122). According to Fleer and Hardy (2001), advocates of process skills suggest that learners should work scientifically to develop specific sets of scientific skills as the focus for teaching Science is on scientific skills. In this approach educator's work collaboratively with learners to "observe, communicate, classify, sort, predict, compare, measure, record information, interpret information, hypothesize and investigate" (Fleer & Hardy, 2001, p. 101). It is a choice of the educator using this approach to focus on particular scientific skills as he/she plans the activities.

## **2.4. Teaching Strategies Suitable For Science Lessons**

Every lesson requires the most suitable teaching strategy which is the combination of the best methods. Killen (2007) asserts that "best methods of teaching produce the best results for pupils regardless of their labels" (p. 125). Moore (2009) is of the view that "good teaching and learning methods produces better results than other teaching methods" (p. 142). Since learners in Grade Four are young, in the concrete-operational stage, it is difficult for them to sit quietly and listen attentively when being taught (Bosman, 2006). The concrete-operational stage is a third stage of four stages postulated by Piaget, ranging from 7 to 11 years. The other stages are the sensory-motor (0-2), the pre-operational (2-7) and formal-operational (11 and up). For this study the concrete operational (7-11) is of particular interest as this is the age range of grade four learners. The thinking of children in the concrete- operational stage (7-11) is very different to the first two stages. In this stage learners in their thinking avoid opposing

descriptions for actions. They make a physical connection between cause and effect (Piaget, 1969). Mental operations become available at around age seven. The operation and the manner in which they are used, are referred to by Piaget (1967) as concrete, ‘because they relate directly to objects and not yet to verbally stated hypotheses’ (p. 52). This means learners can learn best when the learning activity requires physical and intellectual involvement. This can be done through hands-on and kinesthetic experiences: by touching, feeling, moving and talking about what they are learning (Bosman, 2006). It is therefore vital that careful selections of instructional/teaching strategies are made.

The sections below present some different teaching strategies which the educators may use in their teaching context. These teaching strategies include: group-work, expository strategies, discussions, questioning, problem-solving and demonstrations.

#### **2.4.1. Group Work**

Group work is a pedagogical strategy that promotes participation and interaction with the aim of achieving the learning outcomes. “Researchers report that, regardless of subject matter, students working in small groups tend to learn more and demonstrate better retention than students taught in other instructional formats” (Davis, 2009, p. 190). Learners “work in small groups in order to realize a common goal” (Ormrod, 2008, p. 437). Group-work involves working together in any learning and teaching activities or any formal and informal assessment activities. Group work is recommended because it promotes active learning and a sense of belonging since learners are not isolated (Bartley & Turner, 2004). Learners’ interaction is characterized by positive effects. Gawe (2004, p. 211) asserts that in group-work, “Learners construct their own knowledge through social negotiations”. The educator must explain to the learners that group-work may produce more and better solutions than individual work (Bartley & Turner, 2004; Cooper, 2003). The classroom research conducted show that learners learn better from each other than they do from an educator (Bartley & Turner, 2005). Small groups enable learners to engage more readily in verbal interactions and this may give them the opportunity to make sense of the world in a meaningful way. It also encourages individualization as it accommodates different learning styles, as well as allowing learners to progress at their own pace. Problems may be encountered if all group members are not on the same cognitive level (Bradbury and Zinge 1998; Tudge, 1993) as learners with poorer conceptual understanding do not share their ideas willingly with their peers. Another advantage of co-operative learning is the fact that the teacher interacts with smaller groups and

this may make it easier for them to 'listen' to their learners. On the other hand group-work has been criticized as learners may have less control over the activity than completing it alone. If group-work is used for assessment there may be resentment as learners cannot contribute equally. However, educators should be careful and creative when designing tasks since the value of co-operative learning lies in the quality of the task designed for the group activity and not in the group activity per se. Curriculum 2005 (DoE, 1995) encourages the use of group work to facilitate learning. However, the question arises whether this is the best strategy for all learners.

#### **2.4.2. Expository Strategies**

An expository strategy of instruction is also known as the lecture or explanation method of teaching and learning. This method is commonly used by most educators throughout the world. For a method to be classified as either good or poor depends on its appropriate or inappropriate use. Freiberg and Driscoll (2000) and Steyn et al., (1988) have the same view when supporting the lecture method. According to them the spoken word remains indispensable for the primary school learner but warns that it should act as an introduction to other forms of activity. For this method to be effective, Freiberg and Driscoll warned that the educators should not talk for the duration of the lesson. However, the educator may introduce learners to the new subject matter by means of telling explanations (Fox, 2000).

Achievement of lesson objectives will be determined by an educator's preparedness before using the expository strategy (Fox, 2000). This will help educators to have confidence in explaining their work logically. Drawing the attention of the learners is likely to result in better reception of the lesson as well as the content. Educators who are well prepared know what to say and ask, and when to apply certain actions. Adding onto this, Steyn, et al., (1988) asserts the educator should consider the developmental level of the learners. This means that they have to adjust their explanations about the subject matter accordingly. When using this strategy the vocabulary used by the educator should not be too simple or too difficult, as a result learners may lose interest and end up being noisy (Steyn, et al., 1988)

Several studies have revealed that some educators use explaining or the expository strategy in combination with other strategies, possibly due to time constraints. Expository strategies are especially useful at the beginning of the lesson and towards the end. This is supported by Callahan and Clark, cited in Jacobs and Gawe (1998) where they argue that creative educators

can use the lecture method to “arouse pupils’ interest, set pupils’ thinking and wondering, open new vistas, tie together loose facts or ideas, summaries or synthesize and review” (p. 233). It is of great importance to combine the expository strategy with the strategy that is learner-centered to make the learners own their learning.

Each and every strategy has its own advantages. Moore (2009) asserts that the expository strategy is “good for teaching specific facts and basic skills” (p. 145). Killen (2007) is also in line with this when he states “factual material is presented in a direct, logical manner, so it is good to introduce a new subject or topic to the learners as it is used to present new material not yet available in print or books” (p. 128). To add to this Freiberg and Driscoll (2000) are of the view that the expository strategy is “regarded as an efficient strategy to transmit content to a large group of learners as it can also present large amounts of information to that large group” (p. 194). According to Killen, (2007) though, “the lecture strategy can stifle teacher creativity and learners are often passive. It may be difficult for educators to judge learning to check their understanding” (pp. 129-130). According to Moore (2009) it is the best strategy to use when there is a lot to be done in a short period of time. The lectures “appeal to those learners who learn by listening (Killen, 2007, p.127).

The weakness of this method identified by Moore (2009) is that it may not be effective for the development of higher order thinking skills, depending on the knowledge base and skill of the educator. According to Killen (2007, p.129-130) some of the advantages are:

“Pure lectures fail to give feedback to both the teacher and the learners; proficient oral skills are necessary. Lectures require effective speakers not appropriate to young learners at school; lectures cannot keep student attention for a long time or for the whole lesson; Information tends to be forgotten quickly if taught through the lecture method; lectures assume that all learners have the same learning styles. Learners have different learning styles, against the assumption of the lecture method.”

Killen (2007) asserts that in this method the educators work harder than the learners and that results in them learning more than the learners.

### **2.4.3 Discussion Strategies**

The small group discussion method is one of the learner-centered methods, defined by Killen (2007) as “an orderly process of group interaction in which learners are exchanging ideas

listening to a variety of points of view, expressing and exploring their own views, applying their knowledge and reflecting their own attitudes and values” (p. 155). In a discussion, communication is between and among learners themselves and, learners and the teacher (that is, learner-learner interaction and learner-teacher interaction). Moore (2009) asserts that every form of discussion is associated with a high level of spoken communication among the learners themselves. Therefore communication is the key to success. During discussion, more emphasis will be on helping one another to reach a common and better understanding of the issues involved, rather than being involved in arguments.

Discussions may be open-ended or guided (Killen, 2007). An open-ended discussion begins with a sincere question posed by the educator or a learner and all listeners should consider the question. On the other hand guided discussion begin with educator –posed questions that the exploration of a particular theme, or topic. Through discussion, learners should achieve a deeper understanding of a topic. Moore (2009) and Killen (2007) strongly support the discussion method when compared to the lecture method alone. According to these authors, discussions can be used to teach any subject at any level of education. However, Moore and Killen both supported the combination of these two methods, lecture and discussion as the best thing to do.

#### **2.4.4. Questioning As a Teaching Strategy**

The questioning strategy is also known as the “Socratic method” (Steyn, Badenhorst, Yule, 1988). According to Steyn et al., when using the question and answer method, educators can activate learners’ existing knowledge. To develop learners’ higher level of thinking is one objective of science teaching, and to achieve this objective, educators need to facilitate communication with and among learners (Blosser, 1990). Learners can be encouraged to communicate using questioning methods. According to Blosser (1990) educators can use questions to serve a variety of purposes which include managing the class, reinforcing concepts, stimulating thinking, arousing interest and helping the learners to develop a critical mind-set To support this statement, Bentley and Watts (1994) point out that, “questioning can be directed towards determining what understanding the child might have of a particular part of Science or topic in Technology, making sense of insufficient data concerning learners’ conceptions and examining their general problem-solving strategies” ( p. 99).

Blosser (1990) developed a category system for questions used in science lessons. “In this system, questions are initially classified as: Closed...limited number of acceptable responses;

Open...greater number of acceptable responses; Managerial...facilitate classroom operations and Rhetorical...re-emphasize, reinforce a point” (Blosser, 1990, p. 5). Educators, who want to improve on their questioning behavior, need to identify a question category system they can use comfortably and then apply it during lesson planning and in post-lesson analysis (Blosser, 1990). It is important to obtain learners’ attention before asking any question. The question should be addressed to the whole class before a specific learner is asked to respond. Learners should be encouraged to speak to the whole class when responding to the question (Killen, 2007). It is essential for educators to have a clear understanding of questioning techniques, wait time and levels of questions. Wait time is defined as the pause between asking the question and giving a response (Moore, 2009). Learners should be provided with additional wait time after a response to allow all learners to reflect on the response prior to further discussion. Increased wait time results in longer responses, more appropriate unsolicited responses, more questions and increased higher order responses. It should be noted that increased wait time is beneficial for students who speak English as a second language (Moore, 2009). It has been mentioned earlier on in this paragraph that the levels of questions are very important and should be considered at all grades and all subject areas. The need for recall or comprehension must be recognized. However, educators also need to challenge learners with higher level questions requiring analysis, synthesis or evaluation. Learners must be given the opportunity to think about and respond to all levels of questions (Moore, 2009). Having this understanding, an educator will be able to plan good questions, state them clearly and to the point, in order to achieve specific objectives.

From the above discussion it may be concluded that educators need to assist learners to become more critical thinkers by providing opportunities in science classes that allow for greater involvement and initiative from learners and less domination by the educators during the learning process. Educators should focus less on becoming information-givers, and rather enhance the facilitating and guiding of the learning process. This can be only developed through the types of questions we ask learners.

#### **2.4.5. Problem Solving**

OBE favours problem-solving as a teaching strategy. There is a huge difference between the expository strategy and problem solving. In the expository teaching strategy learners are being told about the subject matter and every explanation is given to them whereas in problem solving they find out knowledge and facts by themselves. Problem-solving is a much more

challenging and interesting way of acquiring knowledge in any learning context (Mahaye & Jacob 2004).

The problem solving approach supports the outcomes required within the S.A. context since Critical Outcome One clearly states that “learners must be able to identify and solve problems and make decisions using critical and creative thinking” (DoE, 2003.p.2). According to Watts (1991) problem solving may trigger an interest in a subject through self-activity. It enables learners to take ownership of their learning, provides a real life context, encourages decision making and enhances communication. The main idea behind problem solving is to make learners solve the problems logically and be able to explain their solutions with conviction.

#### **2.4.6. Demonstration as the Teaching Strategy**

According Rogan and Grayson (2003) demonstration is part of science practical work used by educators to develop concepts. A demonstration is a process of teaching through examples (Fraser, et al., 1992). They further state that demonstrations may be used to prove a fact through a combination of visual evidence and associated reasoning. Demonstrations are similar to written storytelling and examples, in the way that demonstrations allow learners to relate to the presented information. According to Mazur, Adam, Callan and Crouch, (2011) the aim of demonstrations is to equip learners with certain skills, capabilities or knowledge and understanding, through observation of a series of actions. To add support to this, Fraser et al., (1992) state that learners can see, hear, discuss and participate in demonstrations. Much of the learners’ ability to understand and retain information occurs through observing others, resulting in much more complete learning than passively listening to a talk, even if illustrations are used to support it. Demonstrations can help to raise a learners’ interest and reinforce memory retention because they provide connections between facts and real-world applications. Demonstrations are planned and executed when learners are having a hard time connecting theory to actual practice or are unable to understand the application of the theory. Demonstrations can generate a great deal of interest and enthusiasm for a teaching practice as well as providing the skills required for it. They provide the link between knowing about the content and being able to do what had been learned practical. According to Mazur, et al., (2011), this method helps second language learners who are challenged to understand concepts in Science , since demonstration uses numerous channels of communication and also different senses that included hearing, seeing, touching, smelling and even tasting if the apparatus used are edible. Demonstrations may be combined with discussions and lectures.

Although initially the educator might demonstrate while the learners are watching attentively, as the lesson develops learners will have to participate in demonstrations so that they can display their understanding of the concepts.

According to Fraser, et al., (1992) research has revealed that for demonstrations to be effective they must be accurate, simple and clear for the learners to understand. Demonstrations must be accompanied by brief explanations and discussion. The shortfall of this method is that learners may not have the opportunity to practice the skill themselves due to shortage of time or facilities.

## **2.5. Theoretical Framework**

There are various models that one can choose from to frame the study, which include; variation theory, teacher pedagogical content knowledge, and curriculum implementation. Variation theory has to do with experiences of people (Marton & Booth, 1997), where a person's understanding of the world around him/her cannot be separated from the world in which he/she lives. In this research, because the focus is on educators, this would mean that the educators would relate their knowledge of a phenomenon to previous knowledge and experiences. Also the teacher must be aware of the indirect object (Marton & Booth, 1997), which can be described as how the person who is learning should understand the content. Both educators' pedagogical knowledge and educators' subject matter knowledge and pedagogical content knowledge are important for teaching Natural Sciences (Shulman, 1986). According to Shulman (1986) pedagogical content knowledge includes:

the most regularly taught topics in one's subject area, the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations - in a word, the ways of representing and formulating the subject that make it comprehensible to others .It also includes an understanding of what makes the learning of specific concepts easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning (p. 9).

A framework for this study was developed by adapting the Theory of Implementation proposed by Rogan and Grayson (2003). According to Rogan and Grayson (2003), Curriculum 2005 cannot be implemented in one large step nor can it be implemented in a short

period of time. The solution is to phase-in the curriculum by means of a number of small steps taking into account the context of the school. According to Rogan and Grayson (2003) “the theory of implementation can be based on three major constructs, namely: Profile of Implementation, Capacity to Support Innovation and Profile of Outside Support. Each construct has a number of sub-constructs” (p. 4).

The third construct, which is the Profile of Outside Support was not addressed in this study. This construct is intended to describe the kind of action undertaken by the organization outside the school. It also describes the kinds of forces that an organization chooses to use to bring about change. These forces can be used equally well, in both providing support and applying pressure for change. This construct deals with two forms. These forms include material and non-material support. The material support is divided into two categories: (1) provision of physical resources such as building, books or apparatus; (2) the direct support to learners which might include things such as school lunch programs and safety actions. These forms can also be provided in different levels as that present in the profile of implementation. The non- material support is most commonly provided in the form of professional development. The reason for not including this construct is that this study focused on the educators’ experiences of teaching and also how they used various teaching strategies in the context of implementing a new curriculum.

As it has been mentioned earlier, the theory of Curriculum Implementation was adapted together with the levels and their descriptions; in addition language was added to the Profile of Implementation. The intention to add language was to explore how educators use language in teaching grade four learners. Since these learners are in a transition stage from being taught in IsiZulu to English. The levels were given to this sub-construct starting from 1-4 as those of the original theory.

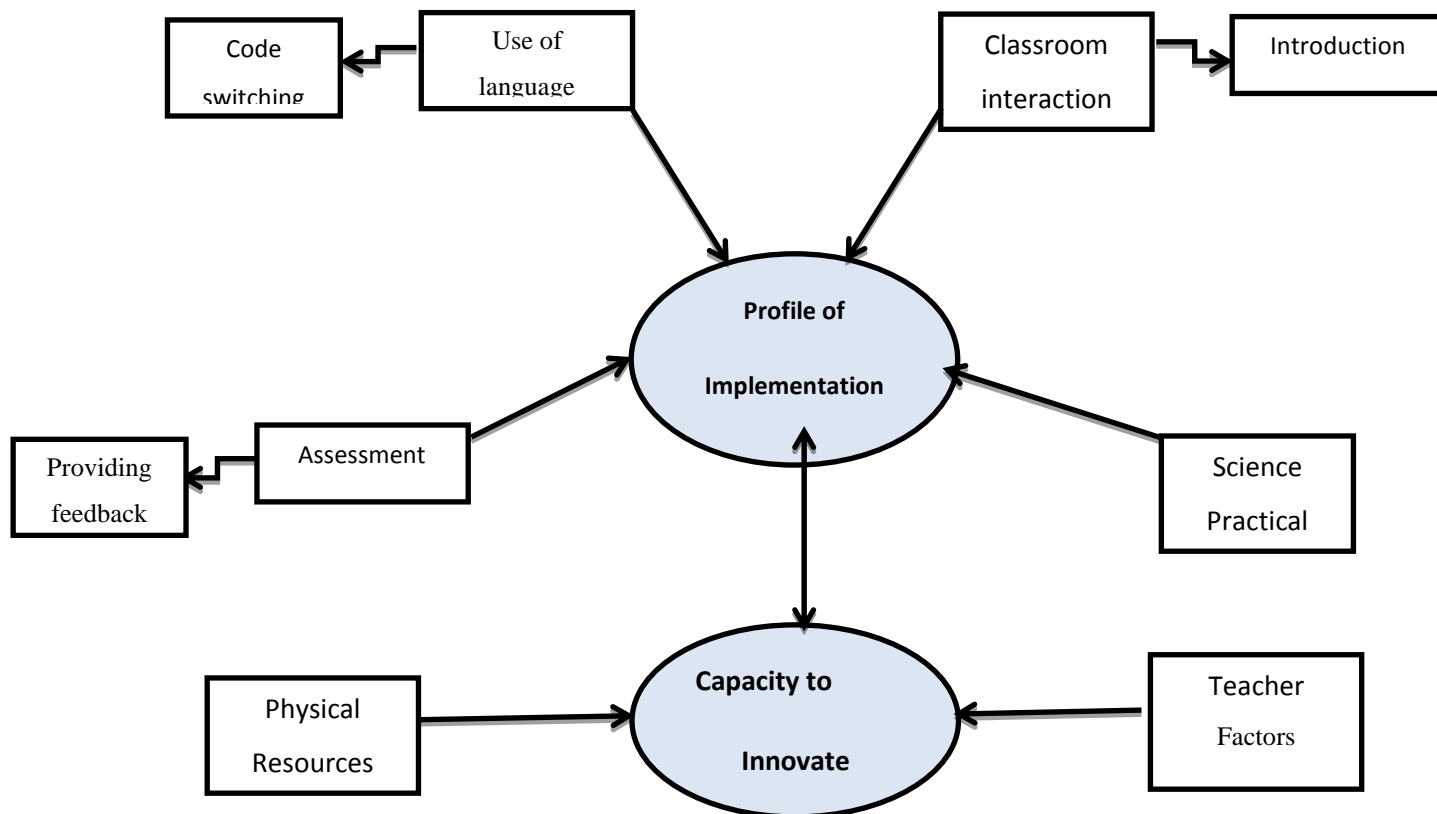
The focus of this study was mainly on the Profile of Implementation and two sub-constructs of Capacity to Support Innovation. The Profile of Implementation is an attempt to understand, analyse and express the extent to which the ideas of a curriculum are being put into practice (Rogan & Grayson, 2003). It includes four dimensions: “classroom interaction, science practical work, science in society and assessment” (Rogan & Grayson, 2003, p. 4). This construct is all about what educators and learners do, how practical work is done in natural sciences classes and how the lack of equipment and laboratories may prevent educators from doing practical work; how the learner’s everyday life experiences are infused in natural

sciences classrooms and how learners are assessed at different levels. For the purpose of this study three dimensions of Curriculum Implementation were addressed together with the generated one. These are: classroom interaction; science practical work and assessment, and the one included in this construct, language sub-construct.

Science in society was not addressed. The above mentioned sub-constructs are “related to the ideals for Science Education as stated in C2005 and represent a large shift from the previous science curriculum” (Rogan & Aldous, 2005, p. 317). These authors described the practices in Levels. At Level four the educators have greater experience, wisdom and knowledge of how to implement the curriculum than those at Level one (Rogan & Aldous, 2005). In moving with the levels, on all four sub-constructs, there is “an increasing emphasis towards learner-centered, standards-based approaches; however the profile does not imply progressing from one level to another” (Rogan & Aldous, 2005, p. 317). According to these authors the levels are “not prescriptive of what should be done, but rather suggest the mastery and use of an array of teaching and learning strategies” (Rogan & Aldous, 2005, p. 317). The levels would not necessarily be the same for all constructs for a single educator; it might happen that he/she displays level one in science practical work, but classroom interaction approach may be at level three or four. This means these four sub-constructs are “to a large extent, independent of one another” (Rogan & Aldous, 2005, p. 317).

I used classroom interaction as a means to determine teaching strategies as used by grade four educators. This was achieved by observing how the lessons were introduced and presented, what language was used in teaching, different resources used and feedback to learners. I then noted whether the educators assigned learners science practical activities and finally observed the assessment during their lesson.





**Figure 2.2 Modified framework of the study.**

### 2.5.1. Profile of Implementation

The section below explores the sub-construct Profile of Implementation as per modified framework.

#### 2.5.1.1. Classroom Interaction

In this sub-construct the focus is on what an educator does and what the learners do. According to the findings of Rogan and Aldous (2005) “a positive relationship existed between the level of classroom interaction and two of the “capacity” sub-constructs i.e. physical resources and the school ethos, as well as one “support” sub-construct i.e. accountability and monitoring” (p. 329). This means that if educators have greater access to curriculum resources and the learning environment is conducive, it is possible that effective teaching and learning take place. Classroom interaction was used to observe how the content was presented, when presenting the content that is where the teaching strategies are used. For this study, the introduction, resources and feedback to learners were added to the sub-construct as they are an important part of lesson presentation. Meiring, Webb and Huber (2002) assert that introduction can be used to obtain or arouse learners’ interest and attention during the beginning of the lesson. According to England, Hubber, Nesbit, Rogers and Webb (2007)

reading may be used to spark the interest and provide learners with basic information during the introduction. As the first research question is about the strategies used by educators, the information about how the lesson was introduced is of great importance because introduction is the key of the lesson. Should it happen that learners are lost at the beginning the probability of being lost up to the end is great.

