

A case study of teachers' implementation of the Grade Four  
Natural Sciences curriculum

By

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A Dissertation Submitted to the School of Education  
University of KwaZulu-Natal

In

Partial Fulfilment of the Requirements for the  
MASTER OF EDUCATION DEGREE

2013

# DECLARATION

I, Mavis Nokuthula Mpanza, hereby declare that this dissertation: *A case study of the teachers' implementation of Grade Four Natural Sciences curriculum*, is my original work and has not been submitted for assessment or completion of any postgraduate qualification in any institution. All the sources used and quoted, have been acknowledged in the text and in the list of references.

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M. N. MPANZA

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DATE

I hereby declare that this dissertation has been submitted for examination with my approval.

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DR. M. STEARS

(Supervisor)

.....

DATE

# **DEDICATION**

This dissertation is dedicated to my beloved Mother, Irene, who sacrificed her happiness to make us better people and my dear daughter Nompumelelo and son Thobani for their tremendous support and encouragement.

# ACKNOWLEDGEMENTS

I would like to express my heartfelt gratitude to the following people who have made a change in my life:

- My supervisor, Dr Michèle Stears for her patience and intelligence in guiding and assisting me to navigate the research journey. Without her I wouldn't be where I am.
- Prof. Paul Hobden for his commitment and dedication in rendering additional cluster research support.
- Educators who participated in my study as willing respondents.
- Miss Z. A. Magwentshu: a sister, friend, colleague and self-appointed 'mentor' for her motivation, advice and support.
- Lehlohonolo Morallana for his outstanding support with IT.
- My family and relatives for their support and understanding.
- Last but not least, God, the Almighty for providing me with the strength and wisdom to complete my study.

## **ABSTRACT**

Many teachers have difficulty in implementing the Revised National Curriculum Statement (RNCS). This is particularly true of the natural science curriculum. The purpose of this study was to explore the ways in which natural science teachers interpret and implement the natural science curriculum in Grade Four. A further aim was to find out which factors impinge on teachers' ability to implement the curriculum. The study is underpinned by a theory of implementation developed by Rogan and Grayson (2003) who argue that major changes in new curricula are difficult to implement and suggest that any curriculum innovation should be ahead of existing practices. Rogan and Grayson's (2003) framework is further used to identify the levels at which teachers are located with regard to their ability to implement the curriculum.

The research was conducted within the interpretive paradigm. It is a case study of four natural science teachers who teach in the Folweni cluster of the Umbumbulu district. The methods of data collection included a questionnaire, document analysis, pre- and post-semi structured interviews and class observation. The data was analysed using Rogan and Grayson's framework.

The findings indicate that teachers are at different levels with regard to their ability to implement the natural science curriculum. This is partly due to the way they interpret the curriculum and partly due to a number of factors that influence their capacity to implement a new curriculum. Teachers have different abilities with regard to their interpretation of the curriculum. These abilities were interpreted in terms of their understanding of content, outcomes and assessment, as well as their ability to teach in learner-centred ways. Teachers' capacity to implement a new curriculum are influenced by factors such as their qualifications, the circumstances of the learners they teach; the physical resources available to them, the support they receive from the school management, as well as the ethos that prevails in the school.

The study concluded that teachers be supported in different ways to improve their capacity to implement the natural science curriculum and that this can ultimately lead to an improvement in teachers ability to implement the natural science curriculum as set out in the Revised Curriculum Statement (2002).



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# CHAPTER ONE

## INTRODUCTION AND OVERVIEW OF THE STUDY

### **Introduction and background**

The birth of democracy in South Africa brought transformation to the system of education in an effort to heal the scars of racial divides and inequalities of the past through a single system of education. This education system was intended to guarantee equality to all South African citizens. Education has an important role to play in realising the aims of the Constitution of the Republic of South Africa, hence the implementation of Curriculum 2005 (C2005), a curriculum driven by Outcome Based Education (OBE) which was first implemented in 1998 in Grades one and seven. C2005 is aimed at enabling all learners to actualise their fullest potential. It suggests the outcomes to be achieved at the end of the process which requires an activity-based and learner-centred approach to education. Owing to the challenges in its implementation, C2005 was streamlined and reviewed in the Revised National Curriculum Statement (RNCS) in 2002, for the General Education and Training (GET) Band. The RNCS affirms the principles of OBE, adopts an inclusive approach and considers the rich diversity of the country. It outlines clearly the kind of a learner we are trying to develop in terms of knowledge, skills and values. It introduces grade specific assessment standards which prescribe the minimum level and depth at which knowledge, skills and values are to be acquired by learners (Department of Education, 2002).

From the study conducted by Zulu (2003) on implementation of OBE, it is evident that teachers have difficulties in interpreting and implementing this curriculum as they express their frustrations and fears because of the inadequate preparation received. According to Fleisch (2002), the five day training workshop offered by district officials was based on the philosophy and theory of outcomes-based-education and focused mainly on the planning aspects of the new framework. Jansen (1999) also alluded to the success of the curriculum being dependent on trained and retrained teachers, radically new approaches to assessment, as well as classroom organisation appropriate to monitoring and assessment. Jansen (1999) further stated that the vague understanding of the principles of assessment the teachers have, cause them to consider assessment procedures tedious and too much to manage.

The complexity of the terminology used the poorly developed notions of sequence, progression, content and concept development further added to the frustrations of teachers (University of Witwatersrand Education Policy Unit [Wits EPU], 2001). Further complications such as the shortage of personnel, resources and learning materials hinder curriculum implementation. Monyokolo (1999), as well as Van Rooyen and Prinsloo (2003), confirmed the absence of the necessary curriculum materials. Furthermore, available textbooks are often of questionable quality as a result of design flaws in the curriculum and the unreliability of the evaluation process (Van Rooyen & Prinsloo, 2003).

Serrao (2008) affirms that the implementation of the curriculum is a matter of concern in terms of inadequate professional development and other challenges that hamper successful implementation hence there are various endeavours by the Department of Education (DoE) to improve the poor quality of education. Strengthening and streamlining of C2005 is one. Perhaps that is why the Minister of Education, in her statement during the announcement of the 2011 National Senior Certificate results, stated that for the streamlining of the RNCS into the Curriculum and Assessment Policy Statement (CAPS) there will be provision of specific content on what to teach and assess on a grade by grade and subject by subject basis. All documents pertaining to the teaching and learning of each subject have been repackaged into CAPS and it stipulates the specific content to be taught, its duration and how it is to be assessed, spelling out the forms of assessment required per term and guidelines to developing questions of different levels. CAPS will be implemented in the intermediate phase with six subjects in January 2013. Natural sciences will incorporate some aspects of technology and the new subject will be natural science and technology. However this study commenced before the introduction of CAPS and is therefore based on the implementation of RNCS, and particularly natural sciences as a learning area in the RNCS. It is important to mention that the CAPS is not a new curriculum but an effort to streamline the existing curriculum. I believe my study is still relevant as it researches the way in which teachers interact with and respond to a new curriculum that differs substantially from the previous curriculum they were accustomed to.

As a subject advisor whose key function is to train, monitor and support educators from grade four to nine in the GET Band with regard to the curriculum, I have learnt that teachers do have primary qualifications that include natural sciences (NS) or general science and/or general science didactics, but are not science specialists. General science has always been part of the curriculum in primary schools, and traditionally consisted of physical science and

biology components. With the introduction of C2005 additional components were added to the knowledge strands *life and living, earth and beyond, matter and materials* and *energy and change*. Few teachers have all the appropriate expertise for all four knowledge strands and there is limited in-service training to empower teachers to teach all four knowledge strands. The support they receive from the DoE is at the most two hours per session in the afternoons, since teachers are not allowed to leave their learners unattended during contact time. There is a lack of continuous support or mentoring from subject advisors due to a lack of capacity in most districts. This may have an impact on curriculum implementation. Berry, Loughran and Mulhall (2008) suggest that the development of pedagogic content knowledge (PCK) in science teachers not only increases their confidence about teaching science but also provides them with a useful framework for preparing meaningful science lessons.

## **1.2 The South African natural sciences curriculum**

In the Natural Sciences Learning Area Statement the content to be taught is not contained within the assessment standards but presented in a separate chapter for each phase without any demarcations into grades. This poses challenges for NS teachers in terms of the material to use since the content in books by different authors is not grade specific. The RNCS training conducted for Intermediate Phase (IP) educators is not learning area specific and from the generic given to them, they have to use the Learning Area Teachers' Guide to develop learning programmes, work-schedules and lesson plans. Such learning programmes are phase specific with grade specific work-schedules and lesson plans which are classroom specific. The Assessment Guideline for Natural Sciences specifies the number of assessment tasks expected per phase, the weighting of different knowledge strands and the recording and reporting of learner performance. The teaching of NS causes complications for some teachers because of its diversified nature in terms of the different knowledge strands it contains. Learners in the IP need to be exposed to all components of NS because they form the basis for the science subjects offered in Further Education and Training (FET). The presence of gaps in the knowledge taught might have negative repercussions for learners' performance in the science subjects, as the study conducted by Howie (2003) indicates that South African learners from Grades 8, 9 and 12 performed poorly in any science topic in the Third International Mathematics and Science Study (TIMSS, 1990). In the Foundation Phase (FP) some aspects of NS are incorporated into life skills as one of the three learning programmes taught. It is in the IP where the learner needs to lay the solid foundation for the science

subjects and it is for this reason that my study focuses on how the Grade four teachers implement the natural sciences curriculum.

### **1.2.1 Learning outcomes (LO) with their assessment standards (AS) for the Intermediate Phase.**

Learning outcomes replaced the specific outcomes (SO) and the assessment criteria (AC) in the original version of C2005. These are streamlined into only three learning outcomes across the intermediate and the senior phase instead of nine specific outcomes. Grade four and five each have eight assessment standards while Grade six has nine. The learning outcomes describe the knowledge, skills and values and precisely illustrate what learners should know and what they should be able to do at the end of the phase. Learning outcomes should never dictate the content and the method to teach. Assessment standards are grade specific and they indicate the minimum level learners should demonstrate in achieving a specific learning outcome. They give the depth and the breadth of the content for the grade and they clearly show conceptual progression for the learning area. Integration of concepts, skills and values are very evident within the assessment standards. The following table shows the three learning outcomes and their assessment standards for the intermediate phase (DoE, 2002)

**Table 1: Learning outcomes with their assessment standards for the Intermediate Phase**

<b>LO1: Scientific Investigation</b>		
<b>The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.</b>		
<b>Grade 4 Level</b>	<b>Grade 5 Level</b>	<b>Grade 6 Level</b>
<b><i>Planning investigation</i></b>		
Learner contributes ideas of familiar situations, needs or materials and identifies interesting aspects which could lead to investigations	Learner lists with support what is known about familiar situations and materials and suggests questions for investigation.	Learner helps to clarify focus questions for investigation and describes the kind of information which would be needed to answer the question.
<b><i>Conducting investigations and collecting data</i></b>		
Learner explores the possibilities in available	Learner carries out instructions and	Learner conducts simple tests or surveys and records observations or responses.

materials, finding out how they can be used.	procedures involving a small number of steps.	
<b><i>Evaluating data and communicating findings</i></b>		
Learner talks about observations and suggests possible connections to other situations.	Learner reports on the group's procedure and the results obtained.	Learner relates observations and responses to the focus question.
<b>LO2: Constructing Science Knowledge</b> <b>The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.</b>		
<b><i>Recalling meaningful information when needed</i></b>		
Learner, at the minimum, uses own most fluent language to name and describe objects, materials and organisms.	Learner, at the minimum, uses own most fluent language to name and describe features and properties of objects, materials and organisms.	Learner, at the minimum, describes the features which distinguish one category of thing from another.
<b><i>Categorising information to reduce complexity and look for patterns</i></b>		
Learner sorts objects and organisms by a visible property.	Learner creates own categories of objects and organisms and explains own rule for categorising.	Learner categorises objects and organisms by two variables.
<b><i>Interpreting information</i></b>		
N/A	N/A	Learner at the minimum interprets information by using alternative forms of the same information.
<b>LO3: Science, Society and the Environment</b> <b>The learner will be able to demonstrate an understanding of the interrelationships between science and technology, society and the environment.</b>		
<b><i>Understanding science and technology in the context of history and indigenous knowledge</i></b>		
Learner describes how local indigenous	Learner identifies ways in which products and	Learner describes similarities in problems and solutions in own and other societies in the

cultures have used scientific principles and technological products for specific purposes.	technologies have been adapted from other times and cultures.	present, the past and the possible future.
<b><i>Understanding the impact of science and technology on the environment and on people's lives</i></b>		
Learner identifies features of technological devices around him or her and tells about their purpose and usefulness.	Learner identifies the positive and negative effects of scientific developments or technological products on the quality of people's lives and/or the environment.	Learner suggests ways to improve technological products or processes and to minimise negative effects on the environment.
<b><i>Recognising bias in science and technology which impacts on people's lives</i></b>		
Learner identifies difficulties some people may have in using technological devices.	Learner describes the impact that lack of access to technological products and services has on people.	Learner suggests how technological products and services can be made accessible to those presently excluded.

Teachers have difficulty implementing a curriculum that is fundamentally different to any curriculum they experienced before. The content outlined in the NS policy document is not embedded within the assessment standards and it poses a big challenge for teachers to relate the content to the assessment standards that they are expected to address.

### **1.3 Purpose, focus and rationale**

In light of the above discussion which highlights the difficulties teachers experience in implementing a new curriculum, the purpose of this study is to explore the ways in which teachers interpret and implement the NS curriculum of the RNCS (2002). I aim to find out how teachers interpret and implement the RNCS curriculum and what factors influence the way they implement the NS curriculum. I will focus on three Grade four NS teachers from Folweni schools in the Umbumbulu circuit of Umlazi district. Studies have been conducted



on how teachers' perceptions of the new curriculum shape the implementation of the RNCS (2002) but these were conducted in primary schools of other provinces (Bantwini, 2009). A study by Cele (2009) has included the different strategies in teaching and assessing NS in primary schools, with the emphasis being on how learners learn. Other researchers, including Bowie, Doidge, du Plessis, Lelliott, Mhlolo, Msimanga, Mundalamo, Mwakapenda and Nakedi (2009), focus on the implementation issues of other subjects or of mathematics and science across the schooling system in relation to C2005. My interest is specifically in the Grade four teachers in a rural setting because they are in the entrance grade for the IP where learners are exposed to nine learning areas for the first time. It is imperative to build a strong foundation for the study of science and to develop all the necessary basic science skills required for constructing scientific knowledge developing skills to conduct scientific investigations as per RNCS Policy for the Natural Sciences. Such an approach may contribute to the promotion of the love of science and may eventually affect the matriculation performance positively (Gibson & Chase, 2000).

#### **1.4 Research questions**

1. How do teachers interpret the Revised National Curriculum for Natural Sciences in Grade four?
2. What factors influence the way teachers implement the natural sciences curriculum in Grade four?
3. How do teachers implement the natural sciences curriculum in Grade four?
4. Why do teachers implement the natural sciences curriculum in the way that they do?

#### **1.5 Overview**

This study consists of five chapters and the content is as follows:

**Chapter One** sets the scene for the study and explains the background as well as the purpose and focus of the study. It discusses the rationale, states the research questions, gives the overview of the chapters, outlines the acronyms alphabetically, the limitations as well as the conclusion.

**Chapter Two** provides the review of the relevant literature with regards to curriculum change, reasons for curriculum change internationally and locally, as well as the factors that impact on implementation. There is an outline of the theoretical framework which serves as a lens through which the study is conducted.

**Chapter Three** describes the research design and methodology, as well as issues of reliability, credibility and generalisability. Furthermore, ethical considerations are explained in this chapter.

**Chapter Four** presents the findings based on the analysis of the data, as well as a discussion of the findings.

**Chapter Five** summarises the research by demonstrating how the research questions were answered and draws conclusions from the findings. Furthermore it represents a number of recommendations that may inform further research.

## 1.6 Acronyms used in the study

<b>Term</b>	<b>Acronym</b>
Assessment Criteria	AC
Assessment Standard	AS
Continuous Assessment	CASS
Curriculum and Assessment Policy Statement	CAPS
Curriculum 2005	C2005
Department of Basic Education	DBE
Department of Education	DoE
Foundation Phase	FP
Further Education and Training	FET
General Education and Training	GET
Intermediate Phase	IP
KwaZulu-Natal	KZN
Learning Outcome	LO
National Curriculum Statement	NCS

Natural Sciences	NS
Outcomes Based Education	OBE
Pedagogical Content Knowledge	PCK
Relative Education Qualification Value 13	REQV 13
Revised National Curriculum Statement	RNCS
South African Association of Science and Technology Educators	SAASTE
School Based Task	SBT
Science Community Representing Education	SCORE
Specific Outcome	SO
Senior Phase	SP
Science Resource Centre	SRC
Third International Mathematics and Science Study	TIMSS
United Kingdom	UK
United States of America	USA
University of Witwatersrand Education Policy Unit	Wits EPU
Zone of Feasible Innovation	ZFI

## 1.7 Limitations

The initial aim of this study was to work with four Grade four teachers of the same school but on approaching the school I realised that educators were operating across learning areas but within the grades. I then worked with Grade four educators, each from the four primary schools which were in the same circuit. Another challenge was that the fourth teacher could complete only the questionnaire because of ill health from the third term of 2011 until May of 2012. Teachers who substituted for the sick teacher were not eager to participate and commented that they were just helping. I ended up collecting data from three Grade four teachers instead of four.