**Table 2. 2 Profile of Implementation for classroom interaction**

Level	Type and description of classroom interaction
1	Teacher presents content in a well-organized, correct and well-sequenced manner, based on a well-designed lesson plan. Provides adequate notes. Uses textbook effectively. Engages learners with questions.
2	Textbooks are used along with other resources. Engages learners with questions that encourage in-depth thinking.
3	Teacher probes learners' prior knowledge. Structures learning activities along "good practice" lines (Knowledge is constructed, is relevant, and is based on problem solving techniques).Introduces learners to the evolving nature of scientific knowledge.
4	Facilitate learners as they design and undertake investigations and project

Source: Rogan and Aldous, 2005

### **2.5.1.2. Language Use**

Language is very important in the process of teaching and learning as this process involves interaction between the educator and the learner that occurs through the use of language. The Critical Outcomes of Outcomes-Based-Education in the Revised Curriculum Statement (RNCS) requires learners to be able to: "communicate effectively using verbal and visual images" (Department of Education, 2002, p. 7). Education Policy (Department of Education, 1997) allows schools to choose their language of teaching and learning, and requires schools to address the principle of additive bilingualism which involves the maintenance of home language and access to an additional language (Department of Education, 2002). Language is an expression of culture but for many South African learners, the Language of Learning and Teaching (LOLT) is not their home language. The question arises how most South African learners learn Science through a language which is not their mother tongue and how this impacts on the teaching and learning process in science classes? Exposure to a foreign language may be seen as a disadvantage because learners think and speak in their home

language and then they have to translate their thinking to another language which might affect the meaning of what was thought. Most misconceptions in Science are results of many abstract concepts that create a lot of confusion, learners in Grade Four need to be taught using concrete objects to avoid confusion. Most misconceptions in Science are because of a lack of knowledge or misunderstandings. Educators and learners need to be well versed in these scientific concepts and the only way educators can achieve that is through the use of a variety of teaching methods and learning strategies.

The Zenex Foundation (2003) reports that the majority of learners do not have sufficient exposure to English, either at home or at school, to enable them to develop the English literacy skills necessary to cope with learning through language. Most learners struggle with English as it is their second language. The Zenex Foundation (2003) further reports that poor English language skills among both teacher and learner has been identified as one of the key factors that impact negatively on mathematics and science examination results.

Setati (2008) argues that English is a language of power and that the effect of English is felt not only to exist in the business world but also in the classroom. According to Setati (2008, p, 104) “English may be used either to exclude people from or to include them in conversation”. This may happen in a natural sciences class situation if an educator does not explain concepts in a way that will enable all learners to have a clear understanding of the concepts being taught.

In trying to address issues of language and learner performance, the practice of code switching is used often in schools where the majority of learners have traditionally been non-mother tongue English speakers in South Africa. Probyn (2004, p. 28) adds that in the “South African context code switching is a necessary process for conceptual understanding”. This aspect of teaching and learning in Science through two languages (mother-tongue and English), is one that poses a problem for the majority of South African educators and learners. Probyn (2004) conducted a study in the Eastern Cape Province into the perceptions, practices and problems of six educators teaching graded eight Science through the medium of English as an additional language. The findings in this study concluded that there is a constant need for code switching by science educators in order to get concepts across to the learner. Furthermore, concepts needed to be illustrated through demonstration, practical work and consolidation on the chalkboard. It was found that teacher’s skills need to be developed to promote high-order

thinking and it was necessary to provide linguistic and contextual support for educators (Probyn, 2004).

**Table 2. 3 Profile of Implementation for language usage**

Levels	Types and description of levels
1	Teaching in Home Language
2	English is used but with more of Home Language
3	Educator uses English and little of Home language to clarify concepts.
4	Educator uses simple English as the medium of instruction demonstrate and clarify concepts.

Source: Generated by the researcher

### **2.5.1.3. Use of Science Practical Work**

The use of practical work in the teaching and learning of Science has been one of the most recommended and well recognized teaching and learning approaches worldwide. For learners to develop and acquire scientific skills they need to be engaged mostly in practical work where process skills are embedded. These skills include observing and comparing, measuring, recording information, sorting and classifying, interpreting information, predicting, hypothesizing and investigating (Revised National Curriculum Statements, 2005, p.13-14). According to Hayward (2003) all Sciences essentially have a practical basis. In the three Learning Outcomes (LO) in Natural Sciences, LO 1 emphasizes skills about scientific investigations (Department of Education, 2002). Hayward (2003) argues that practical work helps learners to understand facts and concepts as well as encouraging active learning. This gives learners the confidence in doing things by themselves rather than always having to rely on the educator. Hayward (2003) further states that practical work helps to develop cross-curricular skills such as communicating literacy and information communication technology for example, the use of computers. Nevertheless there are various inhibiting factors regarding the carrying out of practical work. The reasons provided by educators for not doing practical work fall into three categories, these are: lack of resources, time pressure and class size (Hayward, 2003, p.47).

According to Millar (2004), practical work refers to any teaching and learning activity which involves observation as manipulation of real objects. In addition Millar (2004) also argues

that learning Science involves seeing, handling and manipulating real objects and materials. Millar (2004) further states that “through actions on the world, a view of what objects there are in the world, what they are made of, what can be made from them, what they can do and can be done to them” (p. 7) form part of practical work. The role of practical work is to help learners make links between two domains of knowledge namely: the domain of objects and observable properties and events on the one hand- and the domain of ideas on the other. If the aim is to help students with a concept, relationship, theory or model, then the task designed needs to scaffold the student’s efforts to secure these links.

Rogan and Grayson (2003) developed a framework to explore Curriculum 2005 implementation in order to understand, analyze and express the extent to which the ideas of a given curriculum are being implemented. Table 2.3 presents their Profile of Implementation for Science practical work in which they classify practical work according to four levels. Level one and two are low levels, where educators demonstrate concepts and observe. Level three and four are activities that place emphasis on learner-centered approaches as the learners take initiative to design and do open-ended investigations.

**Table 2. 4 Profile of Implementation for science practical work**

Levels	Types and description of practical work
1	Teacher uses classroom demonstrations to help develop concepts. Teacher uses specimens found in the local environment to illustrate lessons.
2	Teacher uses demonstrations to promote a limited form of inquiry. Teacher allows some learners to assist in planning and performing the demonstrations.
3	Educators design practical work in such a way to encourage learner discovery of information. Teacher designs practical work in such a way to encourage learner discovery of information.
4	The teacher facilitate learners to design and do their own “open” investigations. They reflect on the quality of the design and collected data, and make improvements.

Source: Rogan and Aldous 2005, p.317

#### **2.5.1.4 Assessment practices**

The RNCS (2002) defines assessment as "a process of gathering information about learners and is measured against assessment standards." (p. 75). Assessment standards describe the various levels at which the learning outcomes may be achieved. Assessment standards describe what learners should know and be able to do. Assessments cannot be separated from teaching and learning, they go hand in hand. Assessment in the OBE is based on outcomes focusing on assessing on practices of knowledge, skills and values as prescribed in the Assessment Policy (Department of Education, 2000).

A variety of assessment strategies should be used to accommodate learner diversity. This should be done continuously by using different assessment activities rather than using a single strategy. In doing so, educators are able to identify and correct learning difficulties at an early stage. It is important for the educator to incorporate assessment in each unit of study to monitor progress of the learners and to facilitate their learning (Department of Education, 2003). Continuous assessment has two related activities, formal and informal. In the Intermediate Phase, the Assessment Policy stipulates that six formal assessment tasks per year are to be recorded. Assessment tasks must be developmentally appropriate, must be set in contexts that are familiar to the learners, must not require reading skills or vocabulary that are inappropriate to the learner's grade level, and must be as free from bias as possible (Department of Education, 2003). Feedback should be given at an appropriate time so that it can be used as the foundation for further development. Assessment should clearly be linked to teaching and learning. Black and Williams (1998) state that if educator improve classroom assessment, effective teaching and learning would also improve and this can only be achieved when assessment is well planned and used effectively.

Assessment can be used for different purposes. It can be used as the baseline to check what learners already know. Baseline assessment usually takes place at the beginning of a grade or phase for diagnostic purposes to find about the nature and cause of the difficulties that learner might experience. Assessment can also be used for formative purposes, to monitor and support the process of learning and teaching, and to inform learners and educators about learners' progress so as to improve both teaching and learning. Lastly, assessment can be used for summative purposes to give the overall picture of the learner's achievements at the end of term or year (Department of Education, 2003).

To accommodate the different ways in which learners construct knowledge, educators need to use different approaches to assessment. By using different assessment strategies, learner diversity will be catered for since different learners may demonstrate their achievement of different outcomes in a different ways such as drawing, writing and demonstrating. Alternative assessment strategies that allow for integrating assessment into instruction and assessing outcomes such as the Critical Outcomes of Curriculum 2005 should be utilized.

Just as they did for other sub-constructs Rogan and Grayson (2003) classify educators’ assessment practices according to levels. Levels one and two refer to the use of more traditional assessments (written tests), whereas levels three and four are those that support the principles of the RNCS. Table 2.5 below shows the levels.

**Table 2. 5 Profile of Implementation for assessment**

Level	Types and description of Assessment
1	Written tests are given that cover the topic adequately. While most questions are of the recall type, some require higher order thinking. Tests are marked and returned promptly.
2.	Written tests include at least 50% of the questions that require comprehension, application, and analysis. Some of the questions are based on practical work.
3	Written tests include questions based on seen or unseen “guided discovery” type activities. Assessment is based on more than written tests. Other forms of assessment might include reports on activities undertaken, creation of charts and improvised apparatus, and reports on extra reading assignments.
4.	Performance on open investigations and community-based projects are included in the final assessment. Learners create portfolios to represent their “best” work.

Source: Rogan and Aldous (2005)

**2.5.1.5. Providing Feedback as Assessment Strategy**

Feedback practices were added to examine the extent to which discussion and interaction affected learners’ conceptual and emotional development in the classroom. According to Mortimer and Scott (2003) a positive learning environment in which learners feel comfortable to express their ideas is required when using the different teaching strategies approach. Learners need to feel and know that their thoughts are acknowledged and valued.

According to Reynolds (2013) feedback is an important part of teaching and learning. In that way providing learners with feedback timeously is necessary for effective learning as learners need information about their achievements to progress. Cross (1996) is of the view that “the basic principle of learning is that learners need feedback. They have to know what they are attempting to achieve and they need to know how close they are to reaching the goal” (p. 64). According to Joyce et al., (2000a), through feedback learners can be able to find out how well they understand the work done by looking at what have been done correctly and the errors they have.

Tyler (2002b) is of the view that learners must be provided with feedback in a way that will assist them to discover for themselves what they have done wrong rather than being told. Judging the learners can lead to learners being reserved, passive and dependent on the educator. Amos (2002) is also concerned about the quality of questions asked; the way they are phrased as well as the time.

Research about how educators provide effective feedback reveals that educators must make sure that they provide feedback in an educative manner, for example, placing focus on what has been done in a correct manner rather than highlighting the mistakes. This must be done in an appropriate manner so that learners will be able to connect feedback with the action because if feedback takes too long, the connection will be lost. Studies of effective teaching and learning conducted by Dinham (2007b) reveal that learners are always eager to know about their performance. According to this author educators must be aware of non-verbal signs like facial expression and gestures as they also provide feedback.

This study also focuses on formative aspect of assessment which is used to monitor and support the process of learning and teaching. Formative assessment informs learners and educators about learners’ progress so as to improve both teaching and learning. The way in which feedback was provided, was observed using the levels presented in the table 2.6.

**Table 2. 6 Learner feedback**

Levels	Types and description of feedback
1	Gives no feedback
2	Gives feedback about incorrect responses only in a manner that discourages further effort.
3	Educator gives feedback for only incorrect responses in a manner that encourages further effort.
4	Educator gives feedback timeously for correct and incorrect responses in a manner that encourages further effort.

Source: Villanueva (2010)

### **2.5.2. Capacity to Innovate**

This construct is an “attempt to understand and elaborate on school based factors that are able to support or hinder the implementation of new ideas and practices (Rogan and Aldous, 2005, p. 317). According to Rogan and Aldous, the indicators of Capacity to Innovate fall into four groups which are: physical resources, teacher factors, learner factors and school ethos and management. For the purpose of this study only physical resources and teacher factors were addressed.

#### **2.5.2.1. Capacity to Innovate: Physical Resources**

This sub-construct is about physical resources including the buildings, furniture, electricity, water, laboratories school grounds and copying facilities. The original Levels and their descriptions were used to describe the research sites. Some of these aspects are not applicable to primary school, for example, grade four natural sciences content does not require laboratories; pictures and real objects are sufficient .The descriptions of levels given in the original theory were used to describe the research sites.

**Table 2. 7 Capacity to Innovate: Physical resources**

Levels	Types and description physical responses
1	Basic buildings classrooms and one office, but in poor condition. Toilets available. Some textbooks not enough for all.
2	Adequate basic building in good condition. Suitable furniture adequate and good condition. Electricity in least one room. Textbooks for all. Some apparatus for Science.
3	Good buildings with enough classrooms and a science room. Electricity in all rooms. Running water. Textbooks for all pupils and educators. Sufficient science apparatus. Secure premises. Well-kept grounds.
4	Excellent buildings. One or more well-equipped science laboratories. Library or resource centre. Adequate curriculum materials other than textbooks. Good teaching and learning resources. Attractive grounds. Good copying facilities.

Source: Rogan and Aldous 2005

For lesson presentation by resources, I was looking at Learner and Teacher Support Material (LTSM) during the lesson which might include textbooks, charts and real objects. In the model for resources the focus is not only the LTSM but also in the buildings and even grounds. It has been mentioned earlier in the section on classroom interaction that a positive relationship exists between this sub-construct and Capacity to Innovate (resources are the part of Capacity to Innovate). It is difficult to leave this component out if you are looking at classroom interaction specifically as the study is about teaching strategies. As mentioned earlier, learners in Grade Four are in the concrete operational stage; therefore resources are of importance in their ability to learn and “every Learning Area relies on different resources for its success” (Department of Education, 2003, p. 13). Educators need to be aware of resources needed and available when they plan their lessons and “educators must be sensitive to the limitations of learners who experience barriers to learning and how their progress may be affected by the availability of resources” (Department of Education, 2003, p. 13). It is not always possible for educators to take the child to see the real situation of what is being taught. The child or learner perceives better when the educator proceeds from the concrete to the abstract (Steyn, Badenhorst & Yule, 1988). In the didactics situation, the child learns more

effectively if it is shown a picture, handles an object, or sees a model rather than just being told in words. Teaching and learning aids are useful when introducing the new subject matter, “to explain words that are unfamiliar to the learners, to consolidate a concept and to present the picture of abstract situation, because abstract ideas and concepts are very difficult to grasp, and it is the duty of the educator to “present a meaningful picture to the learners” (Steyn, et. al., 1988, p. 108).

**Table 2. 8 Modified levels for teaching resources.**

Levels	Types and description of teaching
1	Uses textbooks effectively
2	Textbooks are used along with other picture
3	Uses textbooks, pictures and real objects.
4	Uses visual and audio visual resources.

Source: Modified from Rogan and Aldous (2005)

According to Joyce et al., (2000a) it has been proposed that teaching materials should match individual learning styles of the learners; that is visual, auditory and kinaesitc learning styles. Moreover Joyce et al. stated that learners recall best those ideas or concepts that are presented in a way that is related their senses. The above modified level descriptions were used because of the grade observed. As mentioned in this section, materials should match the learners’ learning styles. Grade Four are in the concrete-operation stage they learn from interacting with concrete objects. Meaning that science educators should concretize Science so as to develop the understanding of concepts by learners and thus support them to move to the abstract stage.

**2.5.2.2. Capacity to Innovate: Teacher Factors**

As the study investigates educators’ experiences in teaching Matter and Materials, it is of great importance that this sub-construct be included. One of the instruments used in this study, required teachers to supply information with regard to their teaching experiences, qualification and even their feelings and understandings. These can affect (emotions, experiences and knowledge) teaching and learning. For this sub-construct the descriptions from the original framework are as presented in table 2.9.

**Table 2. 9 Capacity to Innovate for Teacher factor**

Level	Types and description teacher factors
1	Teacher is under qualified for position, but does have a professional qualification.
2	Teacher has minimum qualification for position. Teacher attends the school/classes regularly.  Teacher is motivated and diligent. Enjoys his/ her work. Teacher participates in professional development activities. Teacher has a good relationship with and treatment of learners.
3	Teacher is qualified for position and has a sound understanding of subject matter. Teacher is an active participant in professional development activities. Conscientious attendance of class by teacher. Teacher makes an extra effort to improve teaching.
4	Teacher is overqualified for position and has an excellent knowledge of content matter. Teacher has an extraordinary commitment to teaching. Teacher shows willingness to change, improvise, and collaborate, and has a vision of innovation. Teacher shows local and national leadership in professional-development activities.

Source: Rogan and Aldous (2005)

*Teacher’s qualifications*

Far more effort was required and has been made by the government to decrease the number of unqualified and under-qualified educators (Shiendler, 2008). According to Shiendler, (2008), changes have been noted; by 2002 there was a decrease of up to sixteen percent from the figures that were reported before 1994 .Reduction of the percentage of unqualified and under-qualified educators does not mean that we have increased the percentage of teaching experts, since being qualified does not necessarily mean that you are an expert and able to yield good results. As it has been highlighted in chapter one, the South African education system was segregated along racial groups and this has affected the current educational system because in many cases the educators are the victims of a segregated education system and “they may teach in the manner in which they were taught” (James, Naidoo & Benson, 2008, p. 2).

According to James et al, (2008) some educators are struggling to teach the content because they never covered those topics when they were learners themselves. The argument of how one can teach what he/she does not know him/herself, may arise from the argument in the previous sentence. To address this imbalance it is important that educators should undergo professional development in the form of in-service training. James et al (2008) are of the view that the number of students entering the tertiary field of Science will be determined by quality science educators in the education systems. This can be achieved through teacher professional development that includes various forms like individual development, continuing education, peer coaching and mentoring. These forms may provide educators with the opportunity to learn new teaching techniques in line with the curriculum (RNCS).

## **2.6. Concluding Remarks**

There is no single method or approach that can be suitable in all learning contexts. It is recommended that educators use different methods and approaches at different times in different contexts to achieve different Learning Outcomes (Fleer & Hardy, 2001, p.195). When choosing strategies educators should consider that learners' learning styles differ from one learner to another, in other words they should adapt to differences the learners have by using a variety of teaching strategies so as to achieve better academic results. .

The Profile of Implementation is an attempt to comprehend and articulate the degree to which the principles of a set of curriculum expectations are being put into practice. It is discussed addressing three dimensions and language usage being added to the profile. Some aspects of classroom interaction that include; nature and use of science practical work and assessment practices were also discussed. Lastly, two sub-constructs of Capacity to innovate namely physical resource and teacher factors were included in the discussion.

# CHAPTER 3

## RESEARCH DESIGN AND METHODOLOGY

### INTRODUCTION

Research is the “systematic investigative delving into an unknown scientific process, whereas methodology is the system of methods followed in a particular discipline including a collection of theories, concepts, ideas, and ideologies as they relate to a particular discipline or field of inquiry” (Yin, 2003, p. 234). This chapter provides an outline of the research design and methodology that were used to investigate the research questions: What are educators’ experiences of teaching grade four Matter and Materials in Natural Sciences? How do grade four educators use teaching strategies to teach Matter and Materials in Natural Sciences? This chapter describes the paradigm in which the research is situated as well as the approaches used. The research strategy, which is a case study, is also discussed and the selection of participants described. The methods and procedures used to collect data, different data collection instruments and the strategies employed to analyze data are also described. Issues of validity and trustworthiness are addressed. The study was guided by strict ethical measures that are outlined and lastly the limitations of the study are also discussed.

### 3.1. Research Design

A research design is defined as “the researcher’s overall plan for obtaining answers to questions” (Pilot & Hungle, 2001, p. 189). Barbie and Mouton (2006) defined research design as a “plan of how the study is to be conducted” (p. 98). Abell (2008) too asserts that in high quality research, “the researcher establishes a strong link between the theoretical framework and research question.” (p. 125). In order to explore the teaching strategies used by grade four educators an interpretive, case study research design was adopted. The purpose of this study is to investigate the teaching strategies used by educators and why they are used in different ways consistent with the characteristics of the interpretive paradigm.

#### 3.1.1. Research Paradigm

Popkewitz (1984) views a paradigm as a general belief or model that defines the ways in which people think or act, and which makes people understand the world they live in. This study is located within an interpretive paradigm. According to Cohen, Manion and Morrison (2007), the interpretive paradigm “strives to view situations through the eyes of participants,

to catch their intentionality and their interpretation of frequently complex situations, their meaning systems and the dynamics of the interaction as it unfolds, ” (p. 384). Thus, the interpretive paradigm strives to understand and interpret the world in terms of its participants, and how the participants themselves define their social reality (Cohen, et al., 2007). Interpretation of reality, according to Cohen, et al., (2007), involves giving meaning to data from the point of view of the people being studied. It views the objectives of research as an attempt to understand and interpret social situations by becoming part of the situations, by listening to the participants and by sharing their perceptions and experience (McFarlane, 2000). According to Packer (1999) “interpretive enquiry aims to characterize how people experience the world, the ways they interact together and the setting in which these interactions take place, ”(p. 2).

Creswell and Plano Clark (2007) are of the opinion that “philosophical ideas remain largely latent in research and it is important that these “hidden” ideas -which influence inquiry- be made explicit, ” (p. 125) Philosophical ideas define the “beliefs and practices, or paradigms that influence the methodological practices in research, including how knowledge is generated (epistemology), a patterned set of assumptions concerning reality (ontology), values (axiology) and the particular ways of knowing that reality (methodology), ” (p. 125).

### **3.1.2. Case Study**

In this study educators were observed in order to explore how they were using teaching strategies to teach grade four Matter and Materials. The case study strategy was used because it is the strategy in which “the research explores in depth a program, event, activity or one or more individuals” (Creswell, 2009, p. 176). Henning et al (2004), explains that case studies are defined by both their boundaries with regards to the unit of analysis and methodology. Henning et al., (2004) also mention that a case study describes how, where and why certain things happen. Furthermore, Cohen, Manion and Morrison (2007), argue that a case study attempts to explain what it is like to be in a particular situation, to catch up to close reality and thick descriptions of participants’ lived experiences, thoughts about and feelings in a situation. Grade four educators were given questionnaires so as to collect data about their experiences and teaching strategies they used. Furthermore, they were observed teaching so as to answer how and what questions. Yin cited in (Cohen et al., 2011, p. 291) identifies four main case study designs:

1. The single-case design can focus on a critical case, an extreme case a unique case, representative or revelatory case.
2. The embedded, single-case design, in which more than one 'unit of analysis' is incorporated into the design.
3. The multiple-case design, comparative case studies within an overall piece of research or replication.
4. The embedded multiple- case design, in which different sub-units may be involved in each of the different cases and a range of instruments.

This study adopts the embedded single-case study, meaning that only one part was studied but more than one unit was incorporated. The case study is within the Camperdown Circuit which is the single-case but using sub-units which are four grade four educators from four primary schools.

Nisbet and Watt (as cited in Cohen et al., 2011) are of the view that results obtained from a case study are comprehensible to everyone as they are written in non-professional language. No translation is required as case studies speak for themselves. Results show the reality of the situation and the design of the case studies make them such that they do not require a team of researchers. Case studies can capture unique features that may otherwise be lost in larger scale data. These unique features might hold the key to understanding the situation (ibid). Lastly, the results can highlight expected events and uncontrollable variables. Therefore, the researcher allowed the participants to conduct classroom activities with no interference.

The selection of information in case study research is problem (Cohen et al., 2007) though it is useful to record typical, representative occurrences; the research need not always adhere to criteria of representativeness. This might happen when a specific behavior is demonstrated once and of importance to understand the case and that it cannot be ruled out simply because it occurred once. This is what is called an 'outlier', something that was not accounted for in your design and which is typical in any research (ibid).

The results from the case study can be generalized depending on what other researchers think; that is in cases where other researchers see their application. They may not be easily double-checked whereas the purpose of any research is that it is repeatable, and should always be checked and re-evaluated. Case studies may be personal and subjective. Another problem with a case study is that the researcher may be biased. Although the critics of case studies are of

the opinion that a case study does not allow one to generalized findings, Wellington and Ireson (2008) state that people reading from case studies can often “relate to them even though they cannot generalized from them, ” (p. 167). This study tried to overcome this weakness by avoiding personal influences and aimed to be as objective as possible. The limitations are discussed more fully in 3.9.

### **3.1.3. Qualitative Approach**

This study uses a qualitative approach with elements of a quantitative approach. According to Maree (2007), the qualitative approach is “based on the interpretive paradigm, focusing on understanding how people make meaning of phenomena in their environment,” (p. 170). Creswell (1994) defines a qualitative study “as an inquiry process of understanding a social or human problem, based on building a complex, holistic picture formed with words, reporting detailed views of informants, and conducted in a social setting,” (p. 195). Nieuwenhuis (2007) asserts that qualitative researchers believe that “the world is made up of individuals with their own assumptions, attitudes, intention beliefs and values,” (p. 155). In view of the fact that there are values and attitudes involved it is essential that a qualitative researcher interacts with the participants. This interaction means that the researcher becomes an integral part of the research process in the qualitative phase. Patton (in Golafshani, 2003) asserts that it is necessary for a researcher to be involved in his/her research in order to record events and to make changes to the research process as events unfolded. Qualitative research “uses a naturalistic approach that seeks to understand phenomena in context-specific settings,” (Golafshani, 2003, p. 600). It was decided to use qualitative data collection methods and instruments at the site where participants experience the issue or problem under study. As a result of this decision information was gathered by “talking directly to people and observing their behavior within context” (Creswell, 2009, p. 175). During this study grade four educators were participants as they are directly involved with the phenomenon under investigation, namely, teaching Matter and Materials. In other words, these educators were the people who were immersed in the setting of the everyday life in which the study was conducted.

### **3.2. Selection of Participants**

The study focused on four grade four natural sciences educators in the Camperdown circuit. According to Mugo (2002), “sampling is the act, process or technique of selecting a suitable sample, or representative part of a population for the purpose of determining parameters or

characteristics of the whole population” (p. 1). In other words the purpose of sampling is to draw a conclusion about the population (Mugo, 2002). However, in this study “convenience sampling” also known as “accidental or opportunity sampling” was applied (Cohen, Manion & Morrison, 2011, p. 155). According to these authors convenience sampling results when the researcher chooses the sample from those to whom she has easy access to. Grade four educators of the Camperdown Circuit were selected as this was more convenient for conducting the research.

### **3.3. Data Collection Methods and Instruments**

Data were collected in the second term during April of 2012, over a period of four weeks during which the topics related to Matter and Materials were taught in grade four classes. Data were collected using questionnaires, documents, observations, unstructured interviews and semi-structured interviews for in-depth data collection purposes. These methods were also used for triangulation and to enhance validity and trustworthiness of the study. According to Cohen, Manion and Morrison (2002) using more than one method for data collection in the study is called triangulation.

The data collection methods used were decided upon according to the type of data required in order for the research questions to be answered. The data collection methods used throughout this study were selected upon criteria that best fit the design of this research and type of data required. Table 3.0. summarises the justification for the choice of data collection strategies.

**Table 3. 1 Justification for strategies to access data for research question 1and 2**

Guiding questions to access data	Justification for strategy to access data	Justification for strategy to access data
1) What type of information is required?	<p>Research question one</p> <p>What are educators' experiences of teaching grade four Matter and Materials in Natural Sciences?</p> <p>Educators' experiences of teaching Matter and Materials</p> <p>Different strategies used by grade four educators to teach Matter and Materials.</p>	<p>Research question two</p> <p>How do grade four educators use teaching strategies to teach Matter and Materials in Natural Sciences?</p> <p>The way in which the strategies are put into practice. (Educators)</p>
2) Why is it required?	<p>To see what influences they have to teaching Matter and Materials.</p>	<p>To find out how educators use these teaching strategies.</p> <p>To explore why natural sciences educators use chosen strategies to teach Matter and Materials. Reasons behind their choice of strategies</p>
3) Where to get this information from?(source)	<p>Grade four Natural Sciences educators from four quintile one primary schools.</p>	<p>Grade four Natural Sciences educators from four quintile one primary schools.</p>
4) How to collect this information?	<p>Educators were given questionnaires on their understanding and feelings about the Natural Sciences teaching strategies they used.</p> <p>Educators were interviewed using face-to-face, unstructured and semi-</p>	<p>Educators were observed in class teaching and their planning documents were analysed.</p>

	structured interviews (only these were tape-recorded).	
5) Are the instruments used appropriate?	Yes the questionnaire had open and close ended questions  Unstructured and semi – structured interview schedules were used. These interviews created opportunity for educators to give information which cannot be captured using any of the instruments.	Observations and Document analysis were appropriate because they reflect what was done in the class.

### 3.3.1. Questionnaires

According to Denzin and Lincoln (2000) a questionnaire is a research instrument “consisting of a series of questions and other prompts for the purpose of gathering information from the respondents” (p. 156). Usually the questionnaire is self-administered and can be posted or hand delivered to the subjects asking them to complete it and return it (Alby, 2008). The questionnaire avoids interviewer bias, guiding, and cues that can impact the validity and reliability of the data collection (Alby, 2008). The problem with a questionnaire is that there is no opportunity to probe or clarify any misunderstandings about purpose, questions or privacy. Subsequently some individuals might not return the questionnaire, thereby reducing the sample size and possibly validity.

The layout of the questionnaire may be influenced by the type of data that is required and the way in which the data will be analyzed. For example, closed questions provide information that is easily coded, whereas an open question provides more freedom of information, and more difficulty of coding (Alby, 2008). Questionnaires can contain structured, closed or open-ended questions. A questionnaire with structured closed-ended questions present a range of responses from which the respondents choose (Denzin & Lincoln, 2000). “Highly structured and closed questions are useful in that they can generate frequencies of response amenable for statistical analysis” (Cohen, Manion & Morrison, 2011, p. 105). A questionnaire with open-ended questions enables the respondents to answer as much as they wish (Cohen, et

al., 2011). The use of questionnaires is not only because they are easy to administer and compare, since questionnaires use the same set of questions for all the participants but is also reliable, (Denzin & Lincoln, 2000). Cohen et.al., (2011) assert that open-ended questions are also quicker to code and analyze than word- based data and, often, they are to the point and deliberately more focused than open-ended questions. Moreover, questionnaires are cost effective (Denzin & Lincoln, 2000).

In this study questionnaires were used as a concise and convenient way of collecting information about participants' backgrounds, attitudes and experiences. The questionnaire consisted of four parts. The first section covers the biographic data of participants that include data on gender and age, qualifications, teaching experience. This section also collected data about teacher development, including initial teacher training and in-service training. The second section asked questions regarding their feelings about presenting Matter and Materials and their understanding of how grade four learners may be taught. The third section describes teaching strategies used. The fourth section contains one open-ended question asking participants to indicate the process skills they use in their lessons. The questionnaire concludes with open ended questions where participants were expected to write about their own practice and their thoughts and suggestions with regards to teaching Natural Sciences. The questionnaire has five sub-sections where the participants were required to indicate their level of agreement by marking the square with a cross. A Likert scale consisting of five levels was used: 1- strongly disagree, 2 - disagree, 3 - neutral/ undecided, 4 - agree and 5 – strongly agree. (See Appendix A – a copy of the questionnaire).

In order to compile the questions for the questionnaire, data from the theory of implementation was used. The first part of the questionnaire covered the sub-construct 'teacher factors' which falls under the Capacity to Innovate. I formulated questions that were specifically designed for grade four educators. In the second part, questions were structured using the expectations of policy documents and the descriptions of the levels of the theory used.

### **3.3.2. Interviews**

According to Lincoln and Guba (1985), interviews are the preferred tool for qualitative research. Gilham (2000) defines an interview as a "conversation where one person, the interviewer, is seeking responses for a particular purpose from the other person the interviewee," (p. 1). Cannel and Kahn (2005) agree with Gilham (2000, p. 1) stating that an interview is a conversation that is initiated by the interviewer for the specific purpose of

obtaining research relevant information from the interviewee. Alby (2008) describes an interview as “a series of questions a researcher addresses personally to respondents,” (p. 39). Interviews are often categorised into three types: structured, semi-structured and unstructured. These categories are “determined by the degree of control” over the interview exercised by the interviewer (Stenhouse, cited in Burgess, 1985, p. 67). In a structured interview, the interviewer prepares a questionnaire with short and direct questions. A structured interview simply has a single set of questions that are put to all interviewees with no divergence or individual tailoring. As a result the “structured interview is regarded as a "formal" or "controlled" interview” (Stenhouse, 1984 cited in Burgess, 1985, p. 67). In a structured interview a researcher strives to be objective by eliminating the human factor. Structured interviews are therefore more appropriate for quantitative research. Stenhouse (1984) agrees with this idea, "structured interviews are avoided in qualitative research" (Stenhouse, 1984 cited in Burgess, 1985, p. 67).

The semi-structured interview is more flexible than the structured one, in such a way that the interviewer is able to ask more questions beyond the planned questions or to probe for deeper understanding and the respondent (interviewee) can expand his/her responses (Hitchcock and Hughes, 1989). In the so-called "unstructured" interview the degree of flexibility is even more. It is sometimes called an "interview-as-a-conversation" or “non-directive interview” (Burgess, 1985, p. 67).

Unstructured interviews are interviews without any set format but in which the interviewer may have some key questions formulated in advance. Unstructured interviews allow questions based on the interviewee’s response and proceeds like a friendly, non-threatening conversation. According to Patton, cited in Cohen et al., (2011) this type of interview “increases the salience and relevance of questions, built on and emerged from observations,” (p.413). According to Patton unstructured interviews can be matched to individuals and particular situations. However, because each interviewee is asked a different series of questions, this type of interview lacks the reliability and precision of a structured interview (ibid.). It can be difficult to analyze and organize data from unstructured interviews as data are not systematic and comprehensive. Unstructured interviews were conducted during the post-observations of the two lessons, but two of the educators' observed did not teach the content that we agreed upon and that led to unstructured interviews.

Face-to-face semi-structured interviews were employed to generate qualitative and rich data,

for example the reasons on why particular strategies were used (Creswell, 2008). The semi-structured interviews were used because they are flexible, less formal and more controlled by the interviewer. They allowed the interviewer to investigate and prompt things that could not be observed. The respondent could be asked to clarify or expand on the response that would result in additional data or information (Cohen et al., 2007; Wellington, 2000). Adding evidence to this, McMillan and Schumacher (2006) indicate that like any other types of interview, it is good to establish trust by keeping eye contact and by responding to the interviewee in a genuine conversation. These are amongst the factors that help to elicit more valid data than a rigid approach. As educators were being interviewed, efforts were made to ensure that the educators were happy to talk to me and that no unnecessary time was wasted on their behalf. It was further explained that the data collected would be presented in an anonymous and confidential manner as in this study.

The interviews were aimed at finding out more about what was observed from the three lessons - looking at the strategies the educators used to teach the selected unit of study. This included an explanation of the approach used to introduce the lessons. Educators were also asked to explain why they had chosen those strategies. The interviews were tape recorded and then transcribed. Permission to tape record the conversations was obtained from all participants. Data from the interviews was then transcribed for analysis (Creswell, 2008).

### **3.3.3 Classroom Observations**

Observation is the most important method for data collection for a qualitative case study (Cresswell, 2003). Cohen and Manion (1994) assert that “at the heart of every case study lies a method of observation” (p. 107). Observations have the unique strength of allowing the investigator the opportunity to “gather ‘live data’ in situ hence increasing the possibility of obtaining authentic data” (Cohen, et al., 2007, p.107). Maree (2007), indicates that an observation is an everyday activity whereby researchers use senses (seeing, hearing, touching, tasting and smelling) to gather bits of data. These authors believe that observation can either be participative or non-participative. According to this view, in a participative observation the researcher takes part in the activities he/she observes. The observer might be considered as one of the members of the group. A non-participant observer does not take part in the activities; he/she can sit at the back of a classroom writing down his/her observations. According to Lubisi (2000, p. 117) observation can be located within two extremes of the continuum, one end of the continuum is a "complete participant observer" followed by a

"participant-as-observer" then an "observer-as-participant" and on the other end is a "complete observer" which is a non-participant observer.

During classroom observations, observations were recorded as a non-participant observer. This means observations were recorded without participating (Cohen, Manion & Morrison, 2011; Creswell, 2008; Hopkins 1993). This type of observation was applied as this method develops a richer understanding of the strategies used by the educators who teach Natural Sciences in Grade Four. Non-participant observations make it possible to observe how different educators approach their lessons and interact with their learners.

According to Cohen, Manion and Morrison (2011) “ the distinctive feature of observation as a research process is that it offers an investigator the opportunity to gather live data from natural occurring social situations,” (p. 456). In this way the researcher can look directly at what is taking place in the situation rather than relying on second-hand accounts. Observation enables the researcher to gather data on “physical settings (physical environment and its organization), the human setting (organization of the people and characteristics of individuals being observed), interactional settings (formal, informal, verbal, non-verbal interaction taking place) and programme setting (resources and pedagogic styles)” (Morrison, 1993, p. 80). Barbie and Mouton (2006) are of the opinion that the greatest advantage of observation is the presence of the observer or thinking researcher on the scene. These authors also emphasize the importance of note-taking during observations. Hopkins (1993) is of the opinion that the disadvantage of observation is that, though it is possible to observe particular people or families, even if they agree to your presence, the fact that you are observing can make individuals behave differently to normal situations. One can never be sure that the participants being observed will react in the same manner as when they are not being observed.

Four methods of conducting classroom observation have been identified by Hopkins: “structured, systematic, focused and open observation” (1993, p. 116). A structured observation resembles a survey, where every respondent is asked the same set of questions. In this study however, particular types of behavior are sought out and counted instead of questions being asked. Systematic observation uses coding scales, while the focused observation focuses on a particular teaching technique, for example questioning. Lastly, in an open observation an observer records all his observations including the interactions of the participants, description of the activities, and the action and gestures of participants.

In this study a structured observation was used. The instrument used was a modified version of a validated classroom observation schedule used in one of the studies (Villanueva, 2010) focusing on integrated strategies for improved science language in second language learners. The classroom observation schedule contained the rating levels (1-4).

The focus of observation was based on:

- Classroom interaction.
- Assessment.
- Science practical work and usage of language.
- Observing the teaching strategies.

The sections of the observation schedule focused on:

- Introduction to the lesson.
- Presentation and assessment strategies.
- Whether or not the educators used practical work with the inclusion of process skills.

Levels one to four have descriptions assigned explaining the behavior observed. Most of the levels were taken from Rogan and Grayson (2003). Some modifications were made to suit the context of the study as Rogan and Grayson's study was conducted in secondary schools whereas this study was conducted in a primary school, particularly the Intermediate Phase. Below each component a section was left open for descriptive notes about the levels recorded. See Appendix A3 for a sample copy of the classroom observation schedule used.

#### **3.3.4. Documents**

Documents were used because they are “convenient to the researcher to analyze them at a convenient time and they are not obtrusive or intrusive” (Creswell, 2009, p. 180). According to Creswell (2012), documents are a valuable source of information in qualitative research as they “consist of public and private records that qualitative researchers obtain about a site or participants in a study” (p. 223). Robson (2002) argues that documents are unobtrusive and can be used without imposing on participants and they can be checked and rechecked for reliability. Adding to this, Creswell (2012) argues that documents provide a “good source of text data, the advantage of being in the language and words of the participants and they are ready for analysis without the transcription” (p. 223). The negative aspect of document analysis is that sometimes they are difficult to locate and obtain, and may be incomplete or

inaccurate (Creswell, 2012). According to Robson (2002), a major problem is that documents may not have been written for the same purposes as the research and therefore conclusions will not usually be possible from document analysis alone. This shortfall is overcome by using more than one method of data collection for triangulation.

The documents that were analyzed were: The National Curriculum Statement Policy Document Grade R-9 Natural Sciences 2002 (Matter and Materials only); Work Schedule for Intermediate Phase (Grade four work schedule); educators' lesson plans and time table for Grade Four. These documents were used to address research question two, as it looking at how the strategies were used. (The National Curriculum Statement Policy Document Grade R-9 Natural Sciences 2002 (Matter and Materials only) was used to check the content that was supposed to be covered in Grade Four although it is not clearly demarcated. The CAPS document was used to assist in content demarcation since in this document the content for Matter and Materials is clearly demarcated. Work schedules were used to check Learning Outcomes, Assessment Standards, learning activities and resources the educators are expected to use for this section. Time tables cannot be separated from these documents for time allocation. The information from these documents was used for classroom observation as these contain the natural sciences content to be taught.

### **3.4. Process of Data Collection**

The process of data collection took place during the second term of the year in 2012. Firstly questionnaires were distributed amongst participating educators on a Monday and collection took place at the end of the week. The collection method was problematic for certain reasons including that all educators did not complete the questionnaire at the given time but as the process went on all of them were returned.

The following week lesson observations commenced, observing three lessons per educator over the period of two weeks, a total of twelve observations. Each lesson was one hour in duration. As each educator was to be observed three times, it was agreed upon to apply consecutive lessons for each educator. It was possible to reach two schools per day and observe three educators in the first week. For example on the first day Monday, for the second and third period (8h00-9h00) I was at the first school and then for the fourth and the fifth periods (10h45- 11h45) at the following one. After the first and second observations unstructured interviews were conducted with the two educators. The fourth educator was

observed in the second week since her natural sciences periods clashed with one of the other three schools.

The last phase of the data collection process was that of interviewing the participants. One - face to face- interview was conducted with each of the four grade four educators from the four schools. The interviews were conducted after school hours at the school premises where the educators worked. Each interview lasted approximately 15 minutes. The original intention was that interviews would be on the day of the third observation but that was not the case. Preparation of interviews was done beforehand to ensure that the participants were asked the same questions. Open-ended questions were used to formulate the interview schedule. All questions were in English and all participants were expected to answer in English.

### **3.5. Data analysis**

According to Cohen, Manion and Morrison (2011) “qualitative data analysis involves organizing, accounting and explaining data,” (p. 537). This can be accomplished by making sense of data in terms of the participants’ definitions of the situation, noting patterns, themes, categories and regularities. According to Cohen et al., (2011) there is no single or correct way to analyze and present qualitative data. Data from classroom observations was both quantitative and qualitative as the instrument used reflects this. The classroom observation schedule has rating levels and spaces for writing description below each component. For this reason the quantitative and qualitative methods were integrated during the analysis of data.

According to the curriculum document no specific teaching strategies are prescribed but emphasis is on “meaningful education which has to be learner-centered” (Department of Education, 2003, p. 26). However the guidelines on things that should be considered when designing lessons are clearly stated. These guidelines include “the focus on development of natural sciences process skills, placing investigations at the centre of all classroom activities and providing opportunities for participation of all learners” (Department of Education, 2003, p. 27).

According to Saunders and Thornhill (2003), data analysis can be divided into two categories; deductive and inductive. Saunders and Thornhill assert that deduction is generally past or present oriented and presumably, its premises are already tested. It draws from general information, and then extracts a specific conclusion which proves the past or present truth. No

new information is found in the conclusion. Deduction moves from the general to the particular (meaning that conclusion is based on the existing theory), from cause to effect, and argument forms can be valid, meaning that the deductive argument is one in which the conclusion necessarily follows from the premise. Deductive analysis can be invalid, meaning that arguments can contain something in the conclusion wholly new and independent from those things mentioned in the premise of the argument. Finally, deductive analysis can be sound or unsound. Data from all the instruments were analyzed deductively using Rogan and Aldous's (2005) levels of implementation of a new curriculum.

Data from the questionnaires was captured into a table and response(s) to each statement were analyzed.

The following observations were made during the lessons:

- teaching strategies used
- different ways of introduction
- lesson presentation
- language used
- practical work
- feedback and assessment

Teaching strategies used by the educators (as well as different ways to introduce the lessons, strategies used during lesson presentation, the language used as a strategy, resources used, practical work, and feedback and assessment strategies) were recorded. All this is connected to the two constructs Profile of Implementation and the Capacity to Support Innovation as my study is framed by the Theory of Curriculum Implementation. According to Rogan and Aldous (2005) "the aim of this profile is to help in understanding what educator and learners do," (p. 1173). The data was examined by using the levels at which the educator could apply the components observed.

Interviews were tape-recorded and transcribed, grouping similar kinds of information together in categories, and relating different ideas and themes to one another (Rubin and Rubin, 1995). I then linked information from the questionnaire, observation and from the interviews to the teaching strategies and that helped to look for trends between the instruments.

### **3.6. Measures to Ensure Trustworthiness**

Maree (2007) defines trustworthiness as the way in which the inquirer is able to convince the audience that the results are worth paying attention to and that the study is of high quality. Rolfe (2006) further states that “trustworthiness is further divided into credibility –which corresponds with the positivist concept of internal validity – dependability –which relates more to reliability – transferability – which is a form of external validity –and confirmability – which is largely an issue of presentation” (p. 305). “Valid analysis is immensely aided by data displays that are focused enough to permit viewing of a full data set in one location and are systematically arranged to answer the research question at hand” (Miles & Huberman, 1994, p. 232). Denzin and Lincoln (2000) are of the view that validity has to do with the degree of capturing the reality of the situation under investigation. Cohen, Manion and Morrison (2007) highlighted the importance of validity as the key to effective research, and that certain aspects should be considered in addressing it, particularly in qualitative research. Some of these aspects include honesty, depth, richness and scope of the data generated, while others include the manner of approaching the participants and the extent of the triangulation of data. Lincoln and Guba (1985) state that trustworthiness of a research study is important in evaluating its worth, which involves establishing credibility, transferability, dependability and conformability. Lincoln and Guba (in Nieuwenhuis, 2007) define each of these terms as important issues in validating case studies; “Credibility refers to confidence in the 'truth' of the findings.” (p. 80). Transferability is a means of presenting results in a manner such that the results have applicability in other related settings; transferability intends to establish the extent to which findings from the study can be used by another researcher. Another important issue of validating the data in naturalistic studies is repeatability, which concerns the issue of whether the process and findings of the study are consistent with time and across other researchers, and could be repeated. Finally, conformability involves a degree of neutrality or the extent to which the findings of a study are shaped by the participants, and not by researcher bias.