## **1.8 Conclusion**

This chapter has provided the background and rationale for the study as well as outlining the structure of the research project, the object of which was to explore how Grade four NS teachers from three primary schools from Umbumbulu circuit in KZN interpret and implement the NCS curriculum, as well as factors influencing the way they implement the curriculum. The following chapter will focus on the review of the relevant literature and the theoretical framework.

# CHAPTER TWO

## LITERATURE REVIEW AND THEORETICAL FRAMEWORK

### 2.1 Introduction

Mertens (2010) claims that the literature review is necessary for planning primary research as it provides the reader with an overall framework for where this piece of work fits in the “big picture” of what is known about a topic from previous research. Several writers agree that the review of the related literature is worth the time and effort because of the different roles it plays in research. Corbin and Strauss (2008) maintain a literature review is useful to decide on a topic, formulate a research plan and enhance researchers’ awareness of subtleties uncovered in previous research. Therefore a carefully conducted and well-presented literature review can uncover flaws in previous research based on its design, data collection, data collection instrument, sampling or interpretation. This can further assist the researcher to develop an appropriate design and a better methodology for studying a similar problem (Boote & Beile, 2005). Carr, McGee, Jones, McKinley, Bell, Barr and Simpson (2007) and Johnson and Christensen (2004), attest to the fact that from the literature review the researcher acquires a comprehensive understanding of what is known about the topic of interest to better one’s thinking on all issues pertaining to the study. The review of related literature “illuminates the related literature to enable the reader to gain further insight from the study” (McMillan & Schumacher’s, 2006, p. 75).

In this study I review the literature relevant to curriculum change nationally and internationally focusing on the reasons for curriculum change, teachers’ reactions to its change and the factors that influence the way they react to change. This is aimed at supporting the data collected to answer the research questions of the study. The literature review will be linked to the theoretical framework in which the reaction of teachers to curriculum change will be viewed based on curriculum implementation.

### 2.2 Definition of curriculum

The literature defines curriculum in a number of ways. Shao-Wen Su (2012) presents a linear conceptualisation of curriculum from the narrow (curriculum as a set of objectives) to the

broad (curriculum as experiences). Curriculum as a set of objectives is seen as a way of achieving only the specific educational goals and objectives. Hence Hoare (2012) views this curriculum as a set of guidelines from the state or district on what should be taught on a given subject. She regards it as being authoritarian with no room for teachers and students to have a voice. She refers to it as a checklist where teachers tick what has been done against outstanding work. She advocates a flexible curriculum which is both teacher and student based, one in which they could delete or add things for the benefit of their desired outcomes.

Ross (2000), Schubert (1997), and Sowell (2000) refer to the curriculum as the programme that outlines the content to be taught in different institutions. This merely refers to the subject matter taught by the teacher and learned by learners without considering the unplanned activities as well as plans leading to the end product. Some authors define the curriculum as a plan for instruction specific to a particular school or student population (Lunenburg, 2011; Ross, 2000). Levy (1991) affirms this and extends the previous definition by regarding curriculum as a plan of the content or specified material of instruction that the school offers to qualify them for the certificate to progress to the higher level or for entrance into a professional or vocation field. This definition has the learners' achievements as an added value.

In the instance where the outcomes are qualifications, the curriculum is regarded as a document which entails details about content, programme goals, outcomes integrated with teaching strategies that focus on high-order thinking skills as prescribed in Bloom's taxonomy. There is also the use of authentic assessment procedures including the development of portfolios and performance testing (Burke, 2009; Cambridge, 2012; Marzano, 2010; Odendahl, 2011; Popham, 2011). Barrow and Milburn (1990) consider it as a syllabus because it outlines official written programmes published by the DoE, boards of education or funded programmes co-ordinated by educational specialists.

Briggs and Sommerfeldt (2002) perceive curriculum differently as they explain it as a relationship between what is taught in schools and the underlying values of a society that schools serve. This curriculum is advantageous in addressing societal demands. There is a broader perspective of the curriculum described by Marsh (1997, p. 5) where he brings in an element of unplanned happenings during the teaching and learning process. This indicates a relationship between "plans" and "experiences." Hence Hyles, Truatman and Schelvan

(2004) link the curriculum to “hidden curriculum” which describes all social rules and expectations of behaviour not taught directly but assumed to be known.

I view the curriculum as a policy outlined in a set of policy documents stipulating the outcomes to be achieved with a specific content to be taught and suggestions as to how the content should be taught and assessed. It encompasses what is done both inside and outside the classroom as prescribed by the assessment standards in the Natural Science Policy (DoE, 2002).

### **2.3 Curriculum change**

Curriculum change is a global phenomenon. Both developed and developing countries review their curricula regularly to meet their various needs. In most instances curriculum changes are attributed to economic, political or social aspects, or a combination of these. Many reasons are given by different stakeholders for curriculum change. Fullan (1999), however, is of the view that not all change leads to improvement, but all improvement leads to change, and in discussing the background of the study it becomes clear that the improvements made on C2005 came with some changes in the way the curriculum is to be implemented in classroom practice. Lemmer (1999) reports that reform is concerned with planned innovation, adoption, changes and departure from established practices. When researching the way stakeholders interact with a new curriculum it is imperative to understand what the nature of that change is.

Berman (1980) defines curriculum change as a new course or programme, or improvements on the aspects of the existing curriculum in practice. Doll (1989) maintains that the process of curriculum change is nothing more than educational engineering. Elliot (1998) confirms Doll’s view in describing curriculum change as not simply changes in the content taught but the reappraisal of the nature of knowledge and outcomes. This suggests a new way of representing knowledge to learners. Since the transition to democracy, South African schools have experienced substantive curriculum change. First there was the change from the Nated 550 curriculum which was viewed as an inferior curriculum when it was in operation to C2005 that envisaged similar outcomes for all learners (Umalusi, 2008). Not only was C2005 introduced to remove any inequality, it also presented a major paradigm shift. Challenges in its implementation resulted in review of the curriculum which resulted in the RNCS which has now been made user-friendly through the introduction of the CAPS (DBE, 2012).

From the given explanation, curriculum change is associated with “new ways” of doing things in schools that impact on classroom practice (Ross, 2000). Rotermund (2009) expresses the view that curriculum change needs to happen at all levels with appropriate guidance. Everyone, including teachers, parents, learners, school administrators, professors and government officials, should be in agreement with regard to such changes and be prepared to embrace them (Rotermund, 2009).

### **2.3.1 Curriculum change internationally**

Kiptoon (2004) is of the view that curricula cannot be constant as they need to change to meet the demands of different societies in terms of social, political and economic realities. Social reconstructionists believe that students are the critical element in bringing about social change and schools should change to reconstruct society. To ensure this reconstruction of society, the curriculum should promote the kinds of values and knowledge that will ensure the building of a new social order (Nias, 1991). It is clear from the literature that curriculum change goes hand in hand with economic and social change as students should be developed to function in changing environments (Knight & York, 2006; Poster, 1999). Beare (2001) confirms that this paradigm shift is necessary as it ensures that schools develop students who will be able to function in a changed social environment.

Tanner and Rehage (1988) claim that curriculum change is common in the United States of America (USA) as there is the tendency to address all social problems by changing the curriculum. Popkewitz (2000) characterises the school curriculum as a cultural system through which national and global identities are constructed. Economic and technological reforms in Japan prompted sweeping curriculum reform. The USA and Britain experienced similar situations (Phorabatho, 2010; Fullan, 2005). The Chinese education system has also been heavily influenced by theories and systems originating in the USA (Guo, 2009; Gregory & Meng, 2002).

Cheleen and Shu-Wei (2006) state that in Singapore there are noticeable differences between the schools of the industrial and the pre-industrial era. This indicates that schools in the knowledge-based economy of the twenty first century change their curriculum to prepare students as per the needs of the country. Large-scale curriculum change in the United Kingdom (UK) has also had an effect on teachers who become demoralised by the amount of



change (Nias, 1999). Various African countries have been subjected to major curriculum changes that have had substantial effects on society at large. Gordon and Power (1999) attest to the fact that poor curricula contribute to the problem of unemployment in Mozambique and in many other countries hence it is imperative for countries to change their curricula to promote entrepreneurship and technical skills which provide school leavers with employment.

### **2.3.2 Curriculum change in South Africa**

In South Africa curriculum reforms were aimed at redressing the past racial inequalities and injustices of the apartheid regime. The democratic South Africa needed to transform and develop the type of learners that would match the society envisaged in the South African Constitution (Vinjevoold, 1999). This is a laudable goal towards social reconstruction as it envisions race and gender equity with a single curriculum for all. Such a curriculum introduced new skills, knowledge, values and attitudes for all South Africans and stands as the most significant educational reform in South African education of the last century. Mungazi and Walker (1997) also allude to the importance of responding to challenges of the lack of entrepreneurial skills which could be the answer to job creation hence learning areas like economic and management sciences, as well as technology are part of the curriculum. Unfortunately change has also been driven by political imperatives with no connection to the realities of classroom life (Fiske & Ladd, 2004; Fullan & Miles, 1992; Jansen, 1998).

According to Maphalala (2006), curriculum change has an effect on the educational system which impacts positively or negatively on the lives of the people. It can divide or unite people socially. Harley and Wedekind (2004) agree with Maphalala's view that the curricula of apartheid South Africa have been used to divide different races and to prepare different groups for dominant or subordinate positions in social, political and economic life. The mission of the new curriculum would be that of uniting all citizens as equals in a democratic and prosperous South Africa. In the first half of the twentieth century black people were mostly educated in mission schools. The Bantu Education Act of 1953 closed down the mission schools and introduced nineteen different departments of education for different race groups which were unequally funded and followed different curricula. One of the major challenges of the democratically-elected government in 1994 was to bring about equality of resources and curricula. Nineteen education departments were merged into one national

department in 1995 and there was a first 'wave' of curriculum cleansing which was aimed at removing the most blatantly racist content from curricula (Bertram, 2008).

Bantwini (2009), Chisholm (2005), and Jansen (1998) are also of the view that there have been three major waves around which curriculum revision has taken place. The first wave aimed at cleansing the syllabi from outdated content for a single democratic system of education but this was welcomed with ambivalence by the educational sector. It was good that the process was seeking to establish a single national core syllabus irrespective of race to facilitate participatory and representation of all South Africans but there was also fear that the education standards would regress. According to Ramroop (2004), the feelings included excitement, anger, trepidation, outrage and caution. The second wave was the birth of C2005 which was driven by the principle of OBE, underpinned by social values. Morrow (2000) described OBE as the 'New Scripture', the path that was chosen to move South African education away from all that was bad about apartheid education. Harley and Wedekind (2004), Jansen (1998), Manganyi (2001), Rooth (2005), and Vambe (2005) agree that C2005 brought about transformation in education and was viewed as the master plan to eradicate the inequalities of the apartheid education system. However, the implementation of OBE is laden with controversy and fears that problems that surfaced with regard to OBE in the USA would also occur in South Africa (Hargreaves, Fullan, Lieberman & Hopkins, 2001). The third wave is about the review and the revision of C2005 to make it a user friendly curriculum that could be effectively used in South African schools. This resulted in the RNCS after the recommendations of the Ministerial Review Committee.

C2005 marked a shift from the traditional content-based teaching where the teacher is the sole source of information to an outcome-based approach. It focuses on clearly defined outcomes rather than adhering to the syllabus content and learners' progress is measured on agreed criteria in a transparent manner (DoE, 1997). There were a number of challenges in the implementation of this curriculum - teachers were not adequately trained to cope with effective classroom implementation of the curriculum as they did not have the necessary discipline knowledge to teach what was specified in the curriculum (Manyokolo & Potenza, 1999). Furthermore, while the curriculum was introduced by the National Department of Education, responsibility lay with the provincial departments to implement this curriculum (Christie, 1999). Jansen (1999) is of the opinion that the main reason C2005 failed and had to be reviewed is because its purpose was symbolic and political rather than pedagogical.

Problems encountered during the implementation of C2005 led to the introduction of the RNCS which was rolled out within the manageable time frames for the GET band (Grade R-9) in 2004 to 2007, and a new set of National Curriculum Statements for the FET band (Grades 10-12) released in 2006 (Parliamentary Monitoring Group, 7 November, 2001). This curriculum reform promoted the vision and values of the South African constitution. These were actualised through the attainment of the learning outcomes which contain aspects of critical and developmental outcomes, which emanated from the constitution itself. When the teacher addresses all learning outcomes with the appropriately designed activities according to their related assessment standards, learners are exposed to all critical and developmental outcomes. It was noted earlier that curriculum change may be a response to economic disparities and it is one of the reasons that necessitates a change in the South African curriculum to allow the disadvantaged population to escape the scourge of deprivation and poverty in which they were trapped for decades under apartheid rule (Phorabatho, 2010).

### **2.3.3 Reform in the science education curriculum**

The RNCS (2002) advises that technology and natural sciences should be offered as separate learning areas as opposed to them being combined in C2005. Combining the two may lead to one learning area being compromised depending on the teachers' competencies. It is imperative that justice prevails in these learning areas because they form the foundation for the science and the technology subject fields in FET. Benson, James and Naidoo (2008) claim that South Africa needs to promote science and technology as a means to improve living standards. South Africa is in need of scientifically and technologically qualified individuals who are passionate about science and technology and would be able to use their skills to advance this country economically. Both C2005 and RNCS require a paradigm shift in the implementation of science from being content-based which is teacher-centred to being achievement-based informed by a learner-centred approach. Changes in the South African policy have led to changes and great expectations in the way teachers implement as well as the way learners learn science in the classroom. Teachers become designers of learning programmes with directives in policy documents (DoE, 1998). In the teaching of NS, learners have to attain a variety of science process skills and construct scientific knowledge as demanded by the learning outcomes in the RNCS.

The way the NS policy is structured creates challenges for teachers to cope with new demands in the absence of work schedules that are effective in classroom practice. It was also Jita's (2004) view that teachers' problems could have been solved had they been provided with relevant teaching plans for classroom practice. Learning Outcome 1 (LO1) pertains to scientific investigations and states that learners should act confidently on curiosity about natural phenomena, investigate relationships and solve problems in scientific, technological and environmental contexts. The teacher exposes learners to a number of science process skills through activities based on scientific investigations. This is supported by Ambross (2011) stating that inquiry-based learning is highly recommended in the teaching of science. King, Shumow and Lietz (2001) attest to the adoption and use of scientific investigations by many states around the world. However developing science process skills and using them appropriately requires skilled teachers (Harlen, 2000). While all three learning outcomes are necessary and important for the teaching and learning of NS, the use of LO1 seems the best in the teaching and learning of science as compared to the traditional way (rote learning or memorisation of science content). It is hoped that it would promote the love of science and may eventually affect the matriculation performance positively (Gibson & Chase, 2000). Matriculation performance is a problem in South Africa and most schools have been complaining about the results that were showing the failure rate of mathematics and physical science. Xulu (2012) was interested into how under-resourced schools could use science resource centres to improve their physical sciences teachers' level of pedagogic content knowledge to improve the learning of science. Tawana (2009) was also interested in identifying relevant factors in implementing a Chemistry curriculum.

## **2.4 Teachers and curriculum change**

Teachers are at the centre of curriculum change and it is important to involve them in curriculum discussions. Policy makers seldom consult teachers directly when changes are made to curricula. It becomes a top down approach. The result is that teachers do not feel that they are part of the decision-making process and this leads to them feeling inadequate and incapable (Kelly, 1994). Therefore lack of ownership creates a major problem. Hargreaves (2004) is of the view that self- initiated change by teachers is highly recommended and is beneficial to learners because teachers will eagerly engage them in the learning process to yield positive results. Most of the times parents and education officers are only interested in a high pass rate in matric examinations and it becomes difficult for teachers to incorporate

suggested changes. Research has shown that teachers often become frustrated enough to resign in the face of curriculum change (Hargreaves, 2003).