The transcripts were returned to the educator participants so that they could verify the accuracy of what had been recorded/observed. Educators were given the opportunity to listen to the recorded interviews, read the data and contact me, should they wish to clarify their verbal comments. Considering the appropriateness of the instruments the questionnaires were appropriate. The observation schedules were appropriate as some modifications on the Rogan and Grayson model were made so that it would better fit the specific context. The

introduction of the lesson, language use and feedback to learners were added to the original sub-constructs. As for the interview, it is appropriate as it collected data that could not be gathered by the other two instruments.

### **3.7. Ethical Considerations**

According to Cohen, et al., (2011) “the principle of informed consent arises from the subjects’ right to freedom and self-determination” (p. 51). They further state that 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.

Before this study was undertaken, an application for ethical clearance was requested from the Ethics Committee of the University of KwaZulu-Natal. The clearance was granted before the study commenced. Letters were written to the Ward manager of Camperdown Circuit and the principals asking permission for conducting this study and explaining the purpose of the study as well as particulars regarding data collection procedures and handling of data. A written consent form which described the study and its purpose was presented and explained to each participant before the data collection. Each participant signed the consent form. The anonymity of research participants was guaranteed at all times (Cohen et al., 2011). Participant’s right to anonymity including their right to refuse participation in the study was respected. Educators participated voluntarily and were made aware that their responses would be used for the study. Focus was on the educators but not everyone was able to make it without the learners being there. Thus informed consent was obtained from both the participant educators and the learners for the observation of their lessons. Letters were written to parents for informed consent since the learners were minors. Although learners were not participating directly, the fact that the educators interacted with learners resulted in their responses being recorded. Learners’ responses were recorded to clarify or to give impression of the background about classroom interaction and discussion.

Ping in Cohen, et al., (2000) argues that “the right to privacy is sometimes contracted by the public’s right to know,” (p. 60). Stardom (2005) defines privacy as that which is not normally intended for others either to observe or to analyze. During this research the participants’ right to privacy was respected in the sense that it was made clear that participants have the right not to answer any questions that they felt were sensitive. To ensure the anonymity and confidentiality of all participants, the questionnaires reserved space for pseudonyms given to

the participant educators. For the sake of anonymity and safekeeping it was agreed upon between the researcher and the University that the recorded data from this study will be held and stored on the University premises. After a period of five years the data will be destroyed

### **3.8. Limitations of the Study**

The participants of the study were four educators from rural areas of UMgungundlovu District; Camperdown Circuit. Therefore the small sample size of four educators cannot be considered the true reflection of all schools in Camperdown Circuit. The findings cannot be generalized to all schools in South Africa. However, the information can be used to raise questions about teaching and learning of Matter and Materials in Natural Sciences in Grade Four.

### **3.9. Concluding Remarks**

The research design that guided the study was discussed in detail in this chapter. It also presented detailed description of the data collection process, the context of the study and the research participant. The qualitative methodology used as well as the paradigm it adopted was described. The type of data collection procedures that were followed, including the selection of participants, a description of the research site and the research participants, and use of interviews to increase the trustworthiness of the data which were generated were all discussed. It is therefore apparent and conclusive that the non-participatory technique (when weighed against other techniques as described in the literary review) is the most applicable (repeatable) and fitting method of data collection as per requirement for this study.

# **CHAPTER 4**

## **FINDINGS**

### **INTRODUCTION**

This chapter presents the findings generated from the qualitative data collected from four grade four natural sciences educators from four primary schools in the Camperdown Circuit. The data was gathered using the data collection methods: questionnaires, classroom observations, interviews and document analysis. This chapter presents the context of the case study, an embedded single case study, and gives details of each of the educators who are the units incorporated in the case study design. These case studies are integrated and Rogan and Grayson's theory of Curriculum Implementation (2004) is used to show how the four educators used particular teaching strategies to teach Matter and Materials in Natural Sciences. This theory of Curriculum Implementation has three constructs: Profile of Implementation, Capacity to Innovate and Outside Influences. The first two constructs, which were described in Chapter Two were used in this research. The sub-construct on language was included within the Profile of Implementation. This chapter also includes a descriptive account of the factors that negatively impacted on the educators' teaching of the section. Educators' views about the way in which teaching science can be improved in their schools are also presented.

#### **4.1 Context of the Study**

In this study I have used the term Quintiles (Department of Education, 2006,) to describe the types of schools that were used in this research. All South African public schools are categorised into five groups, called Quintiles according to the poverty level of the community around the school. Quintile 1 being the poorest and Quintile 5 the least poor, based on the rates of income, unemployment and illiteracy within the school catchment area (Sayed & Motala, 2009). The legislative framework is the Amended National Norms and Standards for School Funding (ANNSSF), which came into effect on 1 January 2007 and amended the 1998 norms. It deals specifically with public funding of both public and independent (private) schools, as well as with the school fee exemption policies (Sayed & Motala, 2009). The provincial quintiles were replaced by national ones in 2006, with the Education Law Amendment Act. In response to this, the 2006 National Norms and Standards declared schools in Quintiles 1 and 2 to be no fee paying schools, compensating these schools with a

higher allocation for non- teaching personnel and non-capital expenditure (Sayed & Motala, ibid).

## **4.2. The Description of the Four Cases**

The section below presents the cases of the four Natural Sciences educators in the four primary schools. All schools are quintile 1 schools, which are located in the Swayimana area. The school names used in the findings are pseudonyms. Full descriptions of the educators' context and the lessons taught are discussed.

### **4.2.1. Case Study of Anele**

#### **Description of the school as the research site**

Anele was teaching at Celimfundo Junior Primary School, which caters for Grade R -4 learners and had three Grade 4 classes. All Grade 4 classes had 28 learners per class making up the total of 84 Grade 4 learners. This was an old school with old buildings, well fenced and had electricity, potable (tapped) and tank water. The classrooms were sufficient in number for the number of learners, well ventilated and spotless. There was enough furniture for the learners as they were sitting two at a desk. The seating arrangement was in groups of six, where there were three desks placed together with two learners in each desk.

#### **Anele's biography and experiences**

Anele is a female in her late forties. She is qualified to teach in a primary school and has a National Professional Diploma in Education (NPDE) and a Further Diploma in Education (FDE). She completed her studies in a part-time frame of study. She has been teaching for 20 years in the Intermediate Phase, teaching Grade four Natural Sciences and Mathematics subjects. Anele did not study Natural Science during her initial teacher training and so did not receive any basic training at that stage. She acquired the basic Natural Sciences content during her own schooling and she highlighted that she was exposed to teaching strategies suitable for Natural Science during her teaching career. Anele stated that the RNCS training was inadequate as it did not prepare her with the knowledge required for teaching NS and the process skills. She stated that the support from the Provincial Department for implementing NS is insufficient and she strongly felt that she needed more training to teach NS. Hence, her lack of understanding of the request to teach Matter and Materials was linked to her lack of

knowledge of the subject. This is supported by the statement that she made during the interview when she said “I’m just doing it my way. Nobody told me how to do it.”

Anele agreed that she had difficulties in teaching NS but at the same time she felt comfortable with teaching any topic of Matter and Materials. There is an inconsistency in these two responses. Anele stated that she had knowledge and skills to teach Matter and Materials effectively. She believed in the principle that all learners can learn science. When asked about her perception of how learning Natural Sciences for Grade 4 learners, she responded by saying that she thought science is too difficult for Grade 4 learners. She rated herself as having a clear understanding of how Grade 4 learners learn. There is an inconsistency in her responses.

It is evident that she has 20 years of experience of teaching Grade four but she still has difficulties with teaching Natural Sciences.

### **Description of Anele’s lessons**

#### **Anele’s first lesson: Maize plant**

I had written a letter to Anele asking her for permission for me to observe her in practice. I also asked her to prepare and present lessons for the theme, Matter and Materials. On the first day of observing her teaching, I observed a lesson that was on Life and Living, not on Matter and Materials. The educator introduced her lesson by asking learners question about the kind of things that we find on our planet. The first question that was asked was, “We have two groups of things on Earth, which are those two groups?” Most of the learners raised their hands and she pointed to one learner to give a response. The learner responded by saying, “living things and non-living things”. She carried on asking different learners for the examples of each group. The learners responded to these questions. At this stage I was thinking that maybe she wanted to build upon the knowledge the learners had of living things and then she was going to introduce the new concept of matter. But, after asking the learners the questions, the educator pasted the chart with a picture of a maize plant on the board and she asked them questions based on the maize plant. The topic for this lesson was the Maize Plant. I observed the whole lesson and I did not stop her because it would not have be good manners to stop her and tell her that that topic was not linked to the theme that I had requested lessons on. At the end of the lesson, I humbly told her that her lesson was good but it was not on Matter and Materials but on Life and Living. She said, “I was not aware that there are four content areas, I always rely on the book and it does not specify the content areas.” I asked her to show me the

textbook and the Natural Sciences policy document that she used when planning the Natural Science lessons. She had no problem giving me the documents requested. She only used the textbook, Science for Me Grade 4 Natural Sciences to plan the lesson. In this textbook the topics in the table of contents were not arranged according to the content areas. She had a policy document in her cupboard which she did not use at all. In fact, she did not use it at all for planning any Natural Sciences lessons. We looked at Chapter 5 of the policy document, checking on the content that should be taught in the Intermediate Phase. After seeing the content that is required, she confessed that she did not use the document. She said, “The problem is I am the only Natural Sciences educator at school since we have only one Intermediate Phase class. I don’t have someone to plan with. I’m just doing it my way. Nobody told me how to do it.” She promised to prepare a lesson on Matter and Materials for the following day.

#### **Anele’s second lesson: Three states of water**

The educator began the lesson by writing the word water on the chalkboard and then asked learners to read the word. She asked the learners for the IsiZulu word for water. They responded saying, “Amanzi”. She then asked them for the sources of water. The learners stated sources including, a river, dam and rain.

The educator used English but with more of the Home language (IsiZulu) when teaching as she was code-switching to clarify various concepts. At the beginning of the lesson the learners were encouraged to speak in English and helped to construct their sentences in English. But as the lesson was progressing more IsiZulu was used by both the educator and the learners.

The educator told learners that water can be in three states, “It can be liquid, solid and gas.” She asked the learners to give examples of liquids. She told the learners that water can be in the form of a gas. She asked them what a gas is. One learner responded in IsiZulu saying “umhwamuko” meaning water vapour. The response of umhwamuko was not entertained rather the new terms of evaporation and water vapour were introduced. She told them that water can be changed into a solid and she asked the question of how this could be done. One learner responded saying, “If water was placed on the freezer it can be a solid.” The educator used a chart (poster) with a picture of a kettle with water, showing water vapour coming out of the spout. She used the chart to describe how boiling the water changes liquid water to a gaseous form called water vapour.

Learners were given A3 chart paper with incomplete sentences written on them and they were asked to fill in the missing words. They were very excited as they were completing the tasks in groups of six. The learners were grouped according to their seating arrangements. After they had completed their work, members of the groups took turns to read what they had written on their charts. The educator then assessed the learners' work and discussed the responses expected (the correct ones) from the learners. She ignored all the incorrect responses.

### **Anele's third lesson: Properties of water**

The topic for that day was Properties of Water. To introduce the lesson the educator asked the learners to give her properties of air taught in the previous term. The learners responded saying, "air is a gas, air is invisible, no colour, no smell, can be compressed, has mass, no taste, occupies space."

The educator asked the learners whether they knew any properties of water and one learner said, "it can change and become ice." The educator praised the learner for that response. Another property of water given by a learner was in IsiZulu, "Amanzi awabambeki", meaning that water cannot be held. The learners argued that they hold water with their hands when drinking from the tap, they use their hands. The educator then gave her own examples saying, "We pay for water, taps must be closed tight, and water (this argument was in IsiZulu) is a solvent of solids."

She asked the learners to give her things that dissolve in water. The learners gave responses that included sugar, salt, powder milk, and the last response was soil. There was another argument about that response. Some learners said that powder milk could be dissolved and other said that it cannot be dissolved. The educator's response was, "musani ukuphikisana, asiqhubekeni", meaning stop arguing let's carry on. Another learner response of a substance that can dissolve was, "Juice." The educator ignored that response. Learners were bored and talked while the educator was writing on the board, writing a chalkboard summary.

The educator wrote the new words: solvent, solute and solution, on the chalkboard. She asked learners to read the summary on the board. She was pointing to the learners to read the words but some of them some were not reading, they were doing their own things. She carried on and wrote on the chalkboard 'properties of water as gas'. She explained the following terms to the learners: water vapour and evaporation. Learners confused these terms when she was asking

them questions to check their understanding. For example she asked, “What do we call water in the form of gas?” Learner responded by saying, “evaporation”. Another learner judging by the educator’s silence that the answer was incorrect raised her hand, after being pointed at and she said, “water vapour”. Only four learners participated in answering questions. The educator then moved on to the properties of water in a liquid state. She stated that water can change into a solid if it is placed in the refrigerator. She also told them that solids that can dissolve in water are called solutes. One learner gave the response, “Rama”, as an example of a solid that can dissolve in water. Other learners laughed and said in IsiZulu that Rama cannot dissolve in water. The educator smiled but did not say a word.

Learners responded in English when they gave the properties of air because it was the work done before. When the new concept was introduced they spoke more in IsiZulu. Learners were given worksheets to write down the properties of water for the different states, to check their understanding. The learners worked in groups. The worksheets were collected and marked by the educator after the lesson. No resources (teaching aids) were used for this lesson, only the educator’s note- book with the content for the lesson, was used.

### **Summary of how Anele used teaching strategies to implement the curriculum**

Anele used questioning to elicit the learners’ prior knowledge as a way of introducing her lessons. She always started from what learners already knew to new concepts. There was consistency between what was written on the questionnaire, what was observed and the response from the interview. Anele’s response in the questionnaire was that she always recognized learners’ prior knowledge before teaching new science content. For three lessons observed, she provided a brief introduction and asked questions to introduce the topic. Her response to the interview question of explaining why she used the questioning strategy was, “I asked learners questions to check previous knowledge and to draw learners’ attention”. This response was confirmed (supported) by data from the questionnaire, classroom observation and interviews.

Anele presented content in an organized, correct and sequenced manner, based on a lesson plan. Anele used the expository method and questioning when presenting her lessons. She engaged learners with questions. She explained the new concepts using the posters and asked questions to check whether learners were still following. In the questionnaire she said she provides learners with enough opportunities to work with concrete materials in science but in

practice this was not the case. When teaching about evaporation she used a drawing of a kettle instead of bringing in and using a kettle as the school had access to electricity. She provided learners with adequate notes. She used group work for assessment. Her response in the questionnaire was that she thinks group work is essential for effective science. Responding to this question: What do you think are useful strategies to teach science? She said, “I think useful strategies are questions and answers, group work, discussions as well as spider-web (mind map) and using chalkboard to write new words”. She wrote the lesson summary on the chalkboard and asked the learners to read the summary after her. Data from the different instruments did not support the claim that she used different strategies to teach Natural Sciences.

Responding to the question about the reasons for her choice of teaching strategy, she said, “I used question and answer to develop their thinking skills...the discussion method to give every learner an opportunity to participate in a lesson. I chose question and answer to develop thinking skills and to motivate learner- centered in the lesson.” When responding to the question regarding the reason for choosing group-work, Anele said “I used group work in my lessons because we have limited resources for a child to use. It was also used to reduce educator's assessment load and to give all learners an opportunity to contribute and share their ideas”. During the observation only a few learners contributed productively, they were the high-ability learners. The low-ability learners just read what was written during the presentation. You could even hear by the way they read that they did not understand what was written.

Anele used English but with more IsiZulu than English for all her lessons. She started off her lessons by using English but as the lessons progressed more IsiZulu was used. She did not attempt practical work, not even the demonstrations whereas in the questionnaire she claimed that she provides opportunities for learners to do practical work in science. For the question in the questionnaire about indicating the process skills that she used most frequently in her science activities, she responded by saying, “Group work, letting learners participate by being hands-on and scientific experiments”. During the interview she was asked which process skills she thought her learners had acquired; “They have acquired thinking skills and drawing skills”. These responses shows that she did not understand what process skills are. She used written and oral work to assess learners. No feedback was given for any incorrect answers. She demonstrated an adequate level of knowledge.

Rogan and Grayson's (2003) indicator levels of implementation as described in chapter 2, were used to rate educator Anele's teaching of Matter and Materials. Anele was rated level 1 for lesson presentation, level 2 for language usage (educators uses English with more of IsiZulu). Anele was rated as level 2 for resources, level 1 for assessment and feedback to learners and level 2 for subject knowledge. These ratings will be presented in the section with the composite data for each educator where the presentation and the description of each level is more fully described.

#### **4.2.2. Case Study of Gugu**

##### **Description of the school as the research site**

Gugu was teaching at Siphimfundo Senior Primary School. The school catered for grade R to seven learners and had two grade four classes. The total number of Grade 4s was 69 but I observed one class with 34 learners. It is an old school, started in 1930, with old and new buildings, well fenced, has electricity as well as potable and tank water. The classrooms are sufficient in number for the number of learners; they are well ventilated, neat and spotless. There is enough furniture for the learners as they were sitting two at a desk. The desks were arranged in groups of threes. The school is under-resourced with regards to science equipment, there are no science kits but it has a computer room. The school has electricity, a photocopier that is used to make copies of learner learning activities.

##### **Gugu's biography, experiences and preparedness for teaching NS**

Gugu is also a female in her late forties. She was qualified to teach in primary school, possessing a Primary Teacher's Diploma and a Higher Diploma in Education, all achieved in a part-time frame of study. She had been teaching for 20 years teaching, 17 years in Foundation Phase (Grade 3) and three years in the Intermediate Phase (Grade 4). According to the information on the questionnaire, Gugu said, "Natural Sciences was one of my modules during initial teacher training." She was positive about the science basics received during her training and had explored different methods of teaching science. Even during her own schooling she acquired science basics. She claimed that she had acquired science knowledge needed in teaching through self-study. Additional teaching knowledge was received from RNCS workshops. She was positive that she had learned more about process skills in those workshops. She stated that she had received sufficient support from the Provincial Education

Department on the implementation of Natural Science Learning Area and did not need more training. Looking at Gugu's responses about the initial teacher training and departmental workshops, they indicated that she is a very skilled educator.

### **Gugu's perceptions of teaching Natural Science in Grade 4**

Gugu seemed to have no difficulties in teaching Natural Sciences and felt comfortable in teaching any topic in Natural Sciences. She said that Matter and Materials was her favorite part of Natural Sciences and that she could answer any grade four learners' questions on Matter and Materials and felt comfortable with this. She had knowledge and skills to teach Natural Sciences effectively and she believed in the principle that all learners (including Grade 4) can learn science and did not think that science may be too difficult for grade four learners. She claimed to have a clear understanding of how grade four learners learn Natural Sciences.

### **Description of Gugu's lessons**

#### **First lesson: Healthy and unhealthy foods**

I wrote a letter to the educator asking her for permission to observe her teaching and asked her to plan and present lessons on Matter and Materials. On the first day of observations, I observed a lesson on Life and living, not on Matter and Materials. Her lesson was about healthy and unhealthy foods. The notes on this topic were already on the board when the lesson started. She read first and the learners read after her. She explained the notes to the learners and then handed out a handout on food pyramids. I did the same as Anele since these were the same cases, where at the end of the lesson I was grateful for the lesson and humbly told her that her lesson was not on the theme Matter and Materials but on Life and Living. Looking surprised she asked me what was expected. I explained to her what I was expecting and asked whether I could check the textbook that she was using and the Natural Sciences policy document, if she had one. She used the textbook: Oxford for Grade 4 NS book. The book was organized according to the content areas. We compared the textbook with the policy document, it matched the document. I asked whether she had ever taught this section before and the reason for her response. She responded, "No, in my first year of teaching NS in this Grade, coming from the Foundation Phase, I paged through the book looking at the activities to be completed by learners. I found them too difficult for them. They are young they would not understand". What I observed when we were having that conversation is that she was in denial of the fact that she did not understand what the content Matter and Materials was. I told her that it was against the policy to choose certain content areas and leave others out. I

requested her to prepare a lesson on Matter and Materials for the following day. She had no problem with doing this.

### **Second Lesson: The phases of water**

The educator greeted the learners and told them that they were going to read the notes on the board after her and then she was going to explain the notes to them. The notes were written on the chalkboard prior to the lesson. The educator read sentence by sentence from the board and explained them. She read the first line saying what is matter? She then integrated the statement that read thus “matter can be divided into two groups: living and non-living”. From this point she then went to the phases of water. Without first telling them that the topic is the phases of matter, Gugu simply said, “Water is an example of matter that occurs in three phases”. Learners were not given a chance to give their own examples of matter, water was the only example given. The notes were about water changing to ice, steam, and water again and about the processes involved. Learners were passively listening to what the educator said. Only notes from the book, written on the board were used as resources. No practical work done by learners. Notes written on the board had no progression. They were not easily followed. She first wrote about the matter and its example, phases of water, heat as a form of energy.

Learners were asked this question: What are the examples of the living and non-living things? They were given handouts with questions to answer individually. They were going to fill in missing words. Handouts were collected and to be marked later.

### **Gugu’s Third Lesson: The properties of materials**

The topic of the day was “properties of materials”. As usual Gugu read out the notes on the board with learners reading out after her and explained each and every sentence to them. There was no link between the previous and new knowledge.

Notes were read on the board and were explained to learners. Learners were bored and looking at the researcher not at their educator.

English was only used when the educator and learners were reading on the board and explanations were given in the Home Language.

Learners were given handouts (worksheets) with questions to answer. The work on the worksheet was first discussed and answered by the whole class with the help of their educator then afterwards the same worksheet was completed individually. The work was collected to be

marked later. The chalkboard was the only resource used for teaching and learning in that classroom. Handouts were only distributed for one lesson.

No practical work or demonstrations were used in the lessons. The educator didn't demonstrate knowledge of the subject as she was reading on the board word by word than translate to Home Language.

### **Summary of how Gugu used teaching strategies to implement the curriculum**

In all her lessons Gugu did not have an introduction that made learners think about the NS topic they were going to learn about. She always started her lessons by reading the notes on the board. Her response on the questionnaire was positive she said that she always recognize learners' prior knowledge before teaching new science content. When she was asked about her introductory approach she responded by saying "To introduce my lessons I wrote the notes on the board and used the teaching aids and the Natural Sciences textbooks." There is an inconsistency in what was said on the questionnaire with what was observed and said in the interview.

Gugu presented content in an organized way using mainly the expository method, rather than questioning when presenting her lessons. There was very little engagement of learners with questions. Learners were engaged more in reading than speaking. She explained the new concepts on the board in IsiZulu. She provided learners with adequate notes since all lessons were based on notes. She thought group work is essential for effective science learning. Responding to the question about the reasons of her choice of teaching strategy she said, "It is easy for the learners to understand the lesson".

Gugu used English but with more IsiZulu; for all her lessons she read in English and explained in IsiZulu. She did not attempt any practical work not even the demonstrations. Her response to the statement on the questionnaire where she was expected to indicate the process skills she used frequently in science activities that she presented in her class was, "Learners must be given the opportunity to say what they think. Question and answer method must be used. They must investigate". During the interview she said, "What? (Looking confused)" then I repeated the question and also gave some examples of the process skills she said "I give them activities". She used written and oral work to assess learners. No feedback was given to incorrect answers. She demonstrated knowledge that is adequate but not comprehensive.