Hargreaves (2004) claims a relationship exists between the emotions of teachers and change. Government changes bring negative emotions because teachers consider them imposed on them with no proper guidance. Abraham (2004), as well as Fullan and Stiegelbauer (1991), are of the same view as Hargreaves that change is painful and requires a strong support system in the form of training, mentoring, seminars, and so on, to make its implementation and management bearable. Nias (1991) describes the pain and negative emotions of teachers from the UK as caused by large-scale legislated education change. Standardised testing requiring a large degree of accountability from teachers is also a contributing factor in the UK. Dinham and Scott (1990) as well as Hargreaves (2003) attest that in the UK, Australia and USA teachers were stressed, lost confidence, felt belittled, abused and some left the system because of large-scale legislated changes in education. Moreover the failure to implement new curriculum changes successfully in classroom practice still prevails. From Hargreaves' (2005) findings it is evident that large-scale legislated education change persists to fail to win credibility from and commitment among most teachers responsible for implementing it. Self-initiated change is desirable but is not common.

It is argued that new well designed curriculum reforms with impressive outcomes have failed because the implementation aspect is overlooked and too much attention focuses on the intended educational change (Rogan & Aldous, 2005). Hinde (2002) concurs with this in that curriculum reforms neglect how things ought to be done in the classroom and focus on what is to be achieved. A number of researchers comment on this expressing it differently. Sethole (2004) describes it as a gap that exists between the intended and the implemented curriculum, Jansen (2001) reports on a disjuncture, and Rogan (2004) as a mismatch between expectation and reality.

## **2.5 Factors which impact on the way teachers implement a new curriculum**

According to Porter (1980, p.75), "the people concerned with creating policy and enacting the relevant legislation seldom look down the track to the implementation stage." If a link existed between curriculum developers and curriculum implementers, the factors that impact negatively on curriculum implementation could be minimised. These factors could be

discussed during the process of decision-making to establish a common understanding and the various strategies to employ them in a classroom practice. This may enable the policy to be interpreted in the same way by everyone.

### **2.5.1 Teachers' philosophy of teaching**

Goodyear (as cited in Coppola, 2000) states that teaching philosophy is about beliefs, values and approaches in classroom practice. Hence science teachers bring into their classrooms many beliefs about the nature of teaching and learning which they have in turn encountered in their teacher education courses (Anderson and Bird, 1995) or through their own experiences. The beliefs entail the meaning of science, the relationship between teaching and learners' learning of science. This also includes the various presentation strategies and the follow up intervention programmes drawn up after each assessment task. The use of appropriate teaching approaches emphasises links with environment, addressing misconceptions and stressing the use of the teachers' pedagogic content knowledge.

According to Lang (1996), as well as O'Neil and Wright (1997), a philosophy of teaching describes the identity of a teacher and provides a focus for teaching activities. A good teacher must know her subject to be able to impart knowledge to learners, and to motivate them to think and to want to learn more. A good teacher must be a life-long learner so as to inspire learning in her learners. She must employ a variety of teaching methods which must be examined from time to time to find new ones, especially those that will mould learners to become critical thinkers. This is done by encouraging them to analyse, apply, synthesize and evaluate all they read and hear. She has to understand her learners and acknowledge the experience they bring to class from their diversified contexts (Hassett, 2000).

In a healthy classroom relationship, relaxed and excited learners learn more and bring a lot of knowledge into the classroom. Furthermore, Dawson and Atkinson (2012) believe that thought-provoking questions will lead learners to scientific discoveries as they engage in investigations. Teachers' beliefs are important in shaping lessons and their content knowledge also contributes to a variety of learning styles for learners to grasp the concepts.

### **2.5.2 Content knowledge**

Teacher education often emphasises pedagogical knowledge above subject or content knowledge. In South Africa, certain colleges of education followed a curriculum where a student teacher enrolled for a Senior Primary Teachers' Diploma would study general science didactics, irrespective of doing or having done any science subject. These students would qualify as science teachers without being exposed to scientific knowledge. This impacted negatively on classroom practice. Teachers' science content knowledge has a great influence on classroom practice. Alonzo (2002) and Sanders, Borko and Lockard (1993) maintain that teachers with a stronger content knowledge can develop a variety of questions to extract the learners' understanding about a particular aspect. They also develop the ability to propose more investigations to clarify concepts for learners. They welcome and readily respond to questions based on different cognitive levels. However Sanders *et al.* (1993) attest that teachers with weak content knowledge struggle to engage learners in the development of events for conceptual progression.

Teachers usually teach the way they were taught and this is confirmed by two studies conducted by Nehm and Schonfield (2007), as well as Rochrig and Luft (2004), where they note that teachers, who see science as a body of knowledge for solving problems, will plan instructions for learners to use in a similar manner. Grayson (2010) claims that many South African science teachers teach the content they are comfortable with and skip the rest because they lack the appropriate content knowledge. Learners' scientific knowledge will in turn have gaps. She then urges teachers to increase their science content knowledge through studying. Basista and Matthews (2002) regard content knowledge as a pre-requisite for greater performance in classroom practice because it provides teachers with an understanding of science before they make learners understand it. That is why there have been calls from the Minister of Basic Education through the media to encourage content workshops for natural sciences and mathematics teachers in the GET band to strengthen the foundation of the gateway subjects. It is my experience that the issue of poor content knowledge is particularly pertinent in the South African context.

### **2.5.3 Pedagogical Content Knowledge (PCK)**

PCK is a blend of content and pedagogy that creates an understanding of how particular aspects of subject matter are organised and adapted to the diverse interests and abilities of learners, and presented for instruction (Loughran, Berry & Mulhall, 2006). Shulman (1986)

introduced PCK to address the dichotomy that existed between subject matter and pedagogy. PCK enables the teacher to select appropriate teaching strategies for particular topics. As connections are made between known concepts and using new strategies, learning takes place and the body of knowledge grows. Jambekar (2000) regards knowledge as a web of concepts with much knowledge between them. Many authors (Graeber, 1999; Henningsen & Stein, 1997; Loughran, Berry, Mulhall & Gunstone, 2002; Loughran, Berry & Mulhall, 2004; Marks, 1990; Shulman, 1987; Van der Valk & Broekman, 1999) claim that PCK concerns itself with the representation and formulation of concepts, pedagogical techniques and knowledge of what makes concepts difficult or easy to learn, knowledge of students' prior knowledge and theories of epistemology. This makes it different from the general pedagogical knowledge shared by teachers across disciplines. It considers the knowledge that the learner brings to the learning situation and addresses learner difficulties, misconceptions and misapplications, fostering meaningful understanding. Confronting issues of content and pedagogy simultaneously will make teachers very successful in their teaching because methods relevant to the subject matter would be used.

PCK boosts the confidence of science teachers and furnishes them with a framework for designing meaningful science lessons. These are the views of Loughran, Mulhall and Berry (2008) that further claim the excellent results yielded by science student teachers who incorporated PCK in their training when faced with challenges in traditional science teaching in schools. Kind (2009) and Rohaan, Taconis and Jochems (2010), point out that excellent teachers are not born with PCK; acquiring the bank of skills is a process that takes time. A rich PCK is a special combination of content knowledge and pedagogical knowledge that is built up over time and experience. The knowledge of content and pedagogy used in the teaching of science does not merely present a linear model but it is very complex with many challenges.

In South Africa poor performance of learners in science is viewed by a number of researchers as emanating from shortages of well qualified and competent science teachers (Makgato, 2007; Mji & Makgato, 2006; Muwangazake, 2008). Science content knowledge and pedagogical content knowledge is inseparable, thus having only one will never make a better science teacher (Trowbridge, Bybee & Powell, 2004). A good science teacher should have expertise to simplify and contextualise science concepts to facilitate understanding thereof (Duit, Niedderer & Schecker, 2007). Networking with other teachers is pivotal as



recommended by Bell and Gilbert (1996), in their model of teacher development. A teacher possessing both the academic and the pedagogic knowledge can engage a variety of approaches, improvise and try out new ideas to meet the needs of curriculum implementation.

#### **2.5.4 Learner factors**

There are eleven spoken languages in South Africa but the language of instruction in schools is English. It is only now with the implementation of CAPS that the home language is used as a medium of instruction in the Foundation Phase (FP) (DoE, 2012). López (2007) attests to classroom learner diversity characterised by unique learner needs. Hence various teaching modes are required to enable all learners to acquire the necessary knowledge and skills. Staub and Stern (2002) believe that during the learning process the development of thinking and reasoning processes should be stressed more than the acquisition of specific knowledge. To achieve these, teachers must employ the enquiry method in the presentation of their lessons and give learners the chance to develop solutions to problems by themselves. Teachers must provide the appropriate guidance. Sometimes teachers will transmit knowledge to learners in a simple structured way, giving straightforward problems that require simple solutions for them to solve. This is recommended by Brown (2000) because some learners lack confidence in themselves, and she believes that scaffolding techniques may solve the problem. Brown (2000) is also of the view that sometimes teachers may have no confidence in learners and this will create a barrier because learners might not be provided with the necessary support. Diverse backgrounds are also a barrier that contributes to learner failure or a decrease in their performance due to a lack of academic support and the provision of basic needs from parents.

#### **2.5.5 Resources**

Cohen, Raudenbush and Ball (2000) allude to the interaction of teachers, learners and the content with the available resources as crucial. They refer to such interaction as theory of instructional resources. They introduce the classroom diversification paradigm which is concerned with the effective and the efficient use of resources during classroom practice. Teachers must be well capacitated in employing their classroom management skills, vary their teaching and instructional methods in guiding learners in the use of resources to maximise their learning. It is not certain that their availability will make a change but how they are used will impact greatly on the outcomes (Grubb, 2008). Buildings in the form of classrooms, laboratories, libraries, and so on, are also regarded as resources.

### **2.5.6 School ethos and management**

These are not similar factors but they are interwoven. They may be positive or negative and are easily detected as one enters school premises. Positive ethos permeates the school and helps in forming a strong sense of social cohesion within the school. They concern the appearance of the school, the relationship of teachers with learners, the school attitudes to visitors, and so on. Donnelly (1999) describes ethos as expressed wishes of the managers in an organisation and is the means by which each member of the organisation is committed to what is deemed natural, proper and right, but it all depends on how the community of a school behaves. Hence Norman (2003) perceives the ethos of a school as the character of a school which is influenced by the behaviour practice of its community. However it all depends on the leadership role of the principal which is critical when it comes to implementation (Fullan, 1991).

### **2.5.7 Practical work**

Good quality practical work can engage learners, assist in developing crucial skills and help them understand the process of scientific investigation and concepts (Woodley, 2009). SCORE (2009) defines practical work in science as a “hands-on” learning experience which prompts thinking about the world in which we live. Abrahams & Millar (2008) are of the view that some learners learn best when they see things happen and contend that practical work promotes a link between what learners observe and the ideas developed. He clarifies it as a link between hands-on and minds-on. He further suggests that learning about scientific ideas “is not discovery or construction of something new and unknown, rather it is making what others already know, your own” (Millar, 2004, p. 12). This may compel teachers to develop the ability to carry out experiments and to possess basic scientific knowledge and professional competencies which according to Fisher (2010) are lacking in most primary school teachers. For some learners and teachers practical work is much easier than any theory learnt because it involves the naming of apparatus and the manipulation of the apparatus as written out under the given procedure. This is not what is meant by Millar (2010) when he emphasises that when group or individual practical activities are conducted, learners must be actively involved in the manipulation or observation of real objects as opposed to watching DVDs for instance. To him its role is to enhance learning as he suggests that a teacher must be very clear about what learners will learn through engaging in a practical task which they cannot simply achieve when it is told to them ( Millar, 2002).

Most of the content in primary school science focuses on “real life” which could be easily used in an ordinary classroom environment. Therefore resources or equipment for experiments should be readily available and simple observations could be easily done as theory and practical sessions are alternated (Clark, 2000). Fisher (2010) claims that most primary school teachers do not conduct practical work giving a number of reasons for not doing so. She recommends that teachers participate in professional development programmes where they will be presented with practical activities using local materials. She presumes that they will be stimulated to think of alternative materials that will best suit the different topics taught. She also claims that teachers should possess a good foundation of theory for them to be able to improve their teaching.

### **2.5.8 Science in society**

Learners should be aware that science is all around us. They must be exposed to how science is influenced by human uncertainties, interests, judgments and values (Abd-El-Khalick & Lederman, 2000). In the RNCS (2002), both science and technology share a learning outcome in science, society and the environment which learners ought to attain as they demonstrate an understanding of the interrelationships between science and technology, society and the environment. This includes understanding the impact of science and technology on the environment and on people’s lives. It is important again that learners be able to recognise bias in science and technology which impacts on people’s lives (DoE, 2002). The term ‘science’ is derived from “scientia” which means knowledge, and it relates to technology, derived from “technologia” (art and skills), as technology uses the sciences theories and laws to make equipment and apparatus. Hence they work hand in hand to improve the quality of human life (Sawday, 2007). There are advantages and limitations in society due to science and technology. It is important that learners are aware of this. Science assists humans in increasing their understanding of how the world works while technology makes discoveries. Learning outcome three (LO3) is intended to develop the understanding that science and technology have an impact on society and the environments they live in.

### **2.5.9 Assessment**

Assessment is an integral part of teaching and learning and whenever one plans how to teach, one must also plan how to assess. It is a process that furnishes the teacher with the learners’ progress and achievement to identify how learning should progress. There are different types of assessment, namely baseline, formative and summative, and the various assessment forms

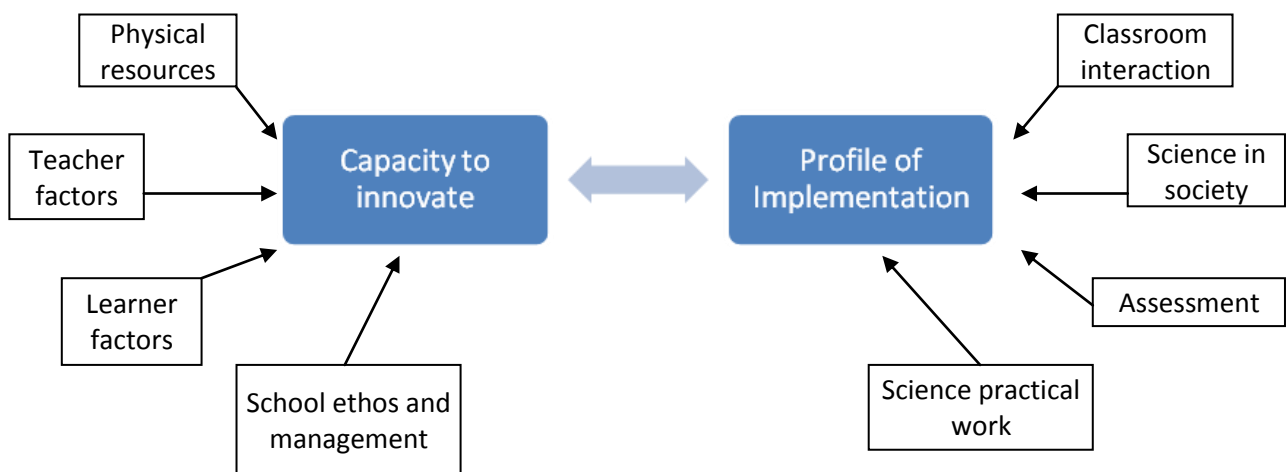
that learners ought to be exposed to cater for the different styles in learning and creates opportunities for all learners to perform well in assessment (DBE, 2002). There are forms of assessment that are highly recommended in science because they promote enquiry learning, e.g. science projects, investigations and demonstrations. In science projects and investigations learners can design things or solve everyday problems applying the knowledge learnt in the classroom. They can also explore issues of their own interest. Diffily (2001) also recommends this form of assessment and attests that any science topic can become a focus for an investigation. When investigations are applied appropriately, they can encourage and strengthen the learners' exploration and the ability to invent. They can stimulate observation and thinking skills while strengthening the analytical skills and the understanding of the relationship between science, technology, society and the environment (So & Cheng, 2001). Tests and exams can promote the acquisition of knowledge and concepts. Herman and Knuth (1991) advise that assessment data allows learners to progress to higher grades. They further allude to quality assessment through ensuring that questions relate to the knowledge, skills and values of the content specific to the grade and that cognitive demands are met.