Gugu was rated level 1 for lesson presentation. Level 2 for language usage, this level is for an educator using English with more of isiZulu. She was rated level 1 for resources, level 1 for assessment, level 1 for feedback to learners and level 2 for subject knowledge. These ratings will be presented again later in the section on the composite data presentation and the description of each level is clearly stated there.

#### **4.2.3 Case Study of S’bu**

##### **Description of the school as the research site.**

S’bu worked at Thulasizwe Senior Primary School which catered for grade R to seven learners and had one Grade 4 class with 28 learners. It was a new school (started in 1999), well fenced, and had electricity, potable and tank water. The classrooms were sufficient in number for the number of learners, well ventilated, neat and spacious. There was enough furniture for the learners as they were sitting two at a desk. Learners were sitting in 4 groups of six learners and one with four learners. The school was under-resourced with regards to science equipment, meaning it had no science kits, but having access to electricity a photocopier was available for making copies of worksheets for lessons.

##### **S’bu’s biography, experiences and preparedness for teaching NS**

S’bu was a male educator in his late thirties. He was qualified to teach in primary school, possessing a National Professional Diploma in Education and a Higher Diploma in Education, all achieved in a part-time frame of study. He is the only H.O.D in the school and he was supervising all phases. He had been teaching for 18 years, in the Intermediate Phase & the Senior Phase (Grade 4-6 and 7). He was also the only Natural Science educator in the school, teaching from Grades 4 -7. Having acquired science basics in his own schooling further took Natural Sciences as one of his modules during initial teacher training and was equipped with more science basics during this training. Even the methods he used were explored during the initial training. Science knowledge needed in teaching have been acquired through self-study. He was ambivalent about the value of the RNCS training and the support he received from Provincial Department but did feel that more training on Natural Sciences Learning Area was necessary.

## **S’bu’s perceptions of teaching Natural Science in Grade 4**

S’bu did not have difficulties teaching Natural Sciences and was comfortable teaching any of the topics. Matter and Materials was his favorite part of Natural Sciences and he felt comfortable answering grade four learners’ questions based on this part. He proclaimed himself knowledgeable and skilled to teach Natural Sciences effectively. S’bu strongly believed that all learners (Grade 4) can learn science and did not think that science might be too difficult for them. He was ambivalent about having a clear understanding of how Grade 4 learners learn Natural Sciences.

### **Description of S’bu’s lessons**

#### **S’bu’s first lesson: The properties of matter**

The topic was on “the properties of matter”. Educator introduced the lesson by asking the learners this question, “what is matter?” One learner responded, “Matter is everything around us.” The educator asked them to give examples of things around them that are matter and then gave examples, “Windows, wall, chair, tables.” He then asked for the states of matter. The questions were based on the work done the previous week.

The educator used English with a little IsiZulu to clarify science concepts. The educator led the lesson by questions, discussing and explaining the properties of each state of matter. Learners were given a handout to name the pictures. The educator used different containers to clarify the property of liquids. He used two containers that he found at the back of the class with different shapes to demonstrate that liquids take the shape of the container. Water, pictures and chalkboard were used as resources.

The educator demonstrated a clear understanding of concepts being taught. He integrated Maths and Science when he was asking different shapes of the solid and the size, for example, the length of a ruler.

Feedback to incorrect answers were not given at the same time when a learner gave incorrect answers, he simply pointed to other learners without giving feedback to the learner who gave the incorrect response. At the end of the lesson learners were given the chance to ask questions if there was anything they did not understand. One learner said he did not understand the properties of liquids. The educator explained again. He then asked questions at the end of the lesson to assess learners’ understanding of the concept taught.

#### **S’bu’s second lesson: Properties of Materials**

The topic of the day was “Properties of Materials.” The educator asked learners to remind him about what was learned the previous day. The learners responded by saying, “we learned about matter”. The educator asked questions based on the previous lessons.

On the previous day they were given handouts about materials for homework, to prepare for the following day. The educator told learners that there was something left behind during the previous lesson i.e. the types of matter. He told them that everything around us is divided into i.e. living and \_\_\_\_\_. Then learners completed the sentence by saying, “non-living”. This was linked with the knowledge gained when they were doing the content Life and Living. They listed the examples of non-living and living.

The educator explained the word, “Materials are things that we use to make other things.” He took two learners to the front and demonstrated that one learner is used to make the other learner and he asked what material was. They responded saying the first learner. He asked learners to give examples of materials and their products. Learners responded saying sugar cane is used to make sugar. Only one learner gave examples of the materials and he was given an incentive of R5 for doing his homework.

Learners were expected to complete the questions at the bottom of their handouts as homework and to bring it to school the following day. English was used with a little IsiZulu to clarify the concepts. Feedback was not given to the incorrect answers in the way that encouraged learners. One learner said, “We used a tree to make planks”. The response from the educator was “please rephrase your statement” he left him like that pointing at other learners and that learner said, “we use wool to make jerseys”. He did not comment on that. He wrote the word ‘wood’ on the board and asked the examples of things that are made out of wood. He should have elaborated on the learner’s point of tree and asked what do we get from trees?

Learners were given homework to complete at the bottom of the handouts and bring it the following day. Educator used the textbook only. And no practical work only a classroom demonstration was used to demonstrate the meaning of the word materials, he demonstrated using two learners. One was a material and other was matter. He said the first learner was the material used to make the second learner.

Learners were given handouts with pictures to look and identify the materials used at each case. It was an individual work. The educator demonstrated the understanding of the concepts taught.

### **Sbu's third lesson; Properties of Matter**

S'bu greeted learners and asked for the homework. Before checking the homework he asked the questions based on the previous work. Learners actively responded to the questions.

They marked the homework writing answers on the board. They exchange their exercise books, it was peer assessment. There was a confusing question which stated, "Write 3 things that are matter". All learners wrote examples of matter e.g. table, stone and desk but the educator expected them to give 3 phases of matter.

The educator wrote the sentence "the properties of matter." He asked learners if they ever heard something about properties and the response was, "no". He then explained what properties are. He explained them as characteristics, the words that describe something.

He explained volume as space occupied and mass as something that can be measured. He used the two litres bottle he found on the back of the class and used it to demonstrate volume. No practical work only demonstration. He was confident and demonstrated clear understanding of the concept taught when he was explaining volume.

### **Summary of how S'bu used teaching strategies to implement curriculum**

S'bu used questioning to introduce his lessons. Questioning was used to elicit learners' prior knowledge. He always started from what learners already knew to new concepts. There was consistency on what was written on the questionnaire, what was observed and the response from the interview. S'bu responded to the questionnaire by saying he always recognized learners' prior knowledge before teaching new science content. For three lessons observed, he provided a brief introduction and asked questions to introduce the topic. His response from interview was, "Ok... what I can say; if I'm introducing Matter and Materials, I use to ask few questions about what the learners already know about Matter. Like: what is matter? Do you know anything which is a material?"

S'bu presented content in an organized, correct and sequenced manner, based on a lesson plan. S'bu used an expository method, questioning and demonstrations when presenting his lessons. He engaged learners with questions. He explained the new concepts using pictures and demonstrations asking questions to check whether learners were still following. S'bu provided learners with handouts of what was taught. His response to the questionnaire was that he thought group work is essential for effective science. However during observations groups were just seated in that arrangement in his class. Responding to this question, "What do you

think are useful strategies to teach science?” He said “There are many useful strategies but I will give you few of them, questioning, discussion and group work”. To describe his teaching strategies used he said “Alright we normally theorize though we also use some other ways because we do not have laboratory or science kit. I normally ask questions and give learners work to do like to cut and paste and also drawing picture.

Responding to the question about the reasons of his choice, he said “I chose question and answer to develop thinking skills and do develop their cutting, pasting and drawing skills.

S’bu used English with little of IsiZulu, for his entire lessons. He claimed that he provide opportunities for learners to do practical work in science whereas he demonstrated to clarify new concepts learners were just observing what he was doing. His response to the statement where he was expected to indicate the process skills he used frequently in science activities he presented in his class, “Theory, practical and investigation”. During the interview he said “Hee (Breathing loud), as we don’t have anything but they gain few of the skills like drawing skills, pasting. That is few of the process skills I can give you now since our school is not well resourced”. He used written and oral work to assess learners. No feedback was given to incorrect answers. He demonstrated a clear understanding of the concepts. He was able to use knowledge and information to extend the knowledge of learners.

S’bu got higher scores than the other three educators in three sub-constructs. He was rated level 1 for lesson presentation as he presented content in a well-organized, correct and well-sequenced manner, based on a lesson plan. He provided learners with handouts and also engaged learners with questions. However, he did not ask questions that encouraged in- depth thinking. He was rated a level 3 for language usage, this level is for educator using English with little of IsiZulu. He was rated a level 3 for resources, level 1 for assessment, level 1 for feedback to learners and level 3 for subject knowledge. These ratings will be presented again later on the section with composite data presentation and the description of each level is clearly stated there.

#### **4.2.4. Case Study of Zodwa**

##### **Description of the school as the research site**

Zodwa was teaching at Nomafo Senior Primary School, which catered for Grade R to 7 learners. It was a new school (built in 2005), well fenced, and had electricity, potable and tank water. The classrooms were insufficient in number, there were four classrooms shared by eight

grades. Two grades were sharing one floor space but due to small enrolment it seemed as if they were in same grade. The classroom observed was the one shared by grade four and grade five class groups. There were nine learners in Grade 4 and 13 in Grade 5 making the total of 22 learners for both grades. There were three educators teaching in Intermediate and Senior Phase. The floor space forced them to specialize in certain Learning Areas and to multi-grade. The classroom was well ventilated and neat. There is enough furniture for the learners as they were sitting in twos at a desk. The desks were arranged in rows. The school was under-resourced with regards to science equipment, meaning it had no science kits, but having access to electricity make them also had access to a photocopier that assisted them in making copies of learning activities that were going to be completed during the course of the lesson.

### **Zodwa's biography, experiences and preparedness for teaching NS**

Zodwa is a female in her middle forties. She had 20 years teaching experience in the Intermediate & Senior Phases (Grade 4-7) National Professional Diploma in Education. She was teaching Grade 4-7, Natural Sciences, Mathematics and Technology. Grade 4 and 5 were in the same class so was Grade 6 and 7 because of the shortage of classes and the high learner enrolment. Zodwa did not do Natural Sciences as a module during her initial teacher training so no science basics were acquired by her during her training. She acquired science basics during her own years of schooling. She also agreed that in her initial teacher training she did not explore different methods of teaching science. Since she did not do science in her initial training the knowledge needed in teaching was acquired through self-study. The training from the department on how to implement RNCS did not equip her with knowledge needed to teach Natural Sciences, nothing was learned about process skills and how to use them. She felt that she did not receive sufficient support from the Provincial Education Department on the implementation of the Natural Sciences Learning Area and she needed more training in the Natural Sciences Learning Area.

### **Zodwa's perceptions of teaching Natural Sciences in Grade 4**

Although Zodwa had no formal training for the Natural Sciences Learning Area, she did not have any difficulties in teaching it. Matter and Materials is her favorite part of Natural Sciences. She was neutral about being comfortable in teaching any topic on Matter and Materials and if she could answer any Grade 4 learner's questions on Matter and Materials. She declared that she lacked the knowledge and skills to teach Natural Sciences effectively.

Zodwa did not believe in a principle that all learners (Grade 4) can learn science but at the same time she disagreed to the point that science may be too difficult for grade four learners. Zodwa did not respond to the statement about learners leading happy & useful lives without scientific skills. According to her, she did not have clear understanding of how grade four learners learn Natural Sciences.

## **Description of Zodwa's lessons**

### **Zodwa's First lesson**

As mentioned earlier, in Zodwa's class there were two different grades. She started with Grade four. Grade five learners were listening but not responding to the questions. The educator greeted learners and asked them to clean the board. The educator introduced the lesson by asking the learners about the Learning Programmes they did in Grade three. They listed them saying, "IsiZulu, English, Life Skills and Numeracy". She told them that Natural Sciences was learned under Life Skills. This was confusing because the data was collected during the second term of the year but the educator was introducing the Learning Area that should have been done at the beginning of the year. She then asked them, "What is matter?" One learner answered by saying, "matter is anything that occupies space and has mass." She rejected a correct definition of matter and simply pointed to the other learner who said, "Matter is everything around us". The educator praised that learner.

Learners were asked to list the phases of matter and the educator wrote them on the board. The learners gave example of each phase. The educator gave the example of car with petrol and as it moves the smoke goes out. She then asked them to, "Identify 3 phases of matter in this statement". Learners did not respond until she rephrased her question and said "what is the phase of the car." Learners answered, "Solid". The educator asked why they said that a car is a solid. They failed to answer that question. No feedback was given for that answer. She asked them about what helped a motor car to move. They shouted, "Petrol". She then asked the phase of matter of petrol. The learners responded, "A liquid". The smoke was left unclassified.

Learners were instructed to take their exercise books and write down the activity from the board. In the activity learners were given words to put under the columns: solid, liquid and gas.

English was used along with more Home Language to clarify the concepts used. The educator had some real objects, a bottle of water, beans and a box of chalk but all these were not used in the first lesson. No practical work was done.

The lesson seemed as if it had been previously taught, no new concept was introduced. The evidence for that was that the concrete objects were not used. Questions were for a revision exercise. Lot of the time was then spent on completing the activity.

### **Zodwa's second lesson: Properties of three phases of matter**

The lesson was about the properties of phases of matter. Zodwa asked for the homework given the day before. She checked the homework. Only one learner had written homework with all answers incorrect, he put juice under solids, stone under liquids. She then completed the activity written the day before which was still on the board.

Zodwa asked the learner the definition that was not acknowledged the previous day that said, "Matter occupies space and has mass". She said that she loved that definition. She wrote it on the board. The educator explained the definition matter occupies space. She demonstrated by using the glass of water and the duster. She explained that the water flowed out because the space left was occupied by the duster. She gave an example saying, "Even the learners were the matter that occupied space in their desks".

Educator asked, "Give me the example of matter that cannot change its shape easily". The learners responded saying, "ice". She then asked for the phase of the ice and the response that they gave was a liquid. The educator corrected them. She gave them the example of a desk and a tin. She explained saying that the desk and the tin could not change their shape. Liquids take the shape of the container; she gave the example that if you take water and put it on the square shaped container, it will take the shape of that container. Even gases take the shape of the container she used the gas used in the school kitchen as an example. The educator demonstrated matter occupying space using the mug in the class. No hands-on activity was given. English was used together with a lot of IsiZulu.

When assessing the learners the educator asked questions:

Educator: Can you tell me what you have learned today?

Learner 1: We learned about containers"

Educator: What is a container?

Learner 1: Container is water.

Learner 2: Matter has mass.

Educator: Can you prove that?

There was no response and no feedback, she just pointed at other learners. The learners ended up giving phases of matter instead of properties of matter.

The educator gave them the activity to match the properties of matter with the state of matter. The learners were completing the given work but the time was up. The next educator was waiting. They were expected to finish during their spare time.

### **Zodwa's third Lesson: Expansion and contraction of solids**

The lesson started with the educator marking the activity of matching the properties of matter with the states of matter. Most of the learners had not finished that work. The teacher then asked the questions based on the work done the previous day.

Zodwa wrote the topic on the board "Expansion and contraction in solids" she asked learners to read the topic. She explained the meaning of expansion and contraction to them by giving examples of the state of electric lines and corrugated iron during very hot days.

No resources were used for this lesson and the educator used the book to write notes. No assessment activity was given. The lesson was the shortest of all the lessons observed for Zodwa. The reason for this was that she wanted them to copy notes from the board, according to her they were very slow they needed more time.

### **Summary of how Zodwa used teaching strategies to implement the curriculum**

Zodwa used questioning to elicit learners' prior knowledge as a way of introducing her lessons. She started from what learners already knew to new concepts. There was consistency with what was written in the questionnaire, what was observed and the response from the interview. She responded in the questionnaire by saying she always recognized the learners' prior knowledge before teaching the new science content. For three lessons observed, she provided a brief introduction and asked questions to introduce the topic. Her response from the interview was "I used whole class method, question and answer method asking previous knowledge about what they know about matter".

Zodwa presented content in an organized, correct and sequenced manner, based on a lesson plan. Zodwa used the expository method, questioning and demonstrations when presenting her lessons. She engaged learners with questions. In her second lesson she explained the new concept using demonstrations and asking questions to check whether learners still followed. Zodwa provided learners with adequate notes. Her response in the questionnaire was that she thought group work is essential for effective science. Responding to this question: What do you think are useful strategies to teach science? She said, "I think useful strategies are group work and individual work to check them on what they have learned". To describe her teaching strategies used she said, "As I used the whole class, as you can remember we had real object when explaining what is meant by matter and again when we were talking about properties."

Responding to the question about the reasons of her choice of teaching strategies, she said, "As the subject is Natural Sciences they have this in mind...we do not have real object but they can imagine as they come across with things taught in real life. Question and answer used to check their understanding." Zodwa used concrete objects during her first two lessons.

Zodwa used English with more IsiZulu, for all her lessons. She demonstrated to clarify new concepts but there was no hands-on work done by learners as she had mentioned in her questionnaire that she provides opportunities for learners to do practical work in science. She indicated only one process skill in her questionnaire the one of investigating "Investigation: learners are given the opportunity to investigate about the concept and they come back we discuss in class". During the interview she was asked to mention the process skills that she thought her learners should have acquired, and she responded, "The process skills that they have acquired are thinking, identifying and separate kinds of matter". Written and oral work was used to assess learners. No feedback was given to incorrect answers. She demonstrated knowledge that is adequate but not comprehensive.

Zodwa was rated a level 1 for presentation in all her 3 lessons, a level 2 for language usage, this level is for educator using English with more IsiZulu, level 2 for resources in the first and third lesson and 3 for the second one where she demonstrated. She was rated level 1 for practical work, level 1 for assessment, level 1 for feedback to learners and level 2 for subject knowledge. These ratings will be presented again later on the section with composite data presentation and the description of each level is clearly stated there.

### **4.3 Composite Data Presentation**

In this section data from the cases discussed above are integrated and presented.

#### **4.3.1. Biographies of the Educators**

The participants of the study were a group of qualified and experienced educators which therefore establishes the quality of their opinion and practices. All of the educators have professional qualifications and they have achieved all their qualification in a part-time frame of study. This means that none of them entered the profession with matric only.

Three of the four participants were female and one was a male. All the participants are above 35 years of age and had been in the profession for a long time, ranging from 18-20 years. With regard to the phases that the educators taught in and the subjects that they taught: Anele taught only Mathematics and Natural Sciences in all three grade four classes. She had been teaching Natural Sciences for 18 years in Grade 4. Gugu was teaching Natural Sciences, IsiZulu and Life Orientation in two grade four classes. She had been teaching Natural Sciences for 3 years in Grade 4. S'bu was the only Head of Department (HOD) in the school and specializing with Natural Sciences in all Grades, 4-7. S'bu had been teaching Natural Sciences since he started teaching, 18 years ago, to grade six and seven learners and in the last two years he has been teaching Grade 4. Zodwa was teaching Mathematics and Natural Sciences in all Grades, 4-7. She has been teaching Natural Sciences for six consecutive years in Grade 4 but before that she was teaching only grade six and seven learners.

#### **4.3.2. Initial Teacher Training and In-Service Training**

Initial teaching training and in-service training were included to explore the training they received. This point is very important because the quality of teacher education is a significant factor in the quality of education that will be provided to learners in Natural Sciences (Department of Education, 2002). The educators were also required to indicate whether the RNCS workshops helped them in implementing the curriculum and whether the support they got from the Department of Education was sufficient. For the purpose of this study: initial teaching development means the training obtained before starting or during teaching for professional qualifications, it can be a three or four year programme. S'bu and Gugu indicated that they did Natural Sciences as a module during their pre-service training and they had learnt the science basics (important science concepts that one must know as foundation of science). Gugu, S'bu and Zodwa indicated that they had acquired much of their science knowledge

through self-study. For the purpose of this study: self –study means to read for your own development. This was not done as part of a formal study programme, rather as part of informal reading that was done when required due to teaching requirements. In spite of Departmental training, three respondents Anele, S’bu, and Zodwa felt that they needed more training on teaching strategies that they could use in Natural Sciences Learning Area. They were also not satisfied about the training they received on how to implement the RCNS and said that the training did not equip them with knowledge and skills needed to teach NS.

#### **4.4. Curriculum Implementation**

Data generated from three sources i.e. questionnaires, observation schedules and interviews have been analyzed and integrated in this section. I used Rogan and Grayson’s theory of Curriculum of Implementation to analyze the data, as the study is about the Profile of Implementation and the Capacity to Innovate focusing on the teaching strategies used by the educators.

The Profile of Implementation is a construct to help to understand, analyze, and express the extent to which the ideas of a curriculum are being put into practice. This section on Curriculum Implementation is about sub-constructs: classroom interactions, followed by practical work then assessment. For the components that were included in the classroom observation I also used graphs to present that data so as to add evidence to what is presented in the table. However the following section 4.4.1 is on Educators’ perceptions of teaching Natural Science in Grade 4 does not have a graph because it contained information mainly from the questionnaire.

##### **4.4.1. Educators’ Experiences of Teaching Natural Sciences in Grade Four**

For this section of work I looked at the educators’ perceptions about teaching NS and the confidence they have towards teaching Natural Sciences.

Gugu, S’bu and Zodwa indicated that they do not have difficulties in teaching Natural Sciences and they feel comfortable in teaching it. On the other hand Anele indicated that she had difficulties in teaching Natural Sciences but at the same time in the next statement she responded by saying she felt comfortable when teaching the topics in Natural Sciences. You could see that there is contradiction in her responses. Anele, Gugu, S’bu and Zodwa indicated that Matter and Materials is their favorite part of Natural Sciences and are comfortable in

teaching and answering any question posed by grade four learners on Matter and Materials. Zodwa indicated that she lacked knowledge and skills to teach Natural Sciences effectively but she had stated that she no difficulties in teaching NS. Anele, Gugu, and S’bu believe that all grade four learners can learn Natural Sciences but do not believe that they are natural scientists nor that science is too difficult for learners.