## **2.6 Theoretical framework**

Lovat and Smith (2003, p. 194) relate change to replacing the "old" with the "new". Those who attempt to maintain the "old" do anything to preserve it, while those who support the "new" are expected to do everything to endorse it. However, Fullan and Stiegelbauer (1999) state that whatever change occurs, new experiences are always dependent on known, reliable constructions of reality which allow people to attach their own meanings regardless of how meaningful they might be to others. Therefore every change represents personal and collective experiences of the people concerned. If their inputs are ignored as part of the change, contradictory results may emerge. A number of authors including Rogan and Grayson (2003) and Bantwini (2009), confirm that curriculum changes are aimed at improving the educational system through the improvement of teaching and learning in the classroom. Rogan and Grayson (2007) are of the view that curriculum change should be gradual to allow teachers to develop in order to meet the demands of the new curriculum. Hargreaves (1998) agrees that sometimes change is too broad and exaggerated so that teachers have to work on too many fronts, or it is too limited and specific so that no remarkable change occurs at all. However, Verspoor (1989) is of the view that low outcomes

may result from poor implementation of what is essentially a good idea. This confirms the necessity of appropriate implementation.

This study is informed by the theory developed by Rogan and Grayson (2003), referred to as a theory of curriculum implementation, because it is about how teachers implement a new curriculum and the factors that influence the way they implement this curriculum. According to Aldous (2004), Rogan and Aldous (2005) and Rogan (2007), the chosen theoretical framework is relevant to curriculum implementation in science education and in the context of a developing country. This framework draws on school development, educational change and science education literature to develop three constructs, with their sub-constructs. The Profile of Implementation (in the classroom), Capacity to Support Innovation and Support and Outside Agencies are three constructs on which the theory is based.



**Figure 1: Rogan and Grayson’s (2003) model adapted for this study**

The constructs that will inform my study are: the Profile of Implementation which attempts to understand and express the extent to which the aspirations of the curriculum are implemented in classroom practice, as well as the capacity to innovate which attempts to understand the teachers’ capacity to implement the curriculum. A third construct, outside influence, was used by Rogan and Grayson (2003), and their research focused on whole school implementation of C2005.- My study will not include this third construct because my focus is specifically on teachers’ interpretations of the RNCS curriculum as well as on the way they implement the curriculum.

I will use Rogan and Grayson's (2003) model to place the teachers at different levels depending on their level of implementation. The levels will progress from one (teacher-centred) to four (learner-centred) and the decision of whether a teacher is located at level one or level four will be informed by the constructs present in figure two.

These levels will map out a number of routes to a number of destinations hence they are flexible and consider the teachers' interpretation of the curriculum and the capacity of their school in working towards a meaningful implementation of RNCS. Higher level practices do incorporate lower level practices which mean that a school could be at level one for one construct and at level four for another. Schools with low-level resources will be placed at one, and those with better capacity to implement will be at four. These levels will inform data analysis as they will be used to determine where teachers are located. Motswiri (2004) recommends the model on the grounds that many schools in developing countries are disadvantaged and under-resourced. This is in agreement with the fact that different teachers in different schools will start at different levels depending on the availability of physical resources, classroom practice and the interpretation of the curriculum. Factors from different sub-constructs may affect schools and teachers differently but the framework will provide the principle of differentiated implementation as the answer. It will help identify gaps between the current practice and the intended practice so as to establish the nature of support needed.

Rogan and Grayson's model was also applied in whole school research concerning the implementation of science or part of the science curriculum. In Tawana's (2009) work on improving the learning of Chemistry in Botswana schools using the content of the proposed curriculum, he also included the ZFI to categorise practice and capacity to implement. There are different models used by researchers of developing countries which are appropriate to their study such as Xulu (2012) who used constructivist theory when investigating the equipment used by physical sciences teachers in the teaching and learning of science in schools.

### **2.6.1 Capacity to Support Innovation**

Capacity to innovate shows how the school context can support or inhibit curriculum implementation.

1. Physical resources. They can be differentiated into human-resources which relate to the availability or unavailability of science teachers in a school and non-human resources in the form of classrooms with classroom furniture, laboratories with science apparatus, libraries or media centres with books and stationary and textbooks for learners and teachers. Other resources may be indirectly involved with teaching in the classroom but may impact negatively on it if they are not available, e.g. toilets, secure premises and well-kept grounds. Poor resources may hinder performance.

2. Teacher factors. These refer to the teachers' ability to teach depending on qualifications, experience, professional development as well as the teachers' science knowledge and their pedagogical content knowledge.

3. Learner factors. This concerns itself with barriers experienced in terms of the language of teaching and learning and the support that learners derive from their homes in doing their school work as a determining factor for their success. Their background also detects the strength and shortcomings they might bring to the learning situation.

4. School ethos and management. Role played by the school leadership in maintaining a healthy and conducive environment where teaching and learning takes place efficiently and effectively. It also involves the support that they provide in terms of the science equipment and other relevant resources.

### **2.6.2 Implementation factors**

The development of a profile of how the curriculum is implemented will contribute to their classification into the different implementation levels.

1. Classroom interaction. This concerns itself with what the teacher does and the learners do during the development of the lesson. The literature reviewed attests to a number of reasons that contribute to science implementation problems in South Africa as well as in other countries like the USA.

2. Science practical work is about the engagement of the teacher and learners in addressing LO1, which is about scientific investigations. It promotes critical thinking and the ability to participate in decision-making in an informed way (DoE, 2002).

3. The incorporation of science in society. This is clearly spelt out in LO3: science, society and the environment. The science in the classroom must relate to the aspects that impact on the well-being of the society and the environment. There is a paradigm shift from prescribed content to a contextualised content to meet the needs of the society and to address the

knowledge, skills and values as set out in the assessment standards of every grade in a conceptual progression.

4. Assessment will only be noted as part of lesson planning. It will be checked if the form of assessment used at different levels is appropriate to the level in question without considering the learners' responses because the study is only about teacher implementation.

## **2.7 Conclusion**

In this chapter I discussed the pertinent literature relating to curriculum change both internationally and locally. I also elaborated on what informs curriculum change as well as its implications for teachers. A discussion of factors that may impact on the way teachers interpret and implement a new curriculum also informed my review of the literature.

I have indicated how I used Rogan and Grayson's theory of implementation to select particular constructs which serve as a theoretical framework for my study. In the next chapter I will discuss the methodology that informed the study.



# CHAPTER THREE

## RESEARCH DESIGN AND METHODOLOGY

### 3.1 Introduction

This chapter focuses on the methodology followed to generate empirical evidence to answer the research questions in this study. It outlines the paradigm within which the study is located, as well as the approach, design and methods chosen for the study. It further clarifies procedures followed in sampling, collecting and analysing data. Procedures for ethical clearance, limitation of the study as well as issues of trustworthiness and credibility are discussed.

### 3.2 Research paradigm

A paradigm is described by Patton (1990) as a “world view” because it provides a conceptual framework for seeing and making sense of the social world. Guba and Lincoln (1994) further clarify it as a “basic belief system that guides the investigation.” The particular world view that defines this study is an interpretive one as the researcher wishes to interpret the perceptions, views and actions of the participants in the study. Neuman (1991) argues that with the interpretive approach the researcher shares the feelings and interpretations of the people studied and sees things through their eyes. Barbie and Mouton (2001) are in agreement with Neuman’s view as they claim that the interpretive tradition emphasises that “all human beings are engaged in the process of making sense of their worlds.” We continually interpret, create and give meaning to define, justify and rationalise our actions. Cohen, Manion and Morris (2007) confirm that the interpretive paradigm strives to understand the participants in their world and how they define their social reality. The interpretation of their reality, according to Cohen *et al.* (2007) includes the meaning given to data from the views of people being studied. This is in contrast to the positivist paradigm which measures independent facts about a single reality (Healy & Perry, 2000). Mertens (1998) advocates that epistemologically, knowledge is socially constructed by those in the research process and that the researcher should be sensitive to the complex experience from the participants’ perspective. As I wish to understand how and why teachers engage with the natural science curriculum in the way they do, the interpretive paradigm is the most appropriate one to use.

### **3.3 Research approach**

The qualitative approach is a suitable approach for my study as I researched the lived experiences of a small number of teachers with regard to the natural science curriculum. The quantitative approach is not appropriate because it will provide me with numbers and will not precisely consider the thinking and feelings of teachers. This is confirmed by McMillan and Schumacher (2001) when they state that quantitative research often uses an experimental design which follows a set of procedures and steps to eliminate unnecessary variables, error and bias in establishing relationships and explaining causes of changes in measured social settings. Johnson and Christensen (2008) claim that it considers a larger sample that is randomly selected and works under controlled conditions, hence it will not be applicable to my study because it only deals with three teachers who are not randomly selected. According to Angen (2000), qualitative research is interpretive and subjective in the sense that different people can perceive the truth differently. It is concerned with describing and understanding human interactions and lived experiences and researchers study phenomena in their natural settings, attempting to make sense or interpret phenomena in terms of meaning people bring to them. Cresswell (2005) views qualitative research as consisting of a number of methods involving interpretive naturalistic approaches to its subject matter. As the number of teachers in the study was very small, this enabled me to study their perceptions and understandings which led to their interpreting and implementing the curriculum in a particular way.

### **3.4 Case study**

Yin (2002) views a case study as a research strategy involving an examination of a single event over a long period of time. It can be qualitative, quantitative or a combination of both. It is a research design situated between concrete data taking techniques and methodologic paradigms (Lamnek, 2005). This means that a case study provides a researcher with a clear understanding of why a particular event happened the way it did and the studies of interest that might emerge from reports compiled after analysing the collected data. This can lead to generating and testing hypothesis, the results of which may be aligned to either qualitative or quantitative or a combination of both. McMillan and Schumacher (2001) refer to a case study as an investigation that gives more global analysis of the situation while Adelman, Kemmis and Jenkins (1980) define it as an instance in action. Nisbet and Watt (1984) elaborate on this view as they refer to it as a specific instance of a bounded system designed to illustrate a

more general principle. Cohen *et al.* (2007) support the case study approach by arguing that “a case study provides a unique example of real people in real situations enabling readers to understand ideas more clearly rather than simply presenting them with abstract theories or principles.”

Case studies can be used for exploratory, descriptive or explanatory research and are widely used to offer insight that cannot be achieved with other approaches. They are probably most valuable in testing new theories (Flyvbjerg, 2006). It is useful when a *how or why question is being asked about a contemporary set of events over which the investigator has little or no control* (Yin, 1994, p. 9). The use of the case study will be necessary for my study to allow the teachers to speak for themselves about their interpretation of the RNCS curriculum and the factors influencing its implementation. I will therefore try to minimise subjectivity when interpreting their words and actions by giving it back to them for verification. I have used a case study in my research to examine a bounded system, which is Grade four NS teachers from three schools which are within a one kilometre radius of each other, using multiple ways of data collection. This concurs with Yin (1984), Merriam (1988) and Robson (2002), as they define the case study as an empirical inquiry that investigates a contemporary phenomenon within its real-life context research strategy usually employing many types of data.

However, case studies have been criticised for their distinctive nature to the studied groups or events. Collected data cannot necessarily be generalised to the wider population because one cannot claim that if a case study produces data from one group or process, it will be relevant for a different group or process elsewhere. They are also disadvantaged by conclusions which may consist of a high level of subjectivity (George & Bennett, 2004). However Pettigrew (1985) is of the opinion that it plays a role in developing and refining generalised concepts and that multiple case studies can lead to generalisations in terms of proportions. Walsham (1993) and Yin (1994) are in agreement that a case study is useful for analytical generalisations where the researcher generalises a particular set of results to some broader theoretical propositions. Its validity emanates from “plausibility and cogency of the logical reasoning applied in describing and presenting the results from the cases and in drawing conclusions for them” (Walsham, 1993, p. 4-5).

I have chosen a descriptive case study which according to Yin (2003) describes the phenomenon as it occurs and the real-life context in which it occurred. This is appropriate to

my study because I will be using the variety of data that will shed light and allow me to gain insight into how the Grade four teachers from a disadvantaged part of Umlazi district implements the NS curriculum.

### **3.5 Sampling**

This study adopts a purposeful sampling method which according to Ary, Jacobs and Razavieh (2002) and Christensen and Johnson (2004), is a small group with a similar background selected to provide the relevant information about the topic or setting. It is purposeful in the sense that I have chosen teachers who teach NS. Purposive samples provide maximum insight and understanding of what is studied. This study focuses on the implementation of the RNCS curriculum by Grade four NS teachers from Folweni, which is the rural part in the Umbumbulu circuit of the Umlazi district. Three Grade four NS primary school teachers were chosen from each school in Folweni, as justified by Patton (1990), that in purposive sampling participants are chosen because of some characteristics. The research sites are the three schools from the same cluster. The three schools are within a radius of less than a kilometre from each other. They belong to the same cluster and are surrounded by informal settlements and low cost housing provided by the government of South Africa for disadvantaged citizens. One of the schools uses prefabricated housing as their classrooms. All the schools have similar learner populations with regard to their socio-economic circumstances.

Grade four is selected for this study because it is an entrance grade in the IP where nine learning areas are taught instead of three learning programmes followed in the FP (RNCS, 2002). NS teachers in Grade four are expected to build a strong foundation for physical sciences and life sciences taught in the FET phase through the implementation of the NCS curriculum.

The participants are three Grade four primary school teachers. They are all females because there was no male teacher in a Grade four NS class in this cluster. Each has a pseudonym. Thulile is the first participant from school A. She was visited in November 2011. Maria from school B is the second participant. Gugu from school C was faced with problems of overcrowding. When she was visited in November 2011 there were 65 learners in her class. She was uncomfortable about presenting her lesson and requested that she present the beginning

of the following year when they would occupy their new premises. She was also concerned with the excitement that the learners had since there were rumours that they would relocate before they wrote their examinations. Gugu was visited in March 2012.

### **3.6 Data collection methods**

This is the procedure which is used by researchers to gather research data from participants. This is conducted in various ways and according to Christensen and Johnson (2004) as well as Conrad and Serlin (2006), qualitative researchers can employ several data collection techniques, including individual and focus group interviews, questionnaires, observations, tests and document analysis to answer research questions. In this study I have utilised document analysis, a questionnaire, semi-structured interviews and observations for data collection. The selected techniques and appropriate instruments are discussed below.

#### **3.6.1 Document analysis**

Bowen (2009) defines document analysis as the qualitative research method in which documents are interpreted for research purposes. I have used the work schedule, the Natural Sciences Policy Document and the Natural Sciences Teachers Guide as a guide to gain insight into the aspects of the lesson plan used for effective teaching, learning and assessment. The documents were used to validate the teachers' interpretation of curriculum content, outcomes, strategies used for teaching and learning and assessment as used in their lesson plan. Document analysis is used in the study to collect data to answer the question: how do teachers interpret the Revised National Curriculum Statement for natural sciences in Grade four.

#### **3.6.2 Questionnaire**

A questionnaire is described by Ary, Jacobs and Razavieh (2002) as a list of written questions that may be completed in the absence of a researcher. To produce qualitative data, my questions are mostly open-ended with very few closed questions. This is to ensure that limitations are minimized as Charles and Mertler (2008) state that one of the limitations of a questionnaire is that the depth of answers furnished by participants seem more limited as compared to any other research method. Although my instrument is a questionnaire by definition as the teachers completed it in their own time, it does not have the characteristics of a questionnaire in that closed questions were limited. Mellenbergh (2008) confirms the fact that questionnaires are not always associated with statistical analysis.

As the questionnaire is completed in privacy it increases the chances of participants responding to questions honestly without any intimidation (Newby, 2010). When a questionnaire is used, all participants are able to answer the same questions to ensure reliability. However, it might happen that the participants do not ascribe the same meaning to questions asked and there might also be a low return rate of completed questionnaires. The problem of a low return rate is encountered in large scale surveys but in this study only three participants were used and the researcher was able to collect the questionnaires on the stipulated date.

I used Appendix E to collect qualitative data about the participants' academic background and their teaching experience under section A. The choice of content for the remaining sections of the questionnaire was guided by the sub-constructs from Capacity to Innovate and Profile of Implementation (Rogan & Grayson, 2003). I based all questions of section B on the construct for Capacity to Innovate while section C was on Profile of Implementation. They were further informed by the sub-constructs of each construct to find out what factors support or hinder the implementation of new ideas in schools as spelt out in the RNCS curriculum.

### **3.6.3 Semi-structured interviews**

This is a technique used to collect qualitative data by setting up a face-to-face, relaxed situation that allows the participants time and scope to express their ideas on a particular subject (Fraenkel & Wallen, 1990). Santiago (2009) describes the three types of interviews as structured, semi-structured and unstructured. She regards structured interviews as being very formal and used for specific information in quantitative research. According to Punch (1998), unstructured interviews are a way to understand the complex behaviour of people without controlling their responses. Participants might open up such that the subject matter gets diverted. Patton (2002) is in agreement with Punch (1998) that unstructured interviews require a lot of time to gather the desired data. Hence I opted for semi-structured interviews because Zhang and Wildemuth (2009) view unstructured interviews as not useful when you already have a basic understanding of a phenomenon and want to trace particular aspects of it.

Fontana and Frey (2005) claim that semi-structured interviews are flexible and more relaxed. Zorn (2009) refers to them as “moderately scheduled” as the interviewer is able to follow up

with probes to seek for in-depth meaning. This technique is significant in understanding the participants' point of view rather than making generalisations about a particular issue in question. The researcher may bond with the participants as they engage in a two-way communication (Kuksennok, 2011). Semi-structured interviews conducted prior to lesson observations were to clarify and add on responses given in the questionnaire to determine how teachers interpret the RNCS in Grade four. Interview questions are based on all aspects of a lesson plan as per the NS section of the RNCS. Section B of the pre-observation interview had questions which either confirmed or elaborated on responses given in the questionnaire. Probes were used on certain questions where necessary to understand how the curriculum is interpreted, how the lesson would be presented and why it would be presented in a particular way.

Santiago (2009) attests to a researcher providing room to explore participants' responses by asking for clarification or additional information. Hence interview questions were based on what transpired during the lesson presentation using the criteria given under each sub-construct from the Profile of Implementation. Time was created for the interviews for each participant before and after lesson observations, in a relaxed, comfortable atmosphere. This environment enabled them to participate freely in our conversation. They granted me permission to use a tape recorder and to take some notes during our discussions. Teachers were able to express how they interpret the RNCS curriculum and I could also explore the factors that influence the way they implement the curriculum because they were talking freely as they discussed the curriculum issues in detail (Robson, 2002).

It is a weakness of the semi-structured interview that the depth of the qualitative information may be difficult to analyse, but a tape recorder is used so that during replay the researcher is able to select the relevant information. However, participants were given the transcript to check for any omissions to verify data and to make corrections if necessary.

#### **3.6.4 Observations**

Fox (1998) defines observations as a technique that allows the researcher to see for himself or herself what happens, rather than depending on what participants report. After the pre-observation interviews, I was part of a lesson of a duration of 60 minutes as an observer. Again after a lesson presentation I conducted post-observation interviews to enhance the quality of the evidence collected from both observations and questionnaires. Anderson and Burns (1989) claim that observations can be used to stimulate change and verify that the

change occurred. Hence I was able to explore what goes on in the classroom during the lesson and witness and receive first hand information on how the teachers implement the curriculum. However Driscoll (2011) reports that a researcher may record what he wanted or expected to see instead of what actually took place hence jeopardizing reliability and the validity of data collected. She further suggests that to avoid bias in the observations a “double-entry notebook” could be used. This would provide a column of observations and the other for thoughts. A tape recorder was also used to capture all the information from beginning to end. Spindler and Spindler (1992) state that there should be more than one observation to establish reliability in the observational data. However in this study it was used in conjunction with the questionnaire and the interviews to practically confirm responses provided. DeWalt and DeWalt (2002, p. 92) affirm that “observation with its limitation as a method helps the researcher to develop a holistic understanding of the phenomena under study as objective and accurate as possible.” I also spent a lot of time with them as their subject advisor and according to Lincoln and Guba (1994) the researcher will view the findings as credible if he or she spends a considerable amount of time in the setting.

The questions developed for classroom observation were informed by the sub-constructs of the profile of implementation as given in the theoretical framework. Observations were linked to the responses of the questionnaire as well as the pre-observation interviews. The researcher also observed if there was correlation between the lesson plan developed and the actual presentation done.

### **3.7 Data collection plan**

This is concerned with the amount and the type of data required and when and how it should be collected (Tooling U, 2012). The table below presents a summary of my data collection.



**Table 2: Data collection plan**

Criteria	Question 1	Question 2	Question 3	Question 4
	<p><b>How do teachers interpret the Revised National Curriculum in Grade four?</b></p>	<p><b>What factors influence the way teachers implement the natural sciences curriculum in Grade four?</b></p>	<p><b>How do teachers implement the natural sciences curriculum in Grade four?</b></p>	<p><b>Why do teachers implement the natural sciences curriculum in the way that they do?</b></p>
<p><b>Why was the data collected?</b></p>	<p>To develop an understanding of the ways in which they interpreted the curriculum and how that influenced their implementation of the curriculum.</p>	<p>To enable me to understand why teachers chose to implement the curriculum in the way they did.</p>	<p>To find out how they implemented the curriculum in the classroom.</p>	<p>To find out what makes teachers implement the curriculum in the way they do.</p>

<p><b>What</b> was the research strategy?</p>	<p>Teachers were required to complete a questionnaire on the interpretation of the RNCS curriculum contained in section C. Collection time was extended to two weeks because they were not ready within a week.</p> <p>Aspects of a developed lesson plan were also considered in relation to the work schedule, NS Policy document and the Teachers Guide.</p>	<p>Section A of the questionnaire in which some background information regarding the participants' biographic details were contained and section B which required information regarding capacity to innovate. Pre-and post-interviews also provided data to answer this question.</p>	<p>Pre-observation interviews were conducted to get a sense of the teachers' interpretation of the curriculum as they provided reasons for selecting particular teaching and learning strategies. These were conducted prior to lesson presentations during the teachers' free time.</p> <p>Classroom observation of the teachers in action. One lesson was observed per teacher which lasted for 60 minutes.</p> <p>Post-interviews were also conducted.</p>	<p>All relevant factors that emerged from the study which related to their implementation of the curriculum.</p>
<p><b>How</b> often was the data</p>	<p>One questionnaire was administered and collected a week before the date set for lesson</p>	<p>Same questionnaire as mentioned in column 1.</p>	<p>Each teacher was observed once. A 30 minute pre-observation interview preceded each classroom observation where a 60 minute</p>	<p>Analysis of above-mentioned documents.</p> <p>Same questionnaire.</p>

collected?	presentation. Pre-interviews lasted for 30 minutes before lesson presentation.	Pre-interviews lasted for 30 minutes before lesson presentation. Post-interviews were also 30 minutes after the lesson presentation.	(double period) lesson was presented.  The post-interviews lasted for 30 minutes after lesson presentation.	One 60 minute lesson.  A 30 minute post-interview after lesson observation.
How would the data be collected?	The data was collected through a set of questions which teachers completed during their own time. However they were requested to return the questionnaire by a certain date.  The lesson plan was interacted with during the pre-interviews and the data obtained was	The data was collected through a set of questions which teachers completed during their own time. However they were requested to return the questionnaire by a certain date.  Answers to probes that were clarifying	Semi-structured interviews were conducted prior to lesson observations. The information obtained was written down and also recorded by tape recorder.  An observation schedule was used and the lessons were recorded.  Answers to probing questions based on questions on the observation table were written out	The data obtained from the first three questions will be used. That will be collected in the forms previously mentioned.

	recorded.	some answers that transpired in sections A and B of the questionnaire were written down and recorded using the tape recorder.	and recorded too using a tape-recorder.	
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### **3.8 Data analysis**

Woods (2011) declares that qualitative data are the best way of explaining difficult issues although Johnson, Dunlap and Benoit (2010) maintain that qualitative data is massive. They refer to it as mountains of words, hence it is less structured and more challenging to analyse as compared to quantitative data, but they do report on strategies that would try to make its analysis as efficient as possible. The results are as valid as those gathered from quantitative data which is claimed to be more reliable than qualitative data. Document analysis, interviews, a questionnaire and a class observation were three techniques used to collect data from participants. The data represented the experiences, views, interpretations and the understanding of the participants about the RNCS curriculum. I had to sort the collected data for better understanding as Powell (2003) argues that data analysis and interpretation is done to bring order and understanding of the people or situations studied. Parson (1997) is also of the same view that in qualitative data analysis various processes and procedures are used to explain, understand and interpret data collected during an investigation.

I recorded the interviews and the class observations so as to capture the accurate information as given by participants. Recorded audiotapes were played several times during transcription. Parson (1997) maintains that it is necessary to play and re-play the recorded information for accuracy of information from which to prompt more questions for subsequent interviews. Maxwell (1966) warns that it is a problem in qualitative studies to pile up transcripts because it makes the final analysis arduous to handle. The descriptive accounts from class observations were given as a result of watching and listening. Interviews were transcribed word for word. Seidel (1998) is in agreement that data analysis is done each time data is collected because he regards it as cyclic or a spiral. For example, the fact that you are thinking about things, you start noticing new things in the data, then you collect and think about these new things.

During the presentation of findings, the transcribed data was organised by questions which are based on two constructs to identify consistencies and differences. These were then categorised into factors or sub-constructs for Capacity to Support Innovation and Profile of Implementation from Rogan and Grayson (2003). According to Powell (2003), these sub-constructs serve as themes that summarise and create meaning to how teachers' implement the Grade four NS curriculum. Powell cautions that narrative data is not for generalization but provides for clarification, understanding and explanation.

### **3.8.1 Steps in data analysis**

During document analysis I analysed the lesson plan to compare its aspects to the work schedule, the NS policy document (RNCS) and the teachers' guide to see what the teachers intended doing as this gave an indication of what their interpretation of the curriculum was. Four constructs guided the analysis of the documents. These were: content, outcomes, teaching strategies and assessment. The knowledge displayed on the different aspects of the lesson plan was compared to the definition and explanations contained by the different policies mentioned above which impact on the implementation of NS. Each teacher's interpretation was considered in terms of her responses in the questionnaire, interview questions and what was written in her lesson plan. It was then concluded how they all interpreted the RNCS.

In the questionnaire, section A required information on the teachers such as experience, age, qualifications, content and pedagogic knowledge and so on, and was analysed as per individual teacher, with no generalisations made. Inductive analysis was adopted with sections B and C of the questionnaire, which according to Schrepp (2003) allows general propositions to be derived from specific examples. Each teacher was then observed against the background of this information to determine her ability to implement the NS curriculum.

McMillan and Schumacher (2001) explain that the researcher may move back and forth between higher levels of data analysis and prior levels to refine her or his interpretation. The factors of the second category were aligned with each sub-construct under Capacity to Innovate to show their availability in each school and the extent to which they are accessible for use. The third category which is comprised of factors for curriculum implementation were classified into the sub-constructs for the Profile of Implementation to determine how each teacher performs in classroom practice based on her interpretation of the RNCS and the available in her school for the capacity to innovate the curriculum.

Krippendorff (2004) maintains that qualitative data collected through interviews and observations can be analysed using content analysis. This involves categorising and classifying the collected information to highlight the important messages, features and findings. Robinson (2009) postulates that categorizing will condense the collected information to expose findings simply and efficiently. Hence I adopted a similar procedure and transcribed all the data collected during the pre- and post-interviews, including those recorded during observations. Transcription was verbatim and it was done after each and

every recording. I went over the data to ensure thorough analysis because Merriam (1998) claims that data analysis is very challenging and complex process that requires moving back and forth scrutinising every bit of the information to construct meaningful ways to present the data. The data was then reworked into different categories, given as sub-constructs under the Profile of Implementation by Rogan and Grayson (2003). These categories described the participants' interpretation of the curriculum in preparing their lessons as well as how they implement the curriculum and the factors influencing the way they were implementing it.

As an indication of where each teacher is in terms of implementing the curriculum, they were placed on the corresponding levels under each factor of the profile of implementation depending on how the teacher's interpretation of the curriculum together with the available factors for capacity to innovate enabled her to implement the curriculum. The levels range from one to four moving from the teacher-centred approach to the learner-centred approach as described by Rogan and Grayson (2003).

### **3.9 Trustworthiness**

Trustworthiness is associated with a qualitative research approach and refers to the accurate representation of the experiences of the participants involved in the study. According to Golafshani (2003), the examination of trustworthiness is crucial to ensure reliability in qualitative research. Arguments around the notion of validity and reliability being inappropriate in qualitative research abound and consequently a number of researchers (Davies & Dodd, 2002; Lincoln & Guba, 1985; Mishler, 2000; Seale, 1999; Stenbacka, 2001) have advocated the use of trustworthiness, quality or rigour in qualitative research. Lincoln and Guba (1985) claim that trustworthiness of a research study is crucial in evaluating what it is worth. This involves establishing credibility, transferability, dependability and confirmability. These correspond respectively to criteria by positivist investigators which are internal validity, external validity, reliability and objectivity.

#### **3.9.1 Credibility**

Merriam (1998) refers to credibility as the situation when the research findings are in agreement with reality. According to Lincoln and Guba (2000), researchers need to record accurately the phenomena under scrutiny. In line with his view, I returned the transcripts to all participants to verify the accuracy of the written information against their own words. Pre-

interviews were conducted before an hour lesson observation, after which there were post-interviews to establish a relationship of trust as Lincoln and Guba (2000), Erlandson, Harris, Skipper and Allen (1993) recommend. According to Guba (1981), Brewer and Hunter (1989), triangulation, which is the use of different methods in collecting data, compensates for the participants' individual shortcomings and exploits their respective benefits. This was achieved by engaging all participants in a questionnaire, interviews and class observation. Participation was voluntary to ensure honesty in informants. Debriefing sessions with my supervisor helped me identify flaws, own biases, preferences and to refine my methods.

### **3.9.2 Transferability**

Merriam (1998) argues that findings from a small number of particular individuals and environments are applied to other situations or populations whenever they are rich, thick descriptions which can enhance the results of a qualitative study. Erlandson *et al.* (1993) allude to the impossibility of generalisability because of the specific context in which the study occurs. Shenton (2004, p. 70) suggests that in order to assess the extent to which findings may be true of people in other settings similar projects employing the same methods but conducted in different environments, could well be of great value. Findings from this study could assist teachers of these schools who teach other grades of NS because they share similar resources and the same environment and might also benefit from the support that could be made available to these Grade four teachers. This does not necessarily imply that teachers are the same.

### **3.9.3 Confirmability**

Questionnaires, interviews and observations are different data techniques employed in the study to ensure confirmability through triangulation to reduce the researcher's bias as stated by Shenton (2004). According to Diehl, Guion and McDonald (2011), triangulation is used in qualitative research to ensure validity of the study as a research question is analysed through multiple perspectives. Thurmond (2001) reports that in a study where questionnaires and interviews were used, the questionnaires assisted the participants to communicate their frustrations in writing while those interviewed found the interviews therapeutic. Hence the data collected in this study through questionnaires, pre- and post-interviews and observations yielded similar findings to establish confirmability. The three methods resulted in more substantial results thus increasing confirmability of findings. I have acknowledged their



strengths and weaknesses as Miles and Huberman (1994) attest to the criterion for confirmability as the admission of the researcher's predispositions.

### **3.10 Ethical considerations**

Charles and Mertler (2008) maintain that the moral aspect of any research must be respected. They warn researchers to be scrupulously ethical with their work to ensure credibility. The researchers must respect the rights, values, needs and desires of the participants (Creswell, 1994).

Confidentiality was maintained at all costs. Participants' anonymity was ensured as pseudonyms were given to both the schools and the participants. All the data was treated with confidentiality, locked in the supervisor's cabinet, and will be destroyed after five years. It was clearly explained to participating teachers that participation was voluntary, and participants could withdraw at any point should they wish to do so. They were treated with respect and there was no remuneration for participation. My position as a subject advisor should have no influence on their participation as they were assured that the information gathered would be shown to neither the staff members of their schools nor the district officials. All the collected data was used with the informed consent of the participants. The research did not interfere with teaching and the running of the school.

Ethical clearance was obtained from both the DoE (Appendix B) and the University of KwaZulu-Natal (Ethical clearance number: 2/4/8/82, Appendix A). Permission to conduct the study was also granted by the principal of the school (Appendix C) and the participating educators (Appendix D).

### **3.11 Conclusion**

This chapter focused on the research design that informed the study. It further presented the reasons for employing a qualitative research paradigm. Discussions on the type of data collected and the explanation of the techniques used as well as sampling and the analysis of data were presented in the chapter. Strategies undertaken to increase trustworthiness were also outlined. The following chapter reports on the findings based on analysis of the collected data.

# **CHAPTER FOUR**

## **FINDINGS AND DISCUSSION**

### **4.1 Introduction**

In Chapter Three I explained how the theoretical framework by Rogan and Grayson was used to shape the instruments, as well as how the said framework guided the analysis of the data. This chapter presents findings based on analysis of the data from the documents, e.g. the work schedules and the policy documents, questionnaire (Appendix E), pre- and post-interviews (Appendix G) as well as observations (Appendix F) as outlined in the previous chapter. The findings are presented as a comparison of the three teachers' interpretations and implementations of the RNCS for NS in Grade four, as well as factors influencing their implementation of the NS curriculum.

### **4.2 The teachers**

The participants are Thulile from school A, Maria from school B and Gugu who teaches in school C. I will first discuss how the teachers interpret the curriculum using the data collected from the lesson plans, work schedules and policy documents, the teachers' responses during the interviews and from section C of the questionnaire. I will thereafter present the findings on each teacher's capacity to implement aspects of the NS curriculum by discussing the different sub-constructs which constitute the capacity to innovate. The teachers' capacities influence their ability to implement the curriculum. Furthermore the profile of implementation which emerged from the data in the questionnaire, interviews and class observations will be discussed by referring to the different sub-constructs that constitute the profile of implementation of each teacher.