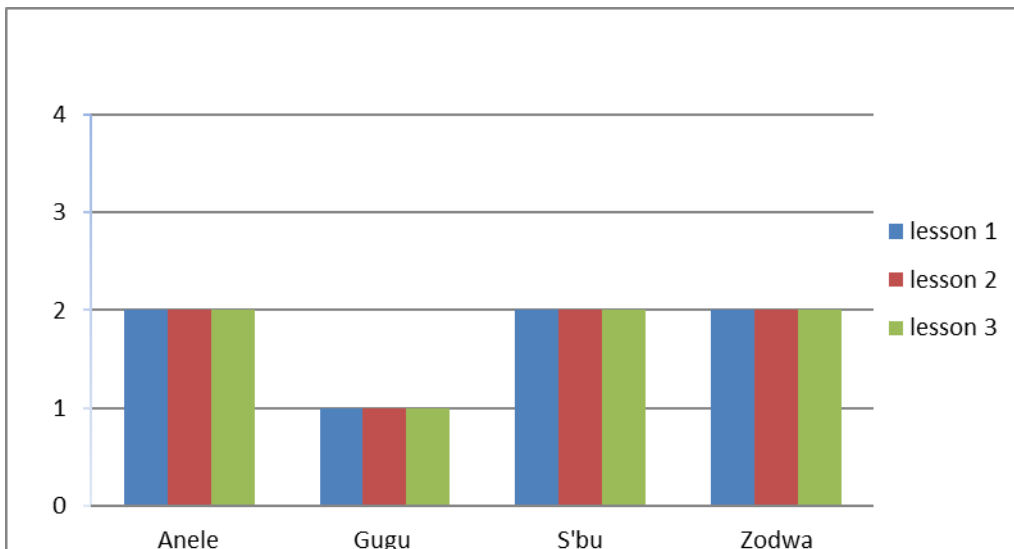
#### **4.4.2. Teaching and Learning Strategies**

This section focuses on the strategies used by educators to introduce, and present lessons, their use of language, and the resources they used to present their lessons.

##### **4.4.2.1 Educators’ Introductory Strategies.**

An introduction is an essential part of any lesson, so it is recognized as a distinct aspect of classroom interactions. Educators need to present an introduction in a well-organized way based on well-organized lesson plans (Killen, 2007). Three of the educators (Anele, S’bu and Zodwa) wrote the topic of the lesson on the board and then used closed-ended questions to investigate the learners’ prior knowledge. No teaching aids or readings were used to stimulate learners’ interest in any of the lessons. Gugu did not use a formal introduction but she read the notes out and then the learners read them out afterwards.

Level two is concerned with the fact that the educator has no introduction that could be used to make the learner think about the Natural Sciences topic. Level two is concerned with the provision of a brief introduction and asks questions to introduce the Natural Sciences topic. For Level three educators are expected to start their lessons by asking questions and linking them the topic and to the learners’ existing knowledge. For Level two educators should use stimulus which can be a teaching aid or the story to introduce a topic and then to link it to the work done before. Figure 4.1.shows ratings of the introductory strategies used by the four educators in each of the three lessons observed.



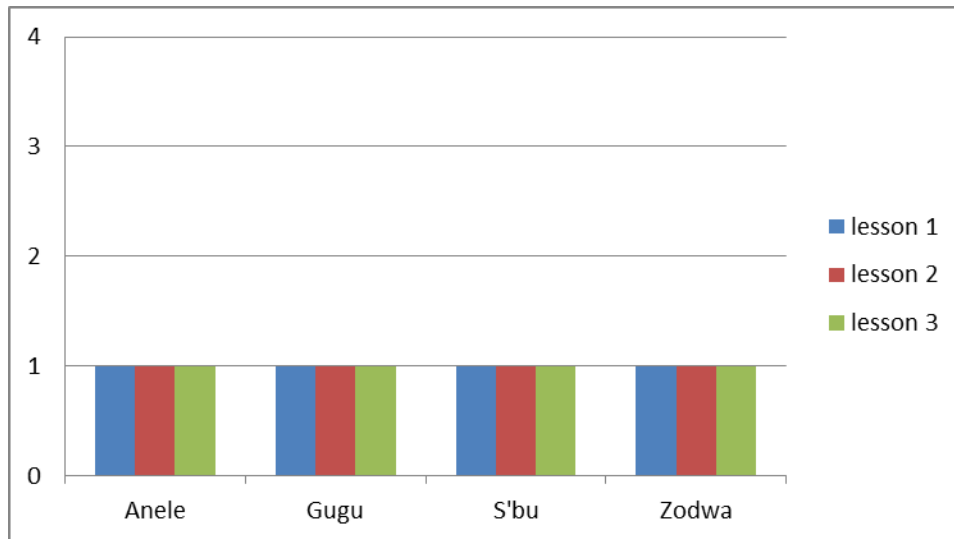
**Figure 4. 1 Indicator level for the Lesson introduction for four educators over three lessons**

From what was observed there was an indication that none of the educators used an introduction to stimulate learners’ thought about the science topic presented to grade four learners. For all of their three lessons, Anele, S’bu and Zodwa were rated at Level two. Gugu was rated Level one for all her lessons, since she did not have an introduction. Although the educators asked questions to introduce their lessons, none of them asked higher order thinking questions related to the science topic. When they were asked about strategies that they have used to introduce their lessons they also mentioned the same strategy as that in the questionnaire, this meant that there was a correlation between what was said with what was observed. The most frequent responses to this question were that they used the question and answer methods to check what the learners already knew. Anele even added “to draw learners’ attention”. Gugu said, “To introduce my lesson I wrote notes on the board to read and explain to them, used teaching aid and text books”. This response suggests that her understanding of the introductory phase of a lesson is limited.

#### **4.4.2.2. Lesson Presentation**

The responses to the questionnaire showed that all the educators agreed that they used different strategies but this was not what was observed. All the educators used an educator-centered approach to teaching and learning. They were standing in front, telling learners about scientific facts. In three of the classes (Gugu’s, Anele’s and S’bu’s) learners were sitting in groups. In one of the classes (Anele’s) learners were given work to complete in groups

whereas in the other classes the groups were just in a group seating arrangement. From what was observed, the conclusion can be that the level of discussion was too low as teaching was based on educators lecturing and learners listening to the educators. Learners only responded to the questions posed by their educators. There was no evidence of the educators facilitating discussions and learner participation in cumulative discussion where discussion is increased from one level to the other.



**Figure 4. 2 Indicator level for the Lesson presentation for four educators over three lessons**

All educators (Anele, Gugu, S'bu and Zodwa) were rated Level one for this component. They presented content in a well-organized, correct and well-sequenced manner, based on a lesson plan. They provided learners with adequate notes and also engaged learners with questions. However, none of the educators have asked questions that encouraged in-depth thinking.

The second and the third question of the interview focused on the useful teaching strategies and methods to teach science, this was linked to the component, lesson presentation. Three of the participant, Anele, S'bu and Zodwa responded by saying there are many teaching strategies but would give some which included questioning, discussions, group-work and Anele added that of the chalkboard summary, as one of the strategies. Gugu repeated the response she gave for the first question that she used chalkboard and talk which is expository

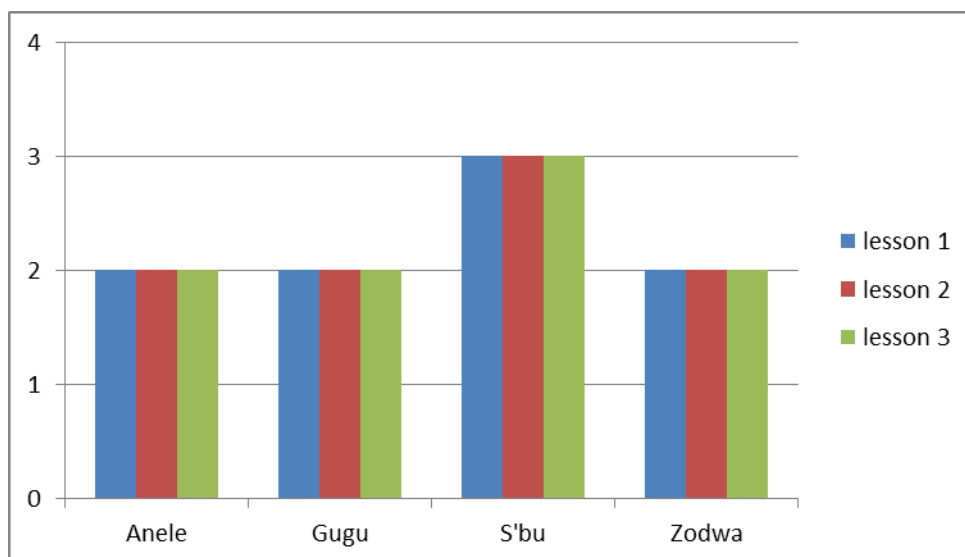
teaching. From what was observed, group work was only used for assessment purposes by Anele. Three of the educators, Anele, S'bu and Zodwa responded by saying question and answer strategy was used to check what learners know and to develop thinking skills, and discussion was used to give every learner a chance to speak. Gugu responded by saying "I used the chalkboard to write notes and explain them".

In the fourth question of the interview, they were asked to explain why they had chosen these strategies. Their responses were: Anele "I chose question and answer to develop thinking skills and to motivate learner- centered in the lesson". S'bu "I chose question and answer to develop thinking skills and do develop their cutting, pasting and drawing skills" Zodwa "It was because as the subject is Natural Sciences they have this in mind even though we do not have real object but they can imagine as they come across with things taught in real life."

Gugu had a different response "it is easy for them to understand the notes when they read notes from the board"

#### **4.5. The Language of Instruction**

In addition to the to the level descriptions given by Rogan and Grayson, this sub-construct was included because using language in teaching is also part of classroom interaction and could be regarded as a strategy of teaching. In all schools in the UMgungundlovu District, the official Language of Learning and Teaching (LOLT) from Grades 4 to 12 is English, and it is not the Home Language of the learners in the area of the study, their home language is isiZulu. The language in science differs completely from everyday spoken language and generally English language was more of a problem at this age. In that way educators introduced new concepts using some of isiZulu words (code-switching). In all classes, the language of instruction is English but in the three of the classes (Gugu, Anele and Zodwa) that were observed, code switching was used with more of Home language (IsiZulu) to clarify concepts, meaning that isiZulu was used primarily for teaching despite the notion that English is officially the LOLT in the school.



**Figure 4. 3 Indicator level for the Language of instruction for four educators across three lessons.**

The educators' use of the LOLT was rated according to levels 1-4, which were also used to rate the educators. The key for the rating levels is presented in Chapter 2, table 2.3. None of the educators used simple English as the medium of instruction to demonstrate and dramatise or clarify concepts (Level 4=0). One educator, S'bu used English with little Home language (Level 3 =1) for his three lessons. The rest, Anele, Gugu and Zodwa used English with more Home language (level 2=3) for their 3 lessons. Gugu read the English notes on the board and then explained them in isiZulu.

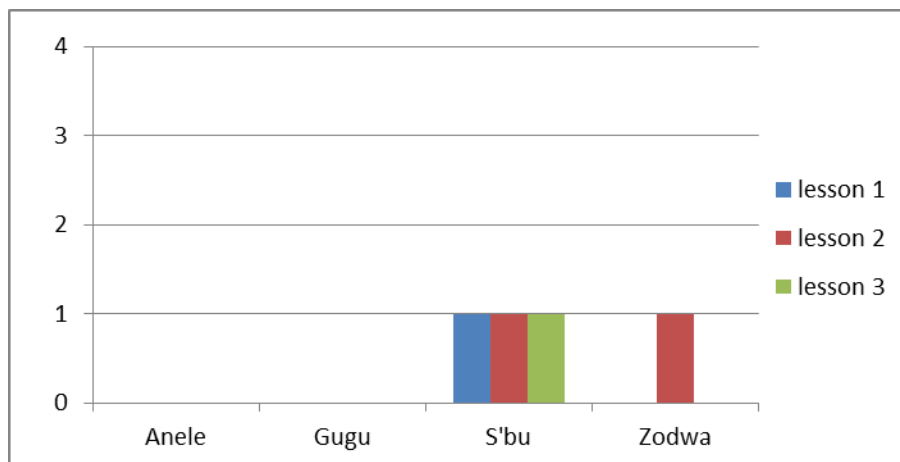
#### **4.6. Profile of Implementation: Science Practical Work**

This section presents the data about science practical work collected from questionnaires, classroom observation and interviews.

All the respondents said in their answers that they all provide learners with opportunities to work with concrete materials and learn by hands on experiences. However there was little evidence of this in the lessons observed. Only two educators attempted one kind of practical work at level one of Rogan and Grayson's model.

The questionnaire and interview questions both required the educators to write/list the process skills that are most frequently used in science activities that they presented in their classes. The major finding was an inadequate understanding of the term process skills, with common

references to hands-on experiments and investigations. Inadequate responses were indicated when to the questions about the process skills; Anele said in the questionnaire “Group-work, letting learners participate in hands-on activities and scientific experiments”. Responding to the interview question she said “They have acquired thinking skills and drawing skills”; S’bu’s responses “theory, practical and investigation.” “ Hee (breathing out) as we don’t have anything but they gained few of process skills like; drawing skills, pasting skills, that is the few I can give you now since our school is not well resourced. Gugu mentioned in the questionnaire that “learners must be given opportunity to say what they think and question and answer method must be used. Learners must investigate.” During the interviews when the question was asked she said “what?” (Looking confused) I repeated the questions and also gave examples of process skills. Then Gugu commented “I gave them activities” she illustrated the feeling. Zodwa mentioned the investigations in the questionnaire but in the interviews she said “the process skills that they have acquired are thinking skills identifying and separate kind of matter.”



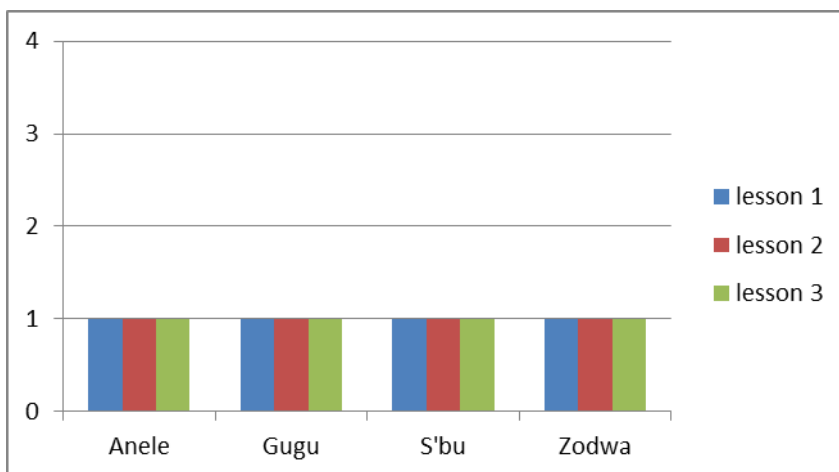
**Figure 4. 4 Indicator levels for Science practical work for four educators over three classroom observations**

Educators were rated using Rogan and Grayson’s (2003) level indicators for science practical work as illustrated in Figure 4.4. S’bu achieved a level one for all his lessons as he conducted demonstrations in all his lessons. According to Rogan and Grayson’s descriptions of level one science practical work; teacher (educator) uses classroom demonstrations to help develop concepts. Zodwa demonstrated once, in her second lesson. Anele and Gugu did not attempt any practical work during their lessons.

#### 4.7. Profile of Implementation: Assessment

This sub-construct is about different assessment strategies used by educators in their classes. Educators were asked to indicate whether they use different assessment strategies to assess learners' performance in science, all of them agreed. From what was observed during three lessons for each educator was different none of the educator used a variety of assessment strategies. However it was noted that not every lesson necessarily involves different assessment strategies. During observation I noted that educator used diagnostic assessment at the beginning of the lesson to check learners understanding and formative during the course of the lesson to check whether they were following. Educators used only the written assessment activities at the end of each lesson to complete individually in their exercise books. Gugu used groups of six learners, she gave them work to fill in correct answers on the charts.

For the sixth question educators were asked about the assessment used in the three lessons. Educators assessed learners orally and by writing activities based on the lesson taught. S'bu said that he assessed the drawing skills, pasting skills, investigations skills observation skills and they also write in their exercise book. Zodwa's response was "I gave learners activities and assess their understanding and matching. I also give them assignment and project. The problem is that they do not return them in time some return them after due date."



**Figure 4. 5 Indicator levels for Learner assessments for four educators over three classroom observations**

All educators were rated Level one this was because they used written work cover the topic adequately with most of the questions are of the recall type. To conclude on assessment strategies observed, educators used only written tests that cover the topic adequately. While most questions are of the recall type, no questions required some higher order thinking.

#### **4.7.1. Feedback to Learners**

During classroom observation educator's feedback practices were analyzed to examine the extent to which discussion and interaction affected learners' conceptual and emotional development in the classroom. According to Mortimer & Scott (2003), it is essential to create a positive learning environment in which learners are free to say whatever they think about the topic, when using a combination of teaching strategies approach. This will boost learners' self-esteem knowing that their thoughts are acknowledged and valued. All educators observed asked simple recall and closed questions in their lessons. Their responses to incorrect contributions were negative. They simple point to another learner not correcting the first one. Below are examples of what was observed:

Anele

*Anele: give me things that dissolve in water.*

*Learner 1: sugar*

*Anele: sugar (saying it loudly as she was writing on the board)*

*Learner 2: salt*

*Anele: salt (saying it loudly as she was writing on the board)*

*Learner 3: soil*

*Anele: soil? (Looking amazed and confused and did not write that response on the board)*

*The whole class laughed and they debated in their Home language, others agreeing and others denying the response. She did not comment about their laughter and simply said after few seconds,*

*Anele: Musani ukuphikisana asiqhubekeni (stop arguing lets carry on)*

*Learner 4: juice*

*Anele :( no response, she carried on with her lesson)*

*S'bu*

*S'bu: give me the examples of materials and their products.*

*Learner 1: sugarcane is used to make sugar.*

*S'bu: Good*

*Learner 2: we use tree to make planks.*

*S'bu: please rephrase your statement. (Not giving him time to do so but pointing to the next learner.)*

*Learner 3: We use wool to make jersey*

*S'bu :( no comment but wrote on the board the word 'wood' not 'wool' mentioned, and he said). Give me examples of things that are made of wood.*

*Zodwa*

*Zodwa: "can you tell me what you have learned today?"*

*Learner 1: we learned about containers"*

*Zodwa: what is a container? (Surprised)*

*Learner 1: container is water.*

*Zodwa: (no response, pointing at the next learner)*

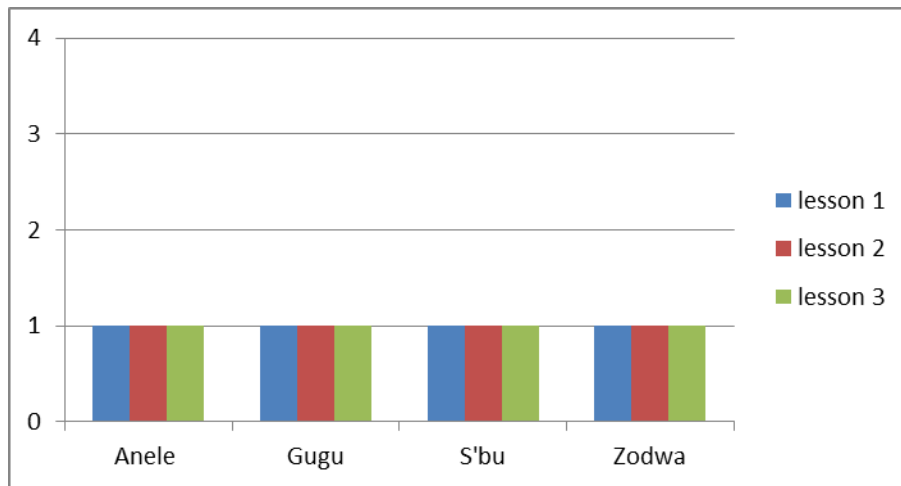
*Learner 2: matter has mass.*

*Zodwa: can you prove that?*

*Learner 2: (no response)*

Zodwa: (ended up pointing to other learners that gave her phases of matter. Instead of telling them what is a container and also prove that matter has mass)

From the above given examples I have analyzed no feedback has been provided.



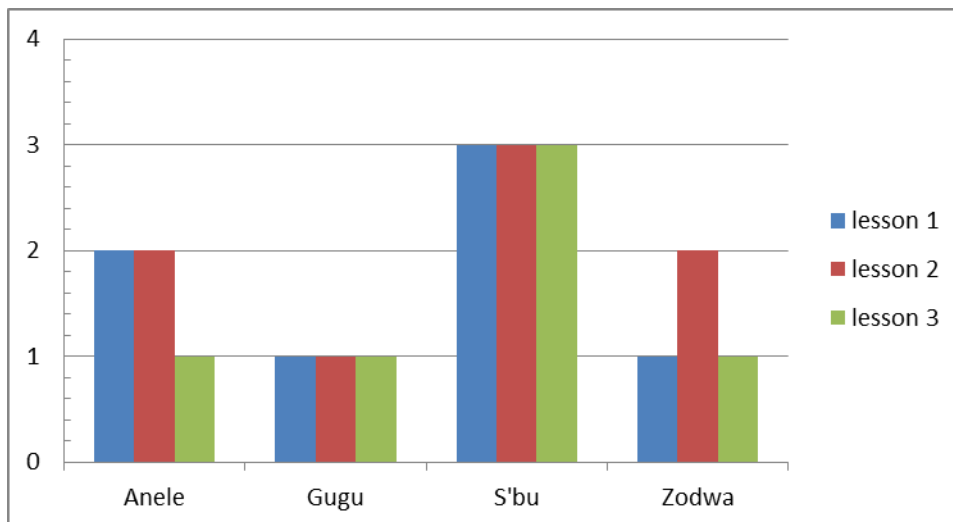
**Figure 4. 6 Indicator levels for Feedback to learners for four educators over 3 classroom observations**

The educators were rated Level one, as indicated in Figure 4.6. The educators’ facial expression, an action of keeping quiet and pointing to another learner without discussing the response of the first learner at the end, can either imply that the answer was incorrect or the other way around. Feedback means that some indication is given to learners about the appropriateness of their answer. In the case of S’bu where a learner’s response was, “*We use tree to make planks*”, the learner’s answer was correct but the point that his answer was not what the educator had in his mind nor what his expectations of the answer were, he was asked to rephrase the answer. I think the educator should have probed, maybe asking what we call the tree if it has been cut down. With three educators Anele, S’bu and Zodwa, incorrect answers were not discussed by the class; instead, they were just left hanging, meaning that learners were not made clear of why the answer was unacceptable.

## **4.8. Capacity to Innovate: Physical Resources**

### **4.8.1 Resources**

The educator participants were teaching learners who were within the “concrete operations stage”, as they were in Grade Four and the average age of grade four learners is 9 years .The “concrete operations stage” ranges from 7-12 years.



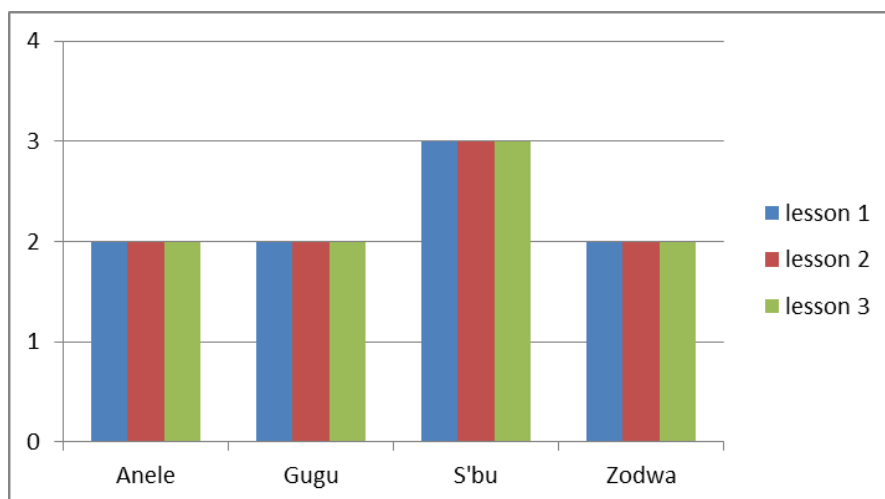
**Figure 4. 7 Indicator levels for Resources used for four educators over three classroom observations**

Anele used the charts with pictures (posters) in her to two lessons to clarify the concepts. Gugu was rated Level one because she used only the textbook and chalkboard. S’bu used real object to demonstrate concepts. Zodwa was rated Level one, for her first and last lesson and had pictures for the second lesson.