### **4.3 The interpretation of the RNCS**

Data from various documents including lesson plans developed by teachers, work schedules and policy documents as well as interviews and sections of the questionnaire were analysed to determine the ways in which the teachers interpret the RNCS. We had discussions on different aspects that appeared in their lesson plans and also sought clarity on some of their responses in the questionnaire through probing questions. Four aspects were identified as

important in evaluating the teachers' interpretation of the curriculum. These are: content, outcomes, teaching strategies and assessment.

#### **4.3.1 Thulile's interpretation of the natural science curriculum**

Thulile experienced problems with the interpretation of exactly what she was expected to teach in Grade four. This became evident from both my interaction with her as well as my analysis of her lesson plan.

##### ***Curriculum content***

The provincial common work schedule stipulates the Grade four curriculum should cover:

- materials for particular uses
- properties of materials (using different senses)
- combining materials to get a new material with different properties
- sorting of materials into solids, liquids and gases, and
- mention of the water cycle (the changes of water into different states and the water cycle are done intensively in Grade five under atmosphere and water).

While one could argue that phase changes of matter could be included in the above topics, the curriculum emphasis is on identifying different phases of matter, rather than the phase changes. Thulile's topic "Phases of liquids" was therefore not part of the content that was included in the Grade four workschedule. As her phrasing of the topic appears to represent some misunderstanding of what is meant by the phases of matter, it is understandable that this specific topic did not appear in the work schedule. So while there is a misinterpretation of what should be taught, there is also some confusion with regard to correct terminology. During the interview it became clear that Thulile thought of water as the only liquid that existed and she therefore used the term liquid as synonymous with water. This points to some misconception as to what is meant by the term 'liquid'. This misconception was re-enforced by the caption of the learner activity which read "The change of liquid from one phase to the other". Thulile appeared to use the term 'liquid' when meaning 'water'. She planned a demonstration showing what happens when water boils and she emphasised that the learners should use the thermometer to measure the temperature at which the water would boil. She regarded this as the important information that they must all know. She also made the following statement in her lesson plan as well as in the interview: "*the water will boil in the test tube until they see the white stuff which is the gas or steam.*" It was not clear from this

statement whether she was focusing on phase changes or the concept ‘boiling point’ (boiling and melting points of different substances is part of the curriculum content for the intermediate phase). A liquid is one of the phases of matter - the term water is used here as an example of a particular substance.

She also appeared to have problems understanding what is meant by prior knowledge or background knowledge as explained in departmental documents on lesson planning. Instead of probing their everyday knowledge of properties of substances such as water, she indicated in the interview that she would ask what they had learnt about the importance of water in the ‘life and living’ knowledge strand.

### ***Outcomes***

Thulile’s lesson plan included LO with Assessment Standards (AS). When asked how they were chosen, she explained:

*The truth is I don’t understand how to work with LOs and ASs, that’s why I copy from books or write anything for the HOD to see but I really teach them experiments which is what science need.*

She had selected LO3 although it was not clear how the activity was addressing this outcome. As I entered the school I noticed that the area where the school is situated had problems with the availability of water as learners were fetching it from the well nearby and placing some buckets outside their classrooms for washing their hands and dishes. The RNCS gives the second assessment standard under LO3 as the impact of science and technology on the environment and on people’s lives. The situation of learners fetching water from the well could have been related to teaching and learning in science. They could also note the effect of the rays of the sun on uncovered water left outside the classrooms. When Thulile was asked if the lesson was based on a specific problem experienced by the local community, she answered:

*“No! It’s just about water.”*

### ***Teaching strategies***

When Thulile was asked to give a brief summary of her whole lesson, she repeatedly said: “No! It’s just about water” and often added that it was about “all kinds of water.” She further

indicated that she had adopted a learner-centred or practical method for presenting her lesson. When asked to elaborate on the method Thulile responded;

*I want them to know- mustn't be just a theory. To do practical and knowledge. I will ask questions and they will brainstorm.*

Her lesson plan was not explicit on teacher and learner activities but she insisted that she would be asking the questions and learners would brainstorm as teacher and learner activity respectively. Thulile's understanding of what is meant by 'learner-centred' was limited to learners responding to her questions. This is quite different to the RNCS understanding of what is meant by learner-centredness. Her lesson plan did not indicate what she intended doing in the classroom and what learners would do during the presentation of her lesson.

During the interview she indicated that she was going to demonstrate how the apparatus would be used to show the changes of water. Learners would observe and provide answers to her questions. Thulile was unable to indicate this in her lesson plan or to show what guidance she would provide under teacher activity. While Thulile indicated that she would promote a limited form of enquiry-based learning, the learners were still too passive; she had no plans to engage them in writing scientific reports. She indicated that she often encouraged learners to analyse and communicate data in the form of graphs and tables yet she pointed out that she never assessed learners on practical work. The information in the lesson plan indicated that there was scope for development of LOs, but Thulile did not appear to see the opportunity.

### ***Assessment***

The curriculum advises that assessment be continuous and should measure the performance of a learner against the relevant assessment standards of the LOs. It is very important because it allows the teacher to monitor her or his progress in terms of the various teaching strategies she or he uses as well as the progress of a learner as much as it improves the learners' individual growth and development. There were no assessment activities or tasks given to check on learners' understanding. She agreed as stated in the lesson plan that she was going to give an activity, a project and an assignment. It appeared as if Thulile could not distinguish between the different forms of assessment because it was not possible to give all types with the little information that was to be taught on that day.

She again contradicted herself where she pointed out in the questionnaire that she did not always give learners closed questions yet she also indicated that she never developed open-

ended questions. However at the end of the demonstration she planned to ask the learners to write down their observations about *what* was happening to the ice in heat. She announced that she would offer a learner who finishes first R1.50 in an effort to get learners to participate.

#### **4.3.2 Maria's interpretation of the natural science curriculum**

Maria's lesson was on "Characteristics of plants and their uses."

##### ***Curriculum content***

Maria's lesson topic tallied with the work schedule, but when asked why she was teaching *life and living* during the time of the interview and not during the first term as suggested by the work schedule, she explained that she was not very comfortable with the physical science aspects of NS and preferred spending less time on its knowledge strands which are *matter and materials* and *energy and change*. The decision taken by Maria is not in keeping with the requirements of the work schedule because she was supposed to follow it as is. Maria explained:

*I normally work on Life and Living much quicker because I understand it better than the other strands and could effectively guide my learners.*

Maria further explained that she takes a lot of time with planning the other knowledge strands because she struggles with them and has got to seek help on most concepts and do and re-do lessons before presenting them. This was the first lesson on *life and living* and Maria's lesson plan presented a variety of ways in which learners were to be assisted in grasping the concept on the different plant parts and their functions. She had prepared a hands-on activity where learners were to grow a plant from a given seed. This was a project to be done over a period of time. She had also indicated that she would cover the variety of plants and their visible differences and similarities by introducing learners to spirogyra and mosses. Spirogyra is grouped under plants in RNCS although in more recent classification systems it is not regarded as part of the plant kingdom. The work schedule does indicate that learners be exposed to bean, maize, black jack, moss and spirogyra for them to observe, describe and compare so that they are able to substantiate why they are plants.

For baseline assessment on prior knowledge she had prepared a short hands-on-activity to establish the knowledge that her learners had about the general features of plants as studied in Grade three. The policy indicates that the content taught in FP where Grade three is located,

was about plants and animals in general, their behaviour and the importance thereof, hence Maria had also included questions about the needs of plants and animals, as well as their similarities and differences. There were a lot of specimens to be brought to class for learners to observe and compare.

### ***Outcomes***

Maria had not written out the learning outcomes and assessment standards and when I enquired about them she stated that she did not understand much about them because she never attended training to understand the RNCS better as she was teaching in the FP during that time. Although the RNCS included the FP, training was conducted per phase. She was able to develop questions that address the assessment standards listed in the curriculum statement. She commented that through developing questions from the assessment standards she had learnt to teach according to the way the questions are formulated so that her learners could be able to answer them.

*I have recently learnt that when learners identify interesting aspects leading to investigations, it is associated with hypothesis or prediction but I don't understand how to apply them in my teaching.*

Although Maria had a poor understanding of the policy documents, her lesson plan indicated an intuitive approach to discovery learning.

### ***Teaching strategies***

During the interview Maria explained that she wanted her learners to acquire the knowledge of the different features of plants and their functions. She further indicated that she was going to expose them to a variety of plants for them to identify the different features through observation. She also stated that from the knowledge gained in the FP, she was going to talk about food that comes from the different parts of plants. *“They are eventually going to be given cabbage, spinach, beetroot, tomatoes and pumpkin seeds to grow,”* she added. In her lesson plan she had written out ‘critical thinking’ as the method that she was going to use. Maria understood critical thinking as a science process skill because she explained it as follows: *“when learners identify and differentiate between the different features, they are engaging in critical thinking.”* However the policy defines critical thinking slightly differently and mentions that it is a long term outcome, hence it cannot be achieved with a single method as it is also not a method of teaching. In the teaching of natural science the

scientific investigations is one of the process skills which is comprised of a number of steps which when used effectively in doing science will promote critical thinking. As a highly complex operation it also involves analysis, synthesis, evaluation and interpretation. It appeared as if Maria was going to employ the investigatory method because learners were going to observe, record their results and draw conclusions. In her lesson plan she had also indicated that learners would be shown seeds and be allowed to state if they would grow or not, which according to the policy is a step of the scientific process.

### ***Assessment***

Maria was very clear about how learners would use their activity books during the lesson and when she would give them a worksheet. She indicated that the work they were doing was to be included in their portfolios which she justified as a book (flip file) where learners keep pieces of work that they had themselves chosen from each concept that was done. She added that they would display their portfolios during the school's awards day each year. According to departmental policy, portfolios are no longer a requirement but some teachers still use them. She also pointed out that the five short questions she had additionally prepared were for weak learners. The questions that she had developed were indeed at the level of a Grade four learner and supporting the demands of the different cognitive levels. These were over and above the worksheet that she was to distribute to learners as homework. These questions assessed the knowledge and skills learnt. Policy requires that there be one project given per year per learning area, hence Maria prepared a project to be done by learners over a longer period (development of plants in order to observe different structures). The information that would be needed for assessment purposes would be according to what she had indicated as:

*Measurements to show the development of the seed, drawing of the different structures emerging from the seed and the use of the collected data to design a graph of the development of the seed to a seedling.*

The intention of the project was to see the development of the different structures of a plant as suggested in the work schedule but the drawing of a graph was an enrichment exercise for high flyers because it is an assessment standard to be achieved in Grade six.

### **4.3.3 Gugu's interpretation of the natural science curriculum**

Gugu had prepared a lesson on "Habitats of different animals."



### ***Curriculum content***

Gugu followed the documents that inform the teaching and learning of NS although she had a number of outstanding aspects that were not catered for in her lesson plan. The content was relevant to the grade and was taken from the common district work schedule. I visited Gugu in term one when the knowledge strand *life and living* was taught according to the departmental work schedule. The lesson plan covered types of animals which are domestic, living in the jungle, in the zoo, in the desert and in water. There would be discussions on how they were adapted to their environment and their social patterns, i.e. whether solitary or found in colonies. The work schedule suggests that pictures of habitats and animals be shown representing for example bees, ants or life in the wild, and so on. Gugu's choice of habitat, e.g. the zoo (an unnatural environment), points to the possibility of misinterpreting the curriculum content if scientific knowledge is lacking.

Gugu had left out how she was going to link the previous lesson on matching plants with their habitats with matching animals with their habitats. It was not clear if she was going to mention the relationships that exist between plants and animals in their habitats.

### ***Outcomes***

Gugu could not account for the learning outcomes and assessment standards that she had chosen as they were copied from the work schedule as they were. She admitted that she had never understood how they were used in an activity to be taught in the classroom. That was also reflected by the lesson plan she had developed because it only gave LO1 AS one to four. The four that she had copied from the work schedule indicated the grade. When I enquired if she knew what each of the four assessment standards entailed, she responded;

*They are for practical where 1 is planning them, 2 collecting information, 3 doing them and 4 finding results.*

This was an indication that she did not understand the policy document very well, but she knew that assessment standards refer to knowledge and skills.

### ***Teaching strategies***

Gugu planned to use the question and answer method to present her lesson as indicated in her lesson plan and the LO1 she said she was addressing could not be attained through question

and answer methods. She recommended and regarded the question and answer method as suitable in finding out the amount of knowledge the learners had about the new concepts and also to cause them to think about the concepts under discussion. In LO1 the skills associated with the scientific process are applied as investigations are done. However in her lesson Gugu needed to state and explain new concepts to learners.

### ***Assessment***

Gugu did not indicate the type of assessment activities/assessment task to be given to check on her learners' understanding yet she was so explicit on the teaching and learning activities. In our discussions I could make out that she knew some of the barriers her learners had because there was a time when she sighed and said:

*I know that not all of them will give this simple information. There is nothing prepared for weak learners, I have taught them for a week, still acquainting myself with them.*

It was hard to see if Gugu's assessment activities were based on what she was required to teach because they were not available. In her interview she had stated that the test, assignment and class activity would be given later while the policy suggests that learners be assessed at the end of the lesson so as to establish how much they have learnt and understood before proceeding to other concepts.

## **4.4 Factors that influence the way teachers implement the natural sciences curriculum in Grade four**

The questionnaire and interviews provided the data to produce the findings with regard to capacity to innovate. This refers to those aspects which influence the teachers' ability to implement the RNCS. Rogan and Grayson's (2003) framework of curriculum implementation was used as an analytical tool to analyse the data.

The capacity to innovate is concerned with the factors that support the teacher in implementing the curriculum. Four sub-constructs are discussed.

### **4.4.1 Teacher factors**

The table below presents information with regard to the three teachers' biographies.

**Table 3: Biographies of the three natural science teachers**

Participants	School	Qualifications					Teaching experience in years		Experience in teaching science in years		Age	
		Matric science subjects	Professional certificate	Year obtained	College science subjects and levels	University science courses and levels	11-20	>20	<5	5-10	36-50	>50
Thulile	A	Biology	NPDE	2007	0	0	X		X		X	
Maria	B	Biology	JPTD	1984	0	0		X	X			X
Gugu	C	Biology and physical science	SPTD	1988	Physical science L1 and biology L2	Chemistry 1 and physics 1	X			X	X	

***Thulile***

Thulile is the only one who started teaching without the basic teaching qualification and accumulated almost all her teaching experience without the basic pedagogic knowledge. She enrolled and completed the National Professional Diploma in Education (NPDE) as a part-time student with majors in Life Orientation and in Learner Support. NPDE was an opportunity provided to South African un- and under-qualified practising teachers to improve the quality of teaching and learning and to upgrade them to REQV 13. Teachers had the opportunity to specialise in any of the three phases, i.e. foundation, intermediate and senior or senior and FET. Thulile was an un-qualified teacher who had taught for 15 years without a professional certificate. She explained:

*I specialised in Foundation Phase because I was teaching those classes. I then did LO in ACE.*

The phase that Thulile was specialising in did not offer any science subject and she is only in her third year of teaching science in Grade four. Immediately after completing her diploma, she was requested to teach NS. She confirmed that she needed to work hard in science because she was last exposed to it when she was at school, with matric biology as her highest academic qualification in a science.

### ***Maria***

Maria's first qualification from a college of education was as a FP teacher. Her qualification only allowed her to study all subjects done by Grades one to three and this excluded science. Her only science experience was therefore her matric biology. Maria received training to work within the framework of the RNCS for both the FP and IP. She subsequently moved to the IP. Maria taught mathematics and English as well and it was her third year of teaching NS. She remarked:

*Natural Sciences has a lot of challenges. It is hard to understand the Policy document because it is not structured like those of other learning areas. The Principal begged me to teach it....no one wants to teach it here. Books have different information perhaps those who did it at tertiary might be better equipped.*

### ***Gugu***

Gugu is better qualified in content and pedagogical knowledge with more experience in the teaching of NS. She specialised to teach in the senior primary school while pursuing the Senior Primary Teachers' Diploma (SPTD) at a college of education. She was in the science stream and was also exposed to the general science didactics because all students studying the SPTD were compelled to do the general science didactics. Gugu also studied science at university level and has been teaching NS in both Grade six and seven for the past five years. At the time when this research was conducted, she was in her second year of teaching Grade four. She was teaching NS to two different grades and was also responsible for technology.

#### **4.4.2 Physical resources**

This construct is concerned with the physical environment in which the teachers work which may influence their capacity to implement the NS curriculum.

##### ***School A - Thulile's school***

It is newly built to accommodate children from the newly built RDP houses and offers Grades R to Grade seven. At the time the research was conducted, the school had no administration offices and was still awaiting the appointment of an administrator. The principal acted as administration clerk. The school has inadequate classrooms, most of which are prefabricated and cannot accommodate all grades. Classrooms are electrified except for the prefabricated ones which are used by Grade four. Thulile indicated that she had two classes of Grade fours that she was teaching. Two-seater desks are used to accommodate up to a maximum of five learners. The teacher's table only fits in with great difficulty and it

cannot be done away with since they have no staff room. The school has no science laboratories or any other room to accommodate learners when they engage in practical work. There are neither books nor science equipment for learners to use during teaching and learning of science. Thulile commented:

*Without the floor space it becomes difficult even to think of improvising because there is no space for group work.*

The school has no library and Thulile complained that the department wants each class to set up a library corner but there is no way in which she can possibly do that. There is a small photocopying machine which was donated by one Model C school. There are no computers for use by learners and only the principal's laptop is available. During Thulile's lessons no books were used because they were not available, not even a few to share. She makes copies for learners depending on the availability of paper and ink. She further explained that:

*...paper is limited and they only make copies of class activities but learners are still left with nothing to improve their reading skills.*

School A has no playgrounds and its yard is very uneven and rocky. There are no plants growing in the school yard. The department had promised to improve the environment, but nothing had been done up to that point. Thulile mentioned that advisors had said there was no excuse for not engaging learners in practicals when studying *life and living* because all specimens were in the school environment but with her school it is a different scenario. Furthermore, learners cannot freely enjoy their variety of games during break times as the existing fence had been removed and part of the school vandalised. This posed a security risk to learners.

### ***School B - Maria's school***

School B only offers Grades R to four. The school has three Grade four classes with 48 learners on average. The classes are larger compared to those of school A. Maria is able to shift the desks around to facilitate group work. The class is able to accommodate the teacher's table and another small table at one corner in front of the class which has books displayed on and under it. There are also projects and models under the table and others are hung on the wall around the area. When asked about that corner, Maria replied:

*This serves as both our library corner and our science corner as advised by the District. Some of the charts displayed were done by learners themselves while others are used for teaching.*

She pointed at the rocks under the table along with a bit of soil which were used to describe the different types of rocks studied in 'Planet Earth and beyond'.

*The file on the corner table has copies of material which could be used by learners when they are given topics to research for classroom presentations or assignments.*

Over and above the material in the science corner, learners have textbooks which they only access during school hours and are only taken home on request by either learner or teacher because of the difficulty in having a successful retrieval plan. The class is conducive to learning with charts hanging on classroom walls because the school doesn't have a problem with vandalism. It is fenced with a security guard at the gate. The school yard is paved and the whole school is painted. They have electricity in all classrooms. There are trees providing shade for learners during break and Maria indicated that there were indigenous trees which were donated to the school by the Parks Board. The school appeared very well maintained.

### ***School C - Gugu's school***

School C looks very dilapidated with a broken fence and a gate that is no longer operational. People and goats invade the school as they please and almost all windows are without window-panes. The school yard is very dusty but there are many children and classrooms are full to capacity such that there is no possible movement between the groups. There is one big class that is used as both the staff room and the office. The school is mostly without water and electricity because cables are stolen time after time. There was excitement in the school, teachers and learners were preparing to relocate to their newly built double-storey school across the road which was about to reach completion. Gugu said:

*Practicals will now be conducted in a well-equipped science laboratory sponsored by Engen,*

Gugu indicated that she would be ready for her lesson presentation when they reached the new school.

#### **4.4.3 Learner factors**

This construct is concerned with the characteristics of learners in the teachers' classes that may influence the teachers' capacity to implement the NS curriculum.

##### ***Learners in Thulile's class***

There were 55 learners in the class, most of whom were second language speakers and a few who were even third language speakers. They all came from different cultural backgrounds and most of their parents were unemployed. Thulile remarked that they never had a single incident of discipline ever since the school was opened but there had been two cases of a Grade one and a Grade six learner having been raped by relatives at their homes. Most learners could not freely communicate in the language of instruction.

Attendance was good as learners were fed from the school nutrition programme. They were only engaged in gospel and cultural music due to the absence of adequate space to engage in other activities.

##### ***Learners in Maria's class***

Maria had a class of 44 learners with more girls than boys but she treated them all the same because everyone irrespective of sex had to clean the classroom floors and also shine them after applying their home-made floor polish. Learners had been taught how to use and access their library and science corner for their assignments, projects and other forms of assessment. Most learners were second language speakers of English but tried very hard to communicate in the English language because Maria made it a rule that they read simple books from their corner library every morning before classes commence. When Maria was asked when in the school timetable she had the time to practice reading with the learners, she laughed and explained:

*We made an agreement with the parents that I would be available to assist grade four learners with reading 30 minutes before lessons start and 30 minutes after school.*

All learners walked to school from the informal settlement of Folweni and most of their parents were school drop outs or still continuing with their studies. The school has a problem with learners who were always unable to do their homework because parents had no time for them or they were staying with illiterate grandparents. Hence the school created an opportunity for them to be assisted with homework every day for 30 minutes after school.

Meals were also provided to cater for those learners who went to school hungry. “*Our learners are generally very well behaved,*” reported Maria.

### ***Learners in Gugu’s class***

It was difficult to first detect the number of learners in Gugu’s class because when I first visited the school to have the questionnaire completed, there were 69 learners in the class because of the unavailability of floor space. I was informed that the class would be split when they occupied the new school. Gugu complained:

*I wish we were to move tomorrow because one cannot work effectively in such conditions.*

In spite of the difficult circumstances, attendance was good as learners went to school because the school had a feeding scheme. There were also no books to take home for further reading because learners stayed mostly with grandparents who were unable to assist with school work. The other problem experienced was that of missing books which the school was never able to retrieve. Learners were also from the same area as those in Maria’s class because her school was a feeder school for Gugu’s school and another school in the area that starts with Grade five. Gugu’s school is on the opposite side of Maria’s but close to the main road. The new premises are on the same side as Maria’s and with additional metres away from the road to accommodate most learners that have to cross the busy main road. Gugu commended her learners as well-mannered and respectful to all teachers although there were cases of Grade seven boys found smoking cigarettes.

### **4.4.4 School ethos and management**

This entails the general management of the school and how it contributes to the promotion of teaching, learning and assessment with special reference to NS teaching and learning.

#### ***In Thulile’s school***

The school has a principal and two HODs forming the management of the school. Thulile stated that as their school was still new, they had not organised field trips. The principal of school A is hardly ever in school because he was still negotiating at the time of the research for a number of things from different places to support teaching and learning in his school. The school management team was proposing to buy at least one science kit to enhance the teaching of science. When the principal brought work schedules for all teachers, he affirmed that he wanted to develop learners for the district science Olympiads so that learners would



build their confidence for external Olympiads and expos. The governing body participated in all school matters and in decisions taken for the smooth running of the school.

#### ***In Maria's school***

Maria was requested by management to replace a teacher who was on extended sick leave because they regarded NS as a foundation of the gateway subjects and needed to be given special attention. In most other schools it did not matter much whether or not there was a teacher in the mathematics or NS class. In Maria's school mathematics, NS and English are treated as priority subjects. The school had a science kit that was purchased eight years ago but had rarely been used. The management is trying to twin Maria with NS teachers of a Model C school in a nearby suburb to enable her to become more competent in the use of the equipment in the science kit. There had never been any field trips except to visit an aquarium. The principal has no teaching load however he delegated work to different committees led by different teachers even if they were not on the school management team. The school has an active governing body which participated in teacher interviews and also makes input into the running of the school.

#### ***In Gugu's school***

The school management is not very supportive in providing resources that are necessary for effective teaching. NS teachers try hard to improvise although they cannot offer lessons outside the classrooms because of the dusty yard. Teachers say they have never heard of any budget allocated for science equipment. They all looked forward to occupying their new premises because it has a well-equipped laboratory. No field trips have ever been taken except visiting the beach.

#### **4.4.5 Teachers' capacity to innovate a new curriculum**

Rogan and Grayson's guidelines are adopted in placing teachers' contexts at different levels for different constructs, based on the researcher's findings.

**Table 4: Profile of Thulile’s capacity to support innovation.**

Level	Physical resources	Teacher factors	Learners factors	School ethos and management
1	<p>School A is a new school which only has prefabricated classrooms. It originated to accommodate children from the informal settlement that mushroomed in the area. There are only two solid blocks that have recently been erected. The school is in a poor condition even the grounds are uneven and need to be worked on. No textbooks for Grade 4 learners.</p>	<p>Thulile is under-qualified to teach science, but has a professional qualification in Foundation Phase studies. She taught for many years without a basic professional certificate which she only obtained four years ago.</p>	<p>Thulile’s learners were from different cultural backgrounds and had difficulties in the understanding of the language. Although school attendance is good, this is because learners receive meals from the school nutrition programme.</p>	
2				<p>The principal was mostly not at school. He went out to negotiate for a number of things that the school needed as it is still new. The</p>

				governing body works hand in glove with the management of the school to promote quality teaching and learning. HODs ensure that there is teaching and learning in the school while the principal is away.
3				
4				

**Table 5: Profile of Maria’s capacity to support innovation**

<b>Level</b>	<b>Physical resources</b>	<b>Teacher factors</b>	<b>Learners factors</b>	<b>School ethos and management</b>
1				
2	School B’s buildings are old but well-maintained and the premises are also in a good condition. There is enough furniture which is suitable for Grade four. All learners have books and there is a science kit although Maria is battling to use it.	Maria has the minimum qualification for teaching junior primary but is motivated to do more for her learners. She makes an extra effort to improve teaching as she helps with homework. She was trained for NCS in both foundation and intermediate phase.	Maria’s learners were reasonably proficient in the language of instruction. They were taught how to access and use material from their corner library and from the science corner. Maria inculcated the culture of reading to the learners as she provided time to help them with their homework. They could also take books home for further reading by themselves. All learners were fed in schools.	The school was very passionate about maths and science and the school management together with the governing body worked very hard to provide all the necessary equipment to promote maths and science in the school. They also had a science kit. The SMT had made all necessary arrangements for Maria to be trained on the usage of the equipment in the science kit.
3				
4				

**Table 6: Profile of Gugu’s capacity to support innovation**

Level	Physical resources	Teacher factors	Learners factors	School ethos and management
1	<p>School C has dilapidated buildings which are not adequate for all learners. The fence had been cut and poles removed to make shack houses. There was no locked gate with a security guard and it became difficult to maintain cleanliness in a few toilets that are available.</p> <p>Electricity is often off as well as water because of theft of cable and copper pipes. No science equipment available. There are some textbooks available for learners but they cannot take them home for reading.</p>		<p>Gugu’s class was overcrowded with learners who lacked proficiency in the language of instruction. There was no plan in place to assist them in school yet they were never even given books to read at home because they had no one to help them at their homes either. They attended school in numbers in order to receive meals from the feeding scheme.</p>	<p>The school management was not very supportive in providing resources necessary for effective teaching. Teachers had never heard of a science budget. No educational field trips were undertaken.</p>

2				
3		Gugu is qualified for her position and had studied science at both college and university levels. She received NCS training for the intermediate phase.		
4				

## **Profile of implementation**

This construct provides information as to how teachers implement the NS curriculum. It is concerned with the factors that influence implementation in the classroom. The questionnaire, lesson observation, post-interviews, the Natural Sciences Teachers Guide as well as the teachers' lesson plans provided the data to produce the findings with regard to profile of implementation. Four sub-constructs are discussed.

### **4.5.1 Classroom interaction**

This construct focuses on the interactions between teacher and learners and between learners themselves during teaching and learning.

#### *In Thulile's class*

Thulile's lesson was presented according to how it was planned. However the introduction she gave to learners left them confused and puzzled. The topic was "phases of liquids" and she said;

*This is similar to what the baby does, the baby sits, crawls and stands to walk...*

Learners were attentive but quiet. Thulile then communicated in IsiZulu hoping to engage the learners with the topic and asked:

*Asuke enjani amanzi menjalo? ... no answer...OK! ... the second one ice phase or...?*

The policy advises that baseline assessment be conducted so that the teacher is able to establish misconceptions, uncertainties and gaps in the knowledge of the learner and address them so that connections can be made with the new knowledge. Thulile kept on asking questions as a way of introducing learners to concepts related to the different processes that were leading to the change of water from one state to the other. Learners were expected to first brainstorm ideas around the question asked in their groups before responding. They participated actively even when they were providing incorrect answers. The teacher posed the question of what was happening to the ice in heat, and the group who was given R1.50 for the correct answer given, which was that the ice boiled. There was no comment or correction from the teacher. Thulile had sequenced her lesson according to what she had written in the lesson plan. She first dealt with prior knowledge where she thought learners would best understand the "phases of liquid" if they had the knowledge of the different stages in the

development of a newborn baby. When asked what she meant by this she simply said: “*I wanted them to see that changing from ice to water to steam is like those stages of development.*” She then introduced the lesson by asking what the colour of water was which she never corrected when learners gave it as ‘white’ but concluded by stating that in the higher grades they would learn what colourless meant. She proceeded to teaching and learning activities where new concepts were explained and defined before embarking on the practical demonstration but she had difficulties with the content or concepts used. Some concepts on the chalkboard were abbreviated or spelt incorrectly, e.g. themomet, evaperation, and so on. Those spelling deficiencies could be followed and memorised by learners. Books were not available for use and the teacher had no other resources except calling out the information and writing on the board. The policy suggests that the chalkboard summary should be correctly and clearly written because all information stated there would be imprinted on learners’ minds.

### ***In Maria’s class***

Maria presented her content as written out in her lesson plan. It was well formulated and sequential to allow learners to make meaning of the information given to them. They were encouraged to express themselves in English and whenever isiZulu words were used, the teacher would try to correct and make the learners repeat. She would in most cases write the sentence on the chalkboard. Learners were given plants in groups, and made to identify the parts they knew from cards forming the word bank which were on the teacher’s table. They would look for the name of the body part identified and place it on the chalkboard on the chart with the structure of the plant. Maria gave them knowledge about dangerous/harmful and useful plants with reference to their school garden.

From the activity described above, Maria was able to detect the knowledge that the learners had on characteristics of plants. She had a big chart with a drawing of the structure of a plant showing the different parts and learners were also asked to use their books concentrating on the relevant pages with the body parts of plants. That was the only time learners were asked to refer to their books. During the interview Maria was probed to comment on the use of the textbook during her lesson and she attested to the fact that there could have been more interaction with the textbooks so that learners become familiar with using them even in their homes. She also added that she had made copies with the information on the uses of plants which could be read and presented by learners in groups.



### ***In Gugu's class***

Gugu used the textbooks effectively with learners as she referred them to relevant pages where there were different pictures of animals. Learners were able to read names of animals from the textbook and aligned them with correct habitats. The concept of habitat was introduced first by guiding questions that probed learners till they were able to give the definition of a habitat. Gugu generated more questions from learner responses leading them to placing and differentiating animals that live on land or in water or both. Some learners were not very attentive and when they were pointed at they gave the habitat of plants that they last dealt with. Gugu spent some time repeating habitats of animals and not of plants for the group that seemed not to understand what they were dealing with.

### **4.5.2 Science practical work**

This construct is concerned with the way the teacher approaches practical work.

### ***In Thulile's class***

Thulile used the demonstration method in an attempt to develop concepts they had discussed in class. She tried to engage them in practical work as she had indicated in the questionnaire. She successfully managed to help them identify the different parts of the apparatus they were going to use for the demonstration together with their functions. These were two test tubes, a glass beaker, a tripod stand without gauze and a thermometer. This apparatus was borrowed from a high school in Doonside. Thulile conducted the demonstration of the process of changing water from one state to the other and requested the different groups to observe, but the aim was not stated. She shouted the procedure as she was putting together the apparatus. Questions were asked as the lesson proceeded and learners were expected to answer.

Two volunteers were asked to repeat the demonstration following Thulile's verbal instructions. She made them aware of the safety measures by stating that the test tube should face the chalkboard and not their faces. They were so excited, and the second pair was also allowed to continue with the demonstration. Learners were not exposed to writing a scientific report or at least to describe their observations and during the interview Thulile stated: *"I left it because it was going to waste time."* The response contradicted what she had indicated in the questionnaire. It further came up that she had never had any exposure to practical work even during her academic study. She then exclaimed:

*It could have been better if I had specialised in science for my NPDE because I have a challenge with many things but I will learn along the way.*

### ***In Maria's class***

Learners already had the knowledge about the different types of soil which they had learnt when they were dealing with soil types in “Planet Earth and beyond.” They were shown the different types of seeds which develop into the different vegetables. Some agreed that such developments were possible while others clearly stated that they would never develop into seedlings. Learners embarked on the investigation and they prepared different beds in their groups for the different seeds that they had to grow. This was done in transparent two litre containers. They were labelled and placed on window-sills for observation and recording of data. Maria gave learners the record sheets which they pasted in their books to record their observations.

They were made to draw up the roster in each group to care for the developing seeds. Maria promised to help them analyse their results before they started their examination. When Maria was asked why she regarded practical investigation as a suitable method to use, she responded that it was necessary that learners be exposed to as many science process skills as possible and again in the process are able to construct scientific knowledge. Learners would also get a feel for developing and selling their own seedlings thus seeing themselves as small entrepreneurs, which contributes a lot to the improvement of their lives.

### ***In Gugu's class***

Gugu had two lesson plans previously prepared for her class which were on “Habitats of animals,” which indicated no practical work. She indicated that she had been teaching Grade six and had not encountered any content that required her to conduct practical work. During the interview she indicated that she had dealt with the ecosystem in Grade six and she realised after the lesson that she could have created or brought an ecosystem into the classroom with different communities and caused the learners to make observations which were going to lead them to the definition of a habitat. Gugu had not prepared any practical demonstration involving scientific apparatus during her presentation. She had prepared cards with names of animals which she requested that learners from different groups chose from the table and placed under each of the three categories she had written on the chalk board. Gugu

stated that she was still going to engage learners in practical activities when they investigate the presence of starch in leaves and other plant parts. She said:

*I believe in presenting my lessons in the form that will cause my learners to use all their senses as they observe or compare things, and I am definitely going to expose my Grade fours to practical investigations.*

#### **4.5.3 Science in society**

This construct refers to the way science teachers teach science to enable learners to understand the impact of science on society and the environment. This also assists in relating classroom practice to the learners' everyday lives.

##### ***In Thulile's class***

Thulile tried to make learners think about how and where they experience the processes of freezing and evaporation in their everyday life. They came up with freezing juice to 'isiqeda' and were unable to respond to evaporation. There were no comments again from Thulile and no answer was given to them. When asked during the interview why she never gave learners any exemplar, she explained:

*Eh... the truth is I got confused myself and could not find the paper where I had written a number of examples.*

She also promised to revisit the part of the lesson she left out when she next met her class.

##### ***In Maria's class***

Maria took learners on a tour around their school's vegetable gardens to identify the different types of vegetables grown. In the classroom the variety of vegetables identified in the school gardens were related to the parts of plants they came from, and the teacher briefly stated how some could be planted without using seeds. She explained:

*You can cut the part of a rotten potato with 'eyes' and replant it instead of throwing it in the dust bin.*

One learner stated that her mother threw the rotten potatoes in the garden without planting them and a potato plant came out. Maria told them that their seedlings would be sold to the principal for the school vegetable gardens. Maria had more to say as she commented on learner participation in the "open" investigation that she had designed:

*If learners do their investigation under my guidance, I ensure that they handle things on their own, and hence they acquire a variety of skills and become more confident in applying them to their own lives.*

When Maria was asked if her lesson addressed specific problems or issues faced by the local community, she confirmed that this was so. She elaborated that this was necessary as the school community is poverty-stricken and many parents are bed-ridden, therefore learners are encouraged to grow vegetables with seedlings donated by Woolworths. Learners were supplied with bunches of vegetables as per need. This tallied with the response from the questionnaire which stated that Maria designs lessons based on local community needs and allows learners to make products to meet the people's specific needs.

#### ***In Gugu's class***

When animals were discussed, reference was first made to animals that the learners knew and they had to tell the teacher why the given animals were familiar to them. Domestic animals and pets were discussed with reference to their characteristic and behaviour that made them suitable to their habitat. Gugu explained that the teachers' guide indicates that learners come to class with their own ideas and concepts and need to be assisted in making connections with the new knowledge. This attested what she had agreed to in the questionnaire when she indicated that she uses everyday life examples to illustrate scientific concepts. When Gugu was again asked if she ever designed lessons based on community problems, she confidently replied: "*No...no...no! Lessons are based on the work schedule.*" However according to the policy document LO3 with its assessment standards does make provision for community problems to be addressed with a suitable content from the work schedule. When Gugu was describing physical resources in her school, she had mentioned that goats were sometimes found roaming around the school yard. At times they would get into the classrooms and tear off pages from books thus they could not have science corners and charts on different processes hanging on walls in the classrooms.

#### **4.5.4 Assessment**

This construct is concerned with the different assessment practices employed by the teachers.

#### ***In Thulile's class***

In affirmation of what Thulile had indicated in the questionnaire, she gave her learners short closed questions as the demonstration was conducted. Questions were given verbally and

learners had to write out answers after they had discussed the question as a group. These were discussed and marked and returned to the groups or presented orally by a chosen member of the group and corrected. At the end of the lesson five questions were squeezed in the available space of the disorganised chalk board and the group that finished first with all correct answers was to be given R2. One group managed to secure the R2 coin. She promised to set a test on practical work after she had given them a worksheet on the demonstration conducted. She could give any of the three assessment forms that she had written in her lesson plan as activity, assignment and a project. When she was asked to explain what she meant by activity, she stated that it meant few questions relating to the content studied to be written as a class activity.

### ***In Maria's class***

Learners were given a worksheet to complete as homework because a double period was over. There were questions on the work done with learners during the lesson. There were further questions developed for learners who were not going to cope with the worksheet and they would answer the questions together with the teacher. They were all told to work on their project as a group. Maria had exposed her learners to a variety of assessment activities thus creating opportunities for them to excel as suggested by the policy and as she indicated it in her lesson plan. They would observe the body parts of the plant and assigned appropriate labels given in strips, there was an assignment where they would write out the type of conditions which would be suitable for their seeds to flourish and they would lastly use their hands to grow their seeds. The policy allows only one project per grade per year and this was Maria's first project. She was explicit about why she gave the project during the last term as she elaborated;

*“I love to give a project on Life and Living because that is where my strength lies and I can guide my learners effectively.”*

### ***In Gugu's class***

Gugu had not stated any assessment activity in her lesson plan but during the lesson she had given the groups a relevant sorting activity where she made them find the names of the animals from the textbook, and in their exercise books they were made to sort them according to their habitats. Three different habitats were given per group. When asked in the interview why she never regarded that as an assessment activity, she replied: *“No! It wasn't a test.”* In

the questionnaire Gugu mentioned a test, assignment and a project as the different forms of assessment she would engage her learners in. It then appeared that Gugu never regarded a class activity as an assessment activity. Although the policy recommends that various forms of assessment be conducted to cater for the different learning styles, Gugu still regarded the test as the only assessment form.

#### **4.5 The teachers' profile of implementation**

Rogan and Grayson's guidelines are also adopted for the profile of implementation in placing teachers at different levels for different constructs. The profile of implementation table (Tables 7-9) presents the four sub-constructs discussed and enabled me to create meaning and understanding of the measure to which each teacher is able to put the curriculum into practice.

**Table 7: Thulile’s profile of implementation**

Level	Classroom interaction	Science practical work	Science in society	Assessment
1	<p>Thulile presented her content as planned. It was in a sequential order however the definition of some concepts were incorrect. Notes were very scanty and all over the chalk board.</p> <p>Books were not available for use.</p> <p>She engaged learners with questions based on the demonstration conducted. This was done more in Isizulu than in the language of instruction.</p> <p>Learners were attentive because they were promised incentives but there were no questions raised.</p>	<p>She used a demonstration to illustrate different concepts and in the process she stressed that learners had to observe and brainstorm what they saw.</p> <p>Some learners participated in the demonstration but were expected to follow the teacher’s strict instructions.</p>	<p>When Thulile wanted to illustrate some scientific concepts to learners, she referred to everyday life, e.g. the freezing of ice lollies in the refrigerator. However learners never asked questions about science in their everyday lives.</p>	<p>Verbal and written questions were given but they were mostly of recall type. This was marked and returned promptly because there were incentives for those who gave the correct responses</p> <p>Assessment was done in groups but Thulile promised to give a test to be written in the near future.</p>
2				
3				
4				

**Table 8: Maria's profile of implementation**

Level	Classroom interaction	Science practical work	Science in society	Assessment
1				
2	<p>Maria's content was correct and well organised. It was presented in the way it was written in the lesson plan.</p> <p>Notes given on the board formed the summary of the lesson. Learners had textbooks which they were referred to from time to time as they were used in collaboration with other resources, e.g. worksheets, a chart, flash cards and a number of live specimens. They were all used effectively.</p> <p>Maria engaged learners with a variety of questions including high order questions and learners showed a lot of interest and raised a number</p>		<p>Maria extended her lesson on the different structures and functions of the plant parts to developing seedlings from the different seeds which will grow to different vegetables, thus addressing poverty facing the unemployed community of the school.</p>	<p>A worksheet was given to learners which they had to answer individually. It had questions from the three cognitive levels with some based on the preparations done towards growing seeds. They had to write about the suitable environment that will make the seeds grow.</p>



	of questions.			
3		<p>Maria designed a practical project which learners had to conduct and it encouraged learners to discover information on their own. This hands-on activity was done in groups of five. Maria had exposed learners to writing scientific reports previously but for this lesson they were given a worksheet with guidance on the type of report that was expected of them.</p>		
4				

**Table 9: Gugu’s profile of implementation**

Level	Classroom interaction	Science practical work	Science in society	Assessment
1		<p>Gugu had not prepared any practical demonstration involving scientific apparatus during her presentation but she indicated during the interview that she was still going to expose them to approaches where they would observe and compare things using all their five senses to help them learn more concepts. It was not clear what she intended doing.</p>	<p>Domestic animals were used by Gugu as examples from everyday life to illustrate scientific concepts such as habitat. Learners responded to probes and not many questions were asked. This did not address the aspect of science in society.</p>	<p>Gugu gave her learners an assessment activity where they had to sort and classify animals against their habitats. This was done in groups, marked and returned to learners. An assignment to be done individually was to be given at a later stage.</p>
2	<p>She presented the lesson as planned and referred learners to relevant pages of the textbook. Learners were able to read from the textbooks. Learners were encouraged to participate through</p>			

	probing questions. No concise notes were given. Writing was all over the chalk board.			
3				
4				

## **4.6 Conclusion**

In this chapter findings were presented with regard to the three teachers' understanding of the NS curriculum, the factors that support their capacity to implement this curriculum and the way in which they do implement the NS curriculum. In the next chapter the researcher will use the findings from this chapter to answer the research questions and attempt to explain why teachers teach the NS curriculum in the way they do. Furthermore, I will make certain recommendations as to how teachers' profile of implementation may be improved.

# CHAPTER FIVE

## CONCLUSIONS AND RECOMMENDATIONS

### 5.1 Introduction

In Chapter Four I presented findings based on the analysis of data from the different instruments used as a comparison of the three teachers' interpretation and implementation of the RNCS in Grade four as well as factors influencing their implementation of the NS curriculum. This final chapter will demonstrate how the research questions were answered by interrogating the findings presented in chapter four, as well as present a final conclusion as to why the teachers implement the NS curriculum in the way they do. Furthermore recommendations based on the findings will be presented.

### 5.2 Overview of findings

This study aspired to explore the ways in which teachers implement the NS curriculum and this was conducted with three Grade four teachers. Numerous sources of data enabled me to determine how the three individual teachers interpret the curriculum as well as how they implement said curriculum. The factors that influence their implementation were also explored. The theory of Rogan and Grayson (2003) informed the type of data captured with the questionnaire, classroom observation and interviews and provided the framework for analysing this data to answer the following research questions:

1. How do teachers interpret the Revised National Curriculum for Natural Sciences in Grade Four?
2. What factors influence the way teachers implement the natural sciences curriculum in Grade Four?
3. How do teachers implement the natural sciences curriculum in Grade Four?
4. Why do teachers implement the natural sciences curriculum in the way that they do?

#### 5.2.1 Teachers' interpretation of the curriculum

The first research question is: How do teachers interpret the Revised National Curriculum Statement for Natural Sciences in Grade Four? It appeared that teachers had various interpretations of the new curriculum. From the findings it emerged that the teachers' interpretation of the curriculum influenced the way they planned their lessons. Their

interpretation had a bearing on the content taught, strategies used to present the content to learners and how it was assessed. Thulile had difficulties with the understanding of the content to teach and appeared to confuse certain concepts she was going to teach. This was evident when she treated water as the only substance that is a liquid. Maria had a good understanding of the content she was dealing with and understood what the curriculum expected with regard to the chosen content. Gugu had an idea about the content to teach but she misinterpreted that she had to deal specifically with natural habitats. It appears that all teachers had gaps in their knowledge with regard to the science content. Even Maria admitted that there were sections that she had no knowledge of and avoided teaching. It is very important that teachers know their content so that they are able to follow the work schedule as presented without gaps.

Thulile regarded scientific investigations as an important strategy for the attainment of skills and knowledge in the teaching of science, but her poor knowledge of what the outcomes and assessment standards meant, resulted in no activities related to investigations. Although Maria had a poor understanding of the policy document, the learning outcomes and the assessment standards were correctly addressed by her teaching and assessment activities. Gugu had limited understanding of the learning outcomes and assessment standards and could not apply them appropriately in her lesson and that impinged on the teaching and assessment of the knowledge and skills that learners had to acquire. The chosen LO and AS never tallied with the adopted teaching strategy. In her lesson plan she had included LO1 AS 4 that does not exist.

Thulile was adamant that brainstorming was a method of learner-centred teaching. Demonstration was another method that Thulile indicated in her lesson plan. It remained unclear to her if the questions she had formulated were closed or open-ended questions. Maria's understanding of the content to be taught and the appropriate teaching methods were better applied in the presentation of her lesson plan than both Thulile and Gugu. She planned to systematically move from observing the different parts of the plant to functions, and then use them to develop seedlings. Gugu's question and answer method was appropriate in teaching the new concepts to her learners and connecting them with what they already knew. She underestimated the narrative method which also had a role to play in the explanation of new terms because during the interview she claimed that the narrative method was not suitable for the teaching of science. In her discussions she had incorrectly related the

question and answer method to a scientific investigation which was not addressed by her lesson.

Thulile indicated in her lesson plan that the assessment activities that learners would engage with would be to collect data as they received her verbal instructions. She further wrote that learners would be given an assignment, a project, and then they will develop a portfolio and make oral presentations. During the interview she indicated that all the mentioned forms of assessment were possible from the teaching activity she had planned. Maria had a better understanding of the forms of assessment and was explicit with regard to when and how the chosen forms were to be used. Her assessment had also catered for weak learners for whom she had prepared five simple questions inclusive of all cognitive levels. A worksheet to be given to learners was inserted in her plan. Gugu had not indicated any form of assessment. However when a few forms were suggested to her she agreed that they could be used but kept on saying that they could be used after brainstorming.

The teachers' interpretations of the RNCS vary. Maria interpreted the curriculum better than Thulile and Gugu. All three experienced difficulties with one or more aspects of the lesson plan due to their misinterpretation of the RNCS. The RNCS as an outcomes-based curriculum is very new to teachers, and as the findings show, they made little or no attempt to understand what outcomes and assessment standards meant and only used them to satisfy the subject advisors. Furthermore, two of the teachers, Gugu and Thulile, showed little understanding of what practical activities entailed. This is another example of their lack of experience of a curriculum that places a high premium on learner participation and specifically the development of process skills in science.

### **5.2.2 Teachers' implementation of the curriculum**

Teachers' implementation of the curriculum is best understood by interrogating the second and third research questions which are: What factors influence the way teachers implement the natural sciences curriculum in Grade four? and how do teachers implement the natural sciences curriculum in Grade four? Firstly, the data, as analysed according to my chosen framework, enabled me to place each teacher at a particular level with regard to the factors that enable each of them to support the implementation of the NS curriculum in Grade four. These factors, namely physical resources, teacher factors, learner factors and school ethos and management, demonstrated that:

Thulile was placed at level one with regard to her qualifications and the types of learners she was teaching. She had no qualifications in science which meant that she had difficulty understanding science concepts. Her learners came from disadvantaged backgrounds. This meant that they received very little support from their home environments and struggled with the language of instruction. Thulile also operated at level one with regard to the physical resources available to her; space was limited and no textbooks were available for learners. Furthermore, her school environment was not conducive to teaching and learning. However, the school management had a positive attitude to science and was willing to support the development of science teaching and learning at the school.

Maria operated at level two in relation to physical resources, teacher factors, learner factors, as well as school management. Her learners were from similar backgrounds to those of Thulile and experienced the same constraints to learning, however with the support of the school, learners could take books home to read and do homework. The school buildings were in good condition and the school environment was conducive to learning. Although her qualifications were equivalent to Thulile's, she