#### **4.8.2 Capacity to Innovate: Teacher Factor**

##### **4.8.2.1. Educator’s Knowledge of the Learning Area**

The component was about the educator subject knowledge. It was taken from Integrated Quality Management System (IQMS) instrument (Department of Education, 2003). Performance Standard 2, criterion (a) the expectation of this Performance Standard is possession of appropriate content knowledge which is demonstrated in the creation of meaningful learning experience and is also concerned with whether this knowledge is used effectively. Educators’ understanding of subject knowledge was observed and rated because it is very important as it can influence their choice of teaching strategies.



**Figure 4. 8 Indicator levels for Educator’s knowledge of Matter and Materials for four educators over three lessons.**

Using the key of levels for subject knowledge given in chapter 2, Anele managed to get Level two for all her lessons. Gugu was rated Level two for all her lessons. This was directly related to the idea that she was only comfortable discussing the ‘notes’ and doesn’t deviate from them, she was just explaining what was on the board no extra examples were given to the learners. S’bu was able to use knowledge and information to extend the knowledge of learners he got Level three over the three lessons. Zodwa got Level two as her knowledge was adequate but not comprehensive. She was given Level two because she ignored correct responses given by learners and appeared unable to use these responses to develop the topic further. For example the definition of matter given by the learner during the first lesson, the learner said “matter is anything that occupies space and has mass” she pointed at another who said “matter is everything around us”. Zodwa praised the learner who gave the second response and did not comment about it until the following day, she asked the same learner to remind her, the definition of matter he had given the previous day.

#### **4.9. Factors Inhibiting Teaching**

Towards the end of the questionnaires educators were requested to indicate the contextual factors that have inhibited their teaching. All educators proclaimed that they did not have a shortage of curriculum statements and access of them however the Natural Science resources were insufficient. The numbers of learners in the classes were not large. Zodwa was the only educator teaching more than one grade at the same time (multi-grading).

#### **4.10. Educators' Views about the Ways They Think Teaching Science Can Be Improved In Their Schools**

This component was included in the questionnaire so that the educators could suggest the ways they think Natural Sciences teaching could be improved in their own schools. There was space provided for them to write down their thoughts or suggestions. Educators responded like this: Anele, "By providing efficient support like an in-service training.by buying more scientific equipment." Gugu stated, "Using different resources and relevant teaching aids can improve science teaching". Sbu stated, "Laboratory is a need at least a science kit". Zodwa stated, "Science laboratories must be built in our schools and libraries so that pupils can get information in different books". From their responses I conclude that all the educators think that they needed to improve science teaching. In working with the observations of the lesson, Anele, in two lessons had charts with pictures of what was taught. To teach the concepts evaporation and condensation, Anele had chart with a picture of a boiling kettle instead of doing it practically. Zodwa brought some real objects but these were not used for the first lesson only two were used for the next lesson, the duster and the cup of water. S'bu did not have resources planned before the lesson but as he carried on explaining concepts he looked around the class to find something to demonstrate with. This tells me that he does not prepare beforehand, but is able to relate concepts to everyday experiences. For example when he was explaining the properties of a liquid, that they take the shape of the container, he looked around and found the squared container at the back of the class and asked learners whether there was water in the class. For the last question of the interview educators were expected to say anything that they think it was not covered in the interviews that they want to share, it could have be a thought, reflections or the feelings. Anele and Gugu said they had nothing to share. S'bu was concerned about the language barrier that their learners had. He said:

"I'm little bit worried about the barrier of language since grade four learners come from the Foundation phase where teaching and learning was done in IsiZulu but now in Grade Four they learn about English, that is too much for them and challenging for us as educators".

Zodwa asked for advice and also asked whether the research would assist them in one way or another. This was her response "May I ask you if there were strategies that you think I should have used? And is there any help that we can get from this research?"

#### **4.11. Document: Lesson Plans**

All of the educators had a weekly lesson plan. This means that their planning was for three hours, as Natural Sciences is allocated three hours in a week. As the educators were working in schools in the same cluster, they were using the same lesson plan template (see Appendix E). Learning outcomes and Assessment Standards to be covered were clearly indicated. Lesson plans were just the summary of learning activities to be done for the week there was no clear indication on how the educator would conduct the lessons. Assessment strategies were included but not helpful, not sufficient, even the reflections were not included. This calls for the review of the template they were using.

#### **4.12. Concluding Remarks**

This chapter has presented findings about how four grade four educators teach the topics in the theme Matter and Materials. The qualitative data gathered from instruments such as questionnaires, classroom observations, semi-structured interviews and document analysis are presented in an effort to get a bigger picture of what actually takes place when educators are teaching topics on Matter and Materials. The data was analyzed according to Rogan and Grayson's theory of Curriculum Implementation. Two constructs of this theory were addressed: Profile of Implementation and the Capacity to Support Innovation were used to frame the study and allowing the researcher to understand the relationship between the teaching strategies used by educators and the expectations of the RNCS. The discussion on findings, recommendations and conclusion will be done in the next chapter in relation to the literature.

# **CHAPTER 5**

## **DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS**

### **INTRODUCTION**

This study explored how grade four educators taught Matter and Materials in Natural Sciences of the NCS with reference to particular aspects as stated in the research questions below. This chapter presents a discussion of the findings of the study in terms of research questions which are:

- What are educators' experiences of teaching grade four Matter and Materials in Natural Sciences?
- How do grade four educators use these strategies to teach Matter and Materials in Natural Sciences?

It is vital that in the discussion the findings are justified, sustained and/or opposed if required, by connecting main findings with the subordinate findings (literature review). The conclusions, researcher reflections, the recommendations and future research are also presented. The next section presents the discussion on each research question.

### **5.1. Discussion for Research Question one and two**

This section presents the discussion of the findings about the educators' experiences of teaching grade four 4 Matter and Materials, includes various aspects namely: their qualifications, teaching experiences, perception of their practices and their teaching contexts.

#### **5.1.1 Educators' Experiences of Teaching Grade Four Matter and Materials in the Natural Sciences**

##### **5.1.1.1 Teacher Qualifications and Understanding of the Content**

All the educators were qualified to teach at the primary level and they had achieved their qualifications in a part-time mode of study. They are classified as Level three according to Rogan and Grayson's (2003) model. Level three calls for educators who are qualified and have a sound understanding of the subject matter to be taught. However, these educators demonstrated an unsound understanding of the subject matter. Rogan and Grayson's model

therefore could be adapted to include the levels with a positive and a negative sign. Where the educators have met the full criteria for the level, it should be recorded as for example, level 1<sup>+</sup> (plus) and where it is not fully achieved it should be recorded as for example, level 1<sup>-</sup> (minus).

The educators have been teaching for  $\pm$  20 years. S'bu and Zodwa have been teaching in the Intermediate Phase and Senior Phase for all their teaching years, teaching Natural Sciences and Mathematics. Anele has spent her teaching years in Grade four, teaching Natural Sciences and Mathematics whereas Gugu has spent 17 years of her 20 years teaching, teaching Grade three in the Foundation Phase and it was her third year teaching Grade four. For all the educators they started their teaching careers without any professional development qualification, i.e. they started without the Pedagogic Knowledge Content that is required for teachers to be regarded as competent or qualified to teach in schools. According to Grossman cited in Appleton (2003, p. 3) there are four central components to Pedagogical Content Knowledge: knowledge and beliefs about purpose, knowledge of educators' conceptions, curricular knowledge and knowledge of instructional strategies. In this research, clearly the educators were lacking in these aspects and even though they had been teaching for a number of years, the time spent "practicing" Natural Science did not constructively engage them with the pedagogical development for an understanding of what is required of a Natural Sciences' educator. On focusing on Bucat's (2004a, p. 217) definition of PCK as "knowledge about the teaching and learning of a particular subject matter that takes into account the particular learning demands inherent in the subject matter", these educators exhibited this at a low level. More specifically, Magnusson et al., (1999) saw science PCK as including an educators' orientation to teaching science, knowledge of science curricular, knowledge of assessment, knowledge of scientific literacy, knowledge of student understanding of science and knowledge of instructional strategies. These are minimally accommodated for by these teachers, in this context.

According to Appleton (2003) PCK and PCK development for primary school teachers differ from that of secondary school teachers. In primary schools, educator work from science PCK, using activity-based science with the specific topic PCK but rarely having the opportunity to develop science discipline PCK because of a poor development in the science discipline specialization. My finding is in line with that for James et al, (2008) who stated that some educators are struggling to teach the content because they did not cover these topics when they were learners themselves, and when they were completing their professional development.

This was supported by S'bu who raised the issue of him lacking the proper foundation in terms of the teaching methods that could be used when teaching Natural Sciences, since he had achieved his qualification part-time.

#### **5.1.1.2. Educators' Perceptions of Teaching Grade Four Matter and Materials in Natural Sciences**

Educators had positive responses with regards to their experiences of teaching Grade 4 Matter and Materials in Natural Sciences but there were inconsistencies with regard to what was said in response to the questionnaire and interview, and what was observed. According to Cohen, Manion and Morrison (2011) "the distinctive feature of observation as a research process is that it offers an investigator the opportunity to gather live data from natural occurring social situations" (p. 456). In this way the researcher can look directly at what is taking place in the situation rather than relying on second-hand accounts. Although the educators' responses were positive about their perception of teaching grade four Natural Sciences, there were contradictions to the positive perceptions portrayed by them. These included the educators' choice of content to be taught and their understanding of the term process skills. So, the educators may have a partial understanding of how Natural Science should be taught but lacked a highly, skilled and effective pedagogical approach or practice.

#### **5.1.1.3. Educators: Choosing the Content to Teach**

As discussed in Chapter 1, there are four content areas prescribed in Natural Science, these are: Life and Living, Energy and Change, Planet Earth and Beyond, and Matter and Materials. Grade four learners are expected to receive science education covering the broad range of science knowledge and concepts from all four knowledge strands. Grade four educators need to provide learners with opportunities from all four content areas to ensure sufficient breadth in all three Learning outcomes. Educators themselves should possess sufficient background knowledge that is required to teach the range of content areas.

From what I observed, educators did not cover all four content areas in the year, the evidence of this was that two of the educators observed (Anele and Gugu) have been teaching NS for many years but when they were asked to prepare lessons on Matter and Materials, they prepared lessons on Life and Living. For the first day of observation in two classes I observed lessons which were not on Matter and Materials. I had a post-lesson discussion with both educators and what was revealed was that they do not teach Matter and Materials at all. I

asked for policy document and we looked at it and I showed them (Anele and Gugu) the content area in Chapter 5 of the NSLA document and we looked at the books they used checking for work and activities that were on Matter and Materials. After this intervention the two educators prepared lessons on Matter and Materials but the level of these lessons in terms of content depth and learners' construction of appropriate knowledge was poor. The literature in this field notes that educators lacking in content knowledge and confidence often attempt to minimize their difficulties by avoiding teaching particular science topics (Hopkins, 1993) and this research provided evidence in support of this statement.

#### **5.1.1.4 Understanding and Use of Process Skills in Teaching Science**

The purpose of the Natural Sciences Learning Area is to deal with the promotion of scientific literacy, by the development and use of science process skills in a variety of settings (Department of Education, 2002). The process skills refers to the learner's cognitive activity of creating and structure from new information and experiences (Department of Education, 2002). Examples of process skills include observing, making measurements, classifying data, making inferences and formulating questions for investigation. The literature in this field suggests that great emphasis should be placed on teaching the process scientific skills. Learning Outcome 1 of Natural Sciences, which is scientific investigation that includes "doing" science can only be achieved when learners are provided with sufficient opportunity to engage in scientific investigative processes (Department of Education, 2002). The role of the grade four educator is very critical to effective learner engagement, curiosity arousal and knowledge development as learners are experiencing this learning area for the first time as a particular subject on its own.

Educators themselves should have a clear understanding of what appropriate process skills involve, and they should know how to apply them in practice. If they had the understanding they should be able to facilitate the learners' learning of science, using the process of scientific inquiry. From what I had observed, the educators are not familiar with both the concept of process skill/s and its development. The process of investigation was impossible and this resulted in the non-achievement of LO1, since all educators did activities that did not involve investigations, whereas the section of the content that they worked with allowed for the involvement of different process skills which may include: investigation, observation, measuring and predicting.

### **5.1.2 Grade Four Educators' use of Teaching Strategies to Teach Matter and Materials in Natural Sciences**

Effective usage of different teaching strategies greatly depends on an educator's adequate pedagogical content knowledge, and this will have an effect on, which, when and how each strategy can be used effectively (Shulman, 1986). Every classroom has learners, with different levels of understanding and so meaningful learning to take place if the educator must use different teaching strategies. Rogan and Grayson's (2004) Theory of Curriculum Implementation in this section three out of four the sub-constructs of the Profile of Implementation will be discussed including the modified one, including the strategies as outlined by the Department of Education that the educators should use to teach various sections of work (topics).

#### **5.1.2.1. Strategies that the Educators used to teach Matter and Materials**

In observing the four educators over three lessons, there were various strategies that they used. Anele used the strategies of questioning, explaining and group work, Gugu used explaining/lecture and questioning. S'bu used the strategies of questioning, lecture, demonstrations and for assessment he used written work with questions which are more of recall type. Zodwa used the questioning, expository, demonstrations for one lesson and for assessment she used written work with questions which are more of recall. The common strategies used by all the educators were questioning and explaining or the expository strategy. So, the educators were using the basic strategy of questioning and according to (Killen, 2007) this strategy forms an integral part of most strategies for effective teaching. The challenge for the educators is to work with a level of questioning that can lead to learners developing critical thinking skills.

#### **5.1.2.2 How the Educators Used the Teaching Strategies**

The four educators used particular strategies in particular ways. These strategies were used to elicit learner's prior knowledge, to check learners understanding, to use assess, learners.

- a. Using strategy to elicit learners' prior knowledge to introduce a lesson

For the first question of the interview, the educators were to respond about their approach to introducing lessons. Three of the educators (Anele, Gugu, and S'bu) said they asked questions to see what their learners already knew. This was confirmed during the lesson observations

when the educators questioned the learners. To an extent the educators were using the constructivist approach, which proposes that new knowledge is constructed from the old knowledge. Constructivism holds the educational belief that educators should make connections between the new concepts presented with learners' prior knowledge. Piaget (1967) after much research concluded that children combine prior knowledge with current experiences. The incorporation of prior knowledge in science teaching is also encouraged by the NCS policy document and it is proposed that educators should consider the elicitation of prior knowledge and learning, preferably when introducing a new lesson to encourage continuity and "progression of concepts" (Department of Education, 2003, p. 31). It has been discovered that in college science classes, the prior knowledge of learners determines to a large extent what each individual can learn from a particular situation (Fisher, 2004). Fisher agrees that each learner must assimilate and make sense of new ideas by connecting them to what they already know instead of trying to pour facts into learners' brains, and that is not productive (Stears, Malcolm & Kowlas, 2003; Oloruntegbe & Ikpe, 2011). In this research, the educators did not give the learners an opportunity to assimilate and make sense of new knowledge, as they (learners) were expected to fill in sentences/missing words or to respond to many close-ended questions. Hence, the lecturers did not give the learners an opportunity for greater learning.

If learners are to construct their own meaning out of the new content or learning situation it is of vital importance that educators are aware of the learners' prior knowledge and utilize it in the teaching process. This means that the educators have to figure out how and what to ask learners in order to find out what they already know or understand (Killen, 2007). The reasons given by educators specifically were: "to check whether they still remember what was learned before and to check what they already know about the topic." Anele added that she asked the types of questions to draw learners' attention because they become interested when you ask them something they know.

To conclude this section, Anele, S'bu and Zodwa used questioning as a strategy to check what learners already know before introducing the new concepts and also for formative purposes.

#### b. Questioning as a teaching strategy

The strategy most commonly used was questioning as stated previously. Bentley and Watts (1994, p. 99) point out that, "questioning can be directed towards determining what understanding the child might have of a particular part of science or topic in technology and

making value judgments about the quality of their constructions. All educators asked the questions during their lessons to check learners' understanding. Questions were asked at the beginning of the lesson, during the course of the lesson, and at the end of the lesson. The educators used low level cognitive questions mostly of the recall type. According to Killen ((2007, p. 121) "lower cognitive questions are more effective than higher-level questions with young (primary level) children, particularly the disadvantaged". Killen (2007) further states that although the lower cognitive questions are more effective in primary grades, there is a need of combining it with the high level questions, "combination is superior to exclusive use of one or the other" (p. 121).

The educators observed, used only lower level cognitive questions and in some cases the feedback provided to the learners who gave incorrect responses was discouraging for the learners. Questioning was used with other teaching methods which include, explaining or lecture method and demonstration the data discussed indicated that questioning for eliciting prior knowledge and as teaching and learning strategy educators predominantly used lower level cognitive questions. Educators were limited in the types of strategies used. I recommend that as educators we need to assist learners to become critical thinkers by providing opportunities in our science classes that allow for greater learner involvement and initiative and less educator domination of the learning process. This can be only be achieved by the types of questions we ask learners.

Questioning is regarded as an important part of teaching because of its potential to stimulate student thinking and learning (Killen, 2007). According to Cotton cited in Killen, (2007) research on questioning suggests that the educators should use questioning for these purposes: " to develop interest and to motivate learners to become actively involved, to review and summarize previous lessons, to assess the achievement of instructional goals and objectives and to stimulate learners to pursue knowledge on their own" ( p. 121). This study revealed that the educators' reasons for using questioning were two-fold. Firstly at the beginning of the lesson to check what learners already know and secondly to check whether they were still following the lesson. S'bu even added that he used questioning "to check the effectiveness of the method". Gugu used questioning to "check learners' understanding at the end of the lesson." Anele also added that questioning was used to "promote learner- centered in the lesson". I asked for clarity for this statement, she then say "to make learners active"

c. Group-work

Group work occurs when you ask two or more learners to work together without direct intervention by educators (Killen, 2007). Group work was one of the teaching strategies used by Anele in her lessons. Group work is a pedagogical strategy that promotes participation and interaction with the aim of producing better results. Learners “work in small groups in order to realize a common goal” (Ormrod, 2008, p. 437). Group-work involves working together in any learning and teaching activities or any formal and informal assessment activities. Anele used group-work only for informal assessment activities. Learners in her class were sitting in groups of six. During lesson presentation no work was given to them to complete in groups but to sum-up the lessons, Anele gave them assessment work to complete in groups. According to Killen (2007, p. 169) group work can be used for several reasons which may include: " to shift the focus from learners being passive recipients of information to being active learners, group work can be used to improve oral communication skills at the same time as they learn the curriculum content, and can be used to teach them to learn respect for one another's strengths and limitations". Anele as the only educator who used group work said that the reasons she used group work in her lessons were that there were limited resource for individual child to use and it was also used to reduce educator's assessment load. She added that groups were used to give all learners the opportunity to contribute ideas, even though that was not the case because only two or three out of six learners were participating. During observation only a few learners contributed productively, only high-ability learners were active. The slow learners were just reading what was written during presentation. You could even hear by the way they read that they do not understand what was written.

d. Explaining or expository strategy

All four educators used this method. As it has been discussed earlier in Chapter 2, the lecture method of instruction is an educator-centered method, an expository method, an explaining and a telling method of teaching, widely used by most educators throughout the world. The definition of Kirschner, Sweller and Clark (2006, p. 75) summarizes the expository method as “providing information that fully explains the concepts and procedures that students are required to learn as well as learning strategy support that is compatible with human cognitive architecture”. Educators in this study used the expository strategy as a complementary strategy to other methods (Fraser et al., 1992 & Jacobs; Gawe 1998). For Zodwa and S’bu the expository method was used together with questioning and demonstrating. Anele

complemented the lecture method with questioning and group work on the other hand Gugu used it along with the chalkboard. According to Fraser et al (1992, p. 139) this method can be “ effective, profitable and efficient when teaching art subjects like English and Religious and Moral Education but needs thorough preparation and planning on the part of the educator” and adequate preparation helps the educator to explain the work logically and retain the attention of the learners.

e. Demonstrations (teaching)

According to Rogan and Grayson’s (2003) levels of practical work, demonstrations fall in level 1. According to Pekmez (2005), the most commonly used type of practical work in schools is demonstration while investigations were rarely or never done. The findings of the study by Pekmez (2005) on science educators’ understanding of practical work reveal that educators have no adequate knowledge of the different types and role of practical work, especially in terms of procedural knowledge. Pekmez’s study reveals that educators are reluctant to conduct inquiry-based practical work. This is because it is a challenging task and they themselves as not skilled at it.

S’bu and Zodwa were the only educators who achieved Level 1 of Rogan and Grayson’s level of science practical work as the educator using classroom demonstration to help develop concepts. S’bu used demonstrations for all his three lessons, although they were not part of his preparations as indicated by the fact that every time he was going to demonstrate he would say “Mm mm what can I use to show you this? Ok here is.....” and even things used for demonstrations were not in the list of the resources that were going to be used, but they were used effectively and the concepts that were demonstrated were clearly done. On the other hand Zodwa put the real objects on the desk in front for the first lesson but they were not used. During the interviews neither of these educators mentioned demonstrations as one of the strategies they used. The NCS Natural Sciences policy document encourages educators to understand the nature of practical work and develop strategic ways of conducting practical work in their classroom teaching (Department of Education, 2005).

### **5.1.3 How assessment was used together with these strategies**

According to the National Curriculum Statement assessment is “an integral part of teaching and learning and should be included at all levels of planning, and is not just an ‘add on’ or

something that happens at the end of the learning process” (Department of Education, 2003, p.1). Learners can be assessed through oral questioning, listening to them talk or discussing in their groups, observing them during practical work as well as reading their written work (Wellington, 2000). Different assessment strategies for the assessment of science learning are used in science to make decisions about a learner’s performance. Educators can get a more accurate picture of a learner’s development and progress if they assess the learning process on an on-going, continuous basis (Department of Education, 2003). A variety of strategies may be used for assessment for example science projects, investigations, concept maps and questions and answers (Department of Education, 2003, p. 22). When planning assessment, the educator must make sure that assessment is “always fair to the learners and all the barriers preventing learners from their knowledge, skills and values should be considered. Barriers may include their inability to express themselves in language in which learning, teaching and assessment is done” (Department of Education, 2003, p. 1).

According to Kanjee (2009) assessment is primarily used to assist educators and learners to determine monitor and improve performance. And if it is used effectively it can assist educators in identifying learners’ strengths and weaknesses and provides educator with suggestions for appropriate interventions. This will depends on the educator’s professional judgment and also to be availability of space and resources. In this study, the educators predominantly used written and oral work. This was confirmed by the questionnaire responses for example “assess orally and give them written work, which include classwork, homework and tests”. According to Kanjee (2009) using different assessment strategies would also allow educators to reflect on their teaching and to evaluate their teaching strategies and to check whether learners understand what was taught. In terms of the National Curriculum Statement, in the GET Band, educators should achieve the following purposes, which include: identifying the learners’ strengths, weaknesses and needs, to motivate and encourage learners and demonstrate the effectiveness of the curriculum or teaching strategy (Department of Education, 2003, p.1). As it has been discussed above that all educators used questioning, they used it for assessment. The responses that they gave as a reason for using questioning, were also responses for assessment. Anele also gave the same response as that for group work, as it was used for assessment purposes.

#### **5.1.4 Code-Switching as a Strategy**

In most of the schools in the UMgungundlovu District the Language of Learning and Teaching (LoLT) from Grades 4 to 12 and it is not the home language of the learners in area where the study took place, their home language is IsiZulu. The language in science differs from everyday spoken language and because of this the educators have chosen code switching especially when introducing new concepts for clarity. Code-switching means changing between two languages. Setati and Adler (2001) state that the practice of code switching is supposed to ensure that the language amount used in instruction increases in the classroom and that the understanding of science and mathematics concepts is transferred from one language to the other.

In this study, the official language of instruction was English but in three of the classes (Gugu, Anele and Zodwa) I observed that code switching was used with a predominance of IsiZulu, to clarify the meaning of concepts to the learners. The Language in Education Policy (Department of Education, 1997) allows the schools to choose their language of teaching and learning and requires the schools to address the principle of additive bilingualism which involves the maintenance of Home Language and access to an Additional language (Department of Education, 2002). Educators of Natural Sciences and Technology should be aware that they are also engaged in teaching language across the curriculum. This is particularly important for learners for whom the Language of Learning and Teaching (LoLT) is not their home language. It is important to provide learners with opportunities to develop and improve their language skills in the context of learning Science and Technology. It will therefore be critical to afford learners opportunities to read scientific and technological texts, to write reports, paragraphs and short essays as part of the assessment, especially (but not only) the informal assessments for learning.

#### **5.2. Reflections**

My reflections on what I would do differently if I had to do this research again are presented below. Reflecting on the methodological process, I would have increased the rigour of my study, if I had piloted my instrument. I had initially planned to have both teachers and learners as participants in my study, but the designed questionnaire was not adequate enough to provide sufficient information on how learners respond to the teaching of Matter and Materials. My questionnaire could have consisted of more in-depth qualitative questions to make the study qualitative or more questions formulated could direct the study more towards

the qualitative approach. It could have been more ideal if the questions formulated were grouped into themes according to the theoretical framework adopted.

Reflecting on the technical aspect, I found it more challenging in terms of language structuring. Research language or vocabulary is a bit different from the daily language used. Next time I would purchase or consult the researcher's dictionary to assist me. It would also be of importance for me to acquire more of the computer skills since these will also facilitate the use of Endnotes and other requirements.

### **5.3. Recommendations**

The conclusion of this research indicates that educators are still experiencing difficulty when implementing the Natural Sciences curriculum. Educators have a limited knowledge and practice of using effective teaching and learning strategies when teaching Natural Sciences. These educators should receive further support for them to perform their roles from the Learning Area committees, professional development mentors/centers and learner support materials to improve the current state of teaching and learning in the Primary schools. The following initiatives could be adopted to achieve an improved state of teaching and learning:

- Department of Basic Education: There is a great need for workshops as three out of the four educators feel that they need more training in developing an understanding of how to use the policy document to inform their planning and presentation of Natural Sciences lessons and also for the use of effective strategies for teaching Natural Sciences. Educators are expected to attend workshops regularly to attain the required skills and content knowledge. It is important that Natural Sciences educators are supported and professionally enhanced by the relevant, appropriately qualified subject advisors. This presently is a challenge for the Department of Basic Education where there is a limited number of staff at this level. In the UMgungundlovu district there is only one Natural Sciences advisor who is expected to monitor and support all the schools in the district. It is also recommended that the subject advisor should conduct workshops on a quarterly basis at least, in order to deal with educators developing the content knowledge for the particular term. This should enable educators to know exactly what and how to teach in that term. Workshops can sometimes be effective, but the supporting evidence from this study presented by an educator indicated that he had attended the RNCS workshops for Intermediate Phase educators, and these were good.

This could be a possible reason for his level of knowledge and practice of teaching Natural Sciences, which is different from the other three educators.

- Learning Area specific: Every school should have Learning Area committee specific for Natural Sciences. It should comprise of educators teaching Natural Sciences from all grades. Educators who are qualified to teach Natural Sciences or have taught it effectively, for many years should be retained to teach and mentor educators for teaching Natural Sciences Learning Area. This will assist them to develop and become knowledgeable in the content and the pedagogical, including the PCK aspects of teaching Natural Sciences learning area.
- Attend Professional Development Courses at Higher Educational Institutions: Natural Sciences educators need to upgrade their level of education in the science content and pedagogy so that they can be developed in all the aspects of their subject area. The fact three of the educators predominantly used IsiZulu in their classes, indicates that they need to be helped to work effectively within the current constraints of the language of learning and teaching (LOLT), more specifically they need to follow the gradual change from home language IsiZulu as outlined by Setati & Adler (2001), to English which is the second language of the majority of learners in South Africa. There is therefore a need for training educators, to equip them to deal with teaching Natural Sciences through the medium of a second language.
- Teaching and learning support materials: Schools should prioritize and buy science equipment. Without relevant teaching and learning equipment, the teaching of science can be a disaster and practical work is compromised. It is also recommended that educators should improvise and use available resources to make learning meaningful for learners.

#### **5.4. Suggestions for further research**

This study explored the educators' experiences of teaching grade four Matter and Materials in Natural Sciences and how they used teaching strategies to teach topics in the theme Matter and Materials. The following are suggestions for further research concerning the educators' use of teaching strategies:

- Researching how grade four learners respond to the teaching and learning strategies used by grade four educators.
- Exploring the relationship between assessment and teaching strategies used in grade four Natural Sciences classrooms.
- Exploring the development of process skills among grade four Natural Sciences learners.
- Teaching strategies used to teach Natural Sciences in the Intermediate Phase, with a focus on knowledge and skill development.

### **5.5. Concluding remarks**

This study revealed that the types of teaching strategies used by the educators are: questioning, explaining or expository strategies demonstrations, group work and the code-switching through the lesson. These teaching strategies were used in different ways. Questioning was to elicit learners' prior knowledge during introduction of a lesson. Questioning was also used to check learners' understanding of what was taught and to involve learners in the lesson. Expository, demonstrations were used to clarify concepts. The assessment was used together with these strategies. Educators used these strategies for different reasons which included: drawing learners' attention, motivating learners and encouraging them to participate in the lessons.

In Chapter 1, it was noted that South African education before 1994 was along racial lines and that the education of Africans was greatly affected by this discrimination due to unequal distribution of resources and poor teaching styles (Parker, 1994). The education of Blacks was not in accordance with the ideal. Parker (1994) noted that "the role of education is to produce the right mental attitude, disposition, knowledge and beliefs, and appropriate types of skills" (p. 93). The educators observed in this research were the products of this education; where traditional methods of teaching were the main practice: teaching was educator-centered and learners were passive participants. These kinds of teachings were not effective as learners were not encouraged and did not develop critical thinking and problem solving skills (Darling-Hammond, 1996). Educators did not value activities which could for instance have developed process skills; they seemed to be more concerned with the content to be covered and they taught in the way they had been taught (James, Naidoo & Benson, 2008). With regard to the Profile of Implementation, educators' use of teaching strategies to teach science is not

indicative of an inquiry-based approach to teaching Natural Sciences, especially scientific investigations which are linked to Learning Outcome one of Natural Sciences. However, educators do believe that their learners are able to conduct investigations and a 'hands on' approach to teaching science since they mentioned investigations in their questionnaire and interviews but in practice that was not the case. Although they see the value of science and know that 'hands-on' methods of inquiry should be promoted, they do not have the content knowledge to implement it. For educators to develop competence to select suitable teaching strategies that promote inquiry, the confidence and competence to teach the content and process skills in Natural Sciences is required.

Curriculum Implementation is a process and the value of studies such as that of Rogan and Grayson (2004) and the current study is that they allow those responsible, from DBE to school management to locate the schools at point of a continuum, in this case level one to level four.

The educators in this study were largely at level one in terms of using teaching strategies to implement the curriculum. This study has made recommendation for ways in which progress in the teaching of Natural Sciences can be made for a learner centered, process-driven science education.

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# APPENDICES

## APPENDIX ONE: RESEARCH QUESTIONNAIRE

The purpose of the study is to explore how Grade 4 educators teach a selected unit of study of Natural Sciences section of the NCS. The study will seek to describe the approaches and strategies used by educators for teaching Natural Sciences to Grade 4 learners.

Dear Educator, Your contribution as Grade 4 science educator is very important to the success of this research. Your honest response will be much appreciated.

### SECTION A: BIOGRAPHIC AND DEMOGRAPHIC INFORMATION

Please indicate your response by writing the relevant number in the square provided

A1: Your age

30 years and younger=1	31 years and older=2	
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A2: Highest Academic / Professional Qualification

Teacher's Diploma(3years)=1	Bachelor of Education=3	
Higher Diploma in Education/ACE=2	Honors Bachelor of Education=4	
Other=5 (specify----- -----)		

A3: Years of teaching experience

8 years and less=1	9 years and more=2	
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A5: School location

Urban Area =1	Rural=2	
Township =3		

A6: Language of instruction

Afrikaans =1	English=2	
IsiZulu=3		
Other=4(Specify----- -----)		

## SECTION B

For the following part of the questionnaire please indicate your level of agreement with statement by marking the square with a cross X

Use the following scales:

1.Strongly Disagree	2.Disagree	3.Neutral/Undecided	4.Agree	5.Strongly Agree
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### Initial and in- service training

Natural Sciences was one of my modules during initial teacher training.	1	2	3	4	5
Initial teacher training gave me the science basics.	1	2	3	4	5
In initial teacher training I explored different methods of teaching science	1	2	3	4	5
During my own school years I have acquired the basics of science	1	2	3	4	5
Science knowledge needed in teaching have been acquired through self-study	1	2	3	4	5
RNCS training equipped me with knowledge and skills needed to teach Matter and Materials in Natural Sciences Learning Area	1	2	3	4	5
In RNCS training I learned about process skills and how to use them	1	2	3	4	5
I feel that I received sufficient support from Provincial Department on the implementation of Natural Sciences Learning Area	1	2	3	4	5
I feel that I need more training on Natural Sciences Learning Area	1	2	3	4	5

### HOW DO YOU FEEL ABOUT PRESENTING NATURAL SCIENCE

Statements	1	2	3	4	5
I have difficulties in teaching Natural Sciences.	1	2	3	4	5
I feel comfortable in teaching any topic Natural Sciences	1	2	3	4	5
Matter and Materials is my favorite part of Natural Sciences	1	2	3	4	5
Answering Grade 4 learners' questions on Matter and Materials makes me feel comfortable.	1	2	3	4	5
I lack the knowledge and skills to teach Natural Sciences effectively	1	2	3	4	5
I believe that all Grade 4 learners are natural scientists	1	2	3	4	5
I believe in a principle that all learners (Grade 4) can learn science	1	2	3	4	5
I think science may be too difficult for Grade 4 learners	1	2	3	4	5
I understand that without scientific skills learners can lead happy & useful lives	1	2	3	4	5
I have clear understanding of how Grade 4 learners learn Natural Sciences.	1	2	3	4	5

#### TEACHING STRATEGIES USED TO TEACH NATURAL SCIENCE

10. I know how grade 4 learners learn science best	1	2	3	4	5
11. I provide opportunities for learners to do practical work in science	1	2	3	4	5
12. I try to provide learners with opportunities to construct their own knowledge and understanding of science	1	2	3	4	5
13. I am aware of the teaching methods most suitable for Natural Sciences in Grade 4	1	2	3	4	5
14. I always recognize learners' prior knowledge before teaching new science content	1	2	3	4	5
15. I use different assessment strategies to assess learners' performance in	1	2	3	4	5

science.					
16. I provide learners with opportunities to learn science by doing hands-on science	1	2	3	4	5
17. I am skilled at promoting critical thinking and problem solving in science	1	2	3	4	5
18. I provide learners with enough opportunities to work with concrete materials in science.	1	2	3	4	5
19. I mainly transmit science knowledge through telling the learners about science	1	2	3	4	5
20. I think group work is essential for effective science learning.	1	2	3	4	5

Indicate the important factors that inhibit your teaching of science (if any). Mark the appropriate response (Yes/No) with X

Large number of learners in the class	YES	NO
Inadequate science resources	YES	NO
Teaching more than one grade(multi-grading)	YES	NO
Lack of knowledge and skills to teach science	YES	NO
Shortage of curriculum statements	YES	NO

Please indicate the process skills that you use most frequently in the science activities that you present in your class.

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In what way do you think science teaching can be improved in your school?

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End! Thank you

# APPENDIX TWO: CLASSROOM OBSERVATION SCHEDULE.

CLASSROOM OBSERVATION SCHEDULE –TEACHING MATTER AND MATERIAL IN NATURAL SCIENCE IN GRADE 4

School Name: -----Province: -----

Region: -----District: -----Circuit :- -----

Educator Name: -----Gender: -----Qualifications: -----

Grade Level: -----Number of learners: -----

Observer Name: -----Date of observation: -----

**Component 1:Introduction**

1	Educator has no introduction which makes the learners to think about Natural Sciences topic.
2	Educator provides a brief introduction and asks questions to introduce the Natural Sciences topic.
3	Educator begins the lesson by asking questions and linking them to the Natural Sciences topic and learners existing knowledge.
4	Educators uses stimulus to introduce a Natural Science topic and linking it with learners previous knowledge.

Description:-----  
-----

**Component 2: Lesson presentation and classroom discussion**

1	Teacher: Presents content in a well-organized, correct and well-sequenced manner, based on a well-designed lesson plan.  Provides adequate notes. Engages learners with questions.
2	Engages learners with questions that encourage in-depth thinking.
3	Teacher: Probes learners’ prior knowledge. Structures learning activities along “good practice” lines.  (Knowledge is constructed, is relevant, and is based on problem solving techniques).
4	Facilitate learners as they design and undertake investigations and project

Description :-----  
-----

**Component 3:Language of instruction**

1	Teaching in Home Language
2	English is used but with more of Home Language
3	Educator uses English and little of Home language to clarify concepts.
4	Educator uses simple English as the medium of instruction demonstrate and dramatise clarify concepts.

Description:-----  
-----

Component 4:Science practical work

1	Teacher uses classroom demonstrations to help develop concepts.  Teacher uses specimens found in the local environment to illustrate lessons.
2	Teacher uses demonstrations to promote a limited form of inquiry.  Teacher allows some learners to assist in planning and performing the demonstrations.
3	Teachers design practical work in such a way to encourage learner discovery of information.
4	The teacher facilitate learners to design and do their own “open” investigations.

Description:-----  
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Component 5:Resources

1	Uses textbooks effectively
2	Textbooks are used along with other picture
3	Uses textbooks, pictures and real objects.
4	Uses textbooks, visual and audio visual resources.

Description:-----  
-----

Component 6:Assessment

1	Written tests are given that cover the topic adequately. While most questions are of the recall type, some require higher order thinking.  Tests are marked and returned promptly.
2.	Written tests include at least 50% of the questions that require comprehension, application, and analysis.  Some of the questions are based on practical work.
3	Written tests include questions based on seen or unseen “guided discovery” type activities. Assessment is based on more than tests.  Other forms of assessment might include reports on activities undertaken, creation of charts and improvised apparatus, and reports on extra
4.	Performance on open investigations and community-based projects are included in the final assessment.  Learners create portfolios to represent their “best” work.

Description :-----  
-----

Component 7: Educator subject knowledge

1	Educator conveys the inaccurate and limited knowledge of learning area.
2	Educator’s knowledge is adequate but not comprehensive.

3	Educator is able to use knowledge and information to extend the knowledge of learners.
4	Educator use knowledge to diagnose learner's strengths and weaknesses in order to develop teaching strategies.

Description:-----  
-----

Component 8: feedback to learners

1	Educator gives no feedback to learners
2	Feedback for incorrect responses discourages further effort
3	Only incorrect responses are addressed a manner that encourages further effort.
4	Feedback for both correct and incorrect responses are given timeously in a manner that encourages more effort.

Description:-----  
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## **APPENDIX THREE: SEMI-STRUCTURED INTERVIEW SCHEDULE**

Good afternoon

I am very grateful for your cooperation from the beginning of the data collecting process where you were requested to complete the questionnaire, to classroom observation and interviews.

Please note that you are free to withdraw from these interviews at any time.

1. Can you please explain your approach to introducing the lesson on matter and materials?
2. What do you think are useful strategies to teach science?
3. Can you describe the teaching strategies you use to teach the topic on matter and materials?
4. There are many strategies to teach the same unit. Explain why have you chosen these strategies?
5. What process skills do you think your learner would have acquired in your lessons?
6. How do you assess your learner for your 3 lessons?

Thank you

Is there anything that was not covered in this interview that you want to share, it can be thoughts, reflections or feeling about the interview

## APPENDIX FOUR: ETHICAL CLEARANCE



6 July 2012

**Mrs Hleghwe Mable Ngubane 201044776**  
School of Science and Technology

Dear Mrs Ngubane

**Protocol Reference Number: HSS/0473/012M**  
**Project Title: Teaching and Learning Natural Sciences in Grade 4**

In response to your application dated 27 June 2012, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL**.

**Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number. Please note: Research data should be securely stored in the school/department for a period of 5 years.**

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

Yours faithfully

Professor Steven Collings (Chair)

/pk

cc Supervisor Dr A. James  
cc Academic leader Dr Nyma Amiri  
cc Dr David Davids  
cc School Admin. Mrs Sandhamoney

Professor S. Collings (Chair)  
Humanities & Social SC Research Ethics Committee  
Westville Campus, Govan Mbeki Building  
Postal Address: Private Bag X5400, Durban, 4001, South Africa  
Telephone: +27 (0)31 260 3887/8350 Facsimile: +27 (0)31 260 4507 Email: [adm@op.ac.za](mailto:adm@op.ac.za) / [nyman@ukzn.ac.za](mailto:nyman@ukzn.ac.za)  
Founding Campuses: ■ Edgewood ■ Howard College ■ Medical School ■ Pietermaritzburg ■ Westville

Inspiring Greatness



## APPENDIX FIVE: PARENTS' CONSENT



H.M.NGUBANE  
Student No.204410776  
University of KwaZulu-Natal  
Edgewood Campus  
Private Bag x03  
Ashwood  
3605

20 January 2012

Dear parent/Guardian

Request for Parent consent

Project Title

TEACHING MATTER AND MATERIALS IN NATURAL SCIENCES IN GRADE 4

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

The research I will be undertaking involves classroom observation where I will observe Grade4 educators teaching Grade 4 learners. The purpose is to find out how educators teach particular lessons. The methods they use to teach and analyze their lessons. The focus of the investigation is on both the educator and the learner. The data will be stored at secured place.

The confidentiality of participant will be guaranteed and respected. No one will be forced to participate and all ethical considerations governing research will be strictly adhered to by the researcher and the respondents.

Yours faithfully

H. M. Ngubane (Mrs.)

## APPENDIX FIVE: PARENTS' CONSENT (ISIZULU)



H. M. NGUBANE  
Student No.204410776  
University of KwaZulu-Natal  
Edgewood Campus  
Private Bag x03  
Ashwood  
3605

20 January 2012

Mzali othandekayo

ISICELO SEMVUME YOMZALI

ISIHLOKO SEPROJETHI

UFUNNDISWA KWEMATTER NEMATERIAL KWI NATURAL SCIENCES YESIGABA  
SESINE (TEACHING MATTER AND MATERIALS IN NATURAL SCIENCES IN  
GRADE 4)

Nginguthishofundisa eMkhabela isikole samabanga aphansi, zeziqo zeMasters eNyuvesi  
yakwazulu –Natal. Leziqo zidinga ngenze ucwaningo.

Ucwaningo engizolenza lubandakanya nokungena eklasini ngibuke indlela njengamanje  
ngenza izifundo othisha abafundisa ngayo abantwana nokuthi abantwana bona benzenjan i  
mabefundiswa.

Ulwazi oluzoqoqwa luzogcinwa luyimfihlo.abazophoqwa abantwana ukuba yingxenye  
yocwaningo. Yonke imigudu efanele yocwaningo izolandelwa.

Ozithobayo

Mrs. H. M. Ngubane

## APPENDIX SIX: REQUEST FOR PERMISSION TO CONDUCT RESEARCH



H. M. Ngubane  
Student No.204410776  
University of KwaZulu-Natal  
Edgewood Campus  
Private Bag x03  
Ashwood  
3605

The Science Educator

### REQUEST FOR PERMISSION TO CONDUCT RESEARCH

PROJECT TITLE: TEACHING AND LEARNING MATTER AND MATERIALS IN  
NATURAL SCIENCE IN GRADE 4

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

Full Names & Surname: Hlengiwe Mable Ngubane

Title : Mrs.  
Student No. : 204410776  
School : Science and Technology  
Faculty : Education  
Campus : Edgewood  
Existing Qualifications : Honours Bed. Natural Sciences  
Proposed Qualification for Project : Med in Science Education

#### Contacts:

Cell: 0725713922

Email: h.ngubane@yahoo.com

Supervisor: Dr. A. James

Telephone: 0312603438

Email: [jamesa1@ukzn.ca.za](mailto:jamesa1@ukzn.ca.za)

I humbly request the permission to conduct research in your class. The purpose of the study is to explore how Grade 4 educators teach a selected unit of study of Natural Sciences section of the NCS. The study will seek to describe the approaches and strategies used by educators for teaching Natural Sciences to Grade 4 learners.

This study is an interpretive case study. It will concentrate on both Grade 4 educators and learners. How the participants educators teach the selected unit of study and how the participants learners respond to the strategies used. Educators will participate voluntarily in this study. Only four Grade 4 educators will be selected and one educator per school.

The first stage of my data collection will be questionnaire which will be distributed and filled by Grade 4 Science educators. It will consist of closed and open-ended questions.

The second stage of my data collection will be classroom observation. This will be done twice per educator in a week. I will be observing both educators and learners and record my observation using classroom observation schedule.

The third one will be the interview which will be done after observation. This will be face to face interview, where you will be expected to answer some questions.

The participants will be informed about all aspects of the research. Participant's right to anonymity including their rights to refuse to participate will be respected. Ethical guidelines will be needed to guide against any possible insensitivity. Guidelines relate to factors such as privacy, approval and consent, permission, protection, briefing on how data will be recorded and used as well as publication. To ensure the anonymity and confidentiality of participants I will make sure that the will be handed over to the participants on the day of investigation does not contain any spaces where the participant will be required to write their names.

Thank you in anticipation of favorable response to this application.

Yours faithfully

Mrs. H.M. Ngubane

# APPENDIX SEVEN: TURNITIN REPORT

Turnitin

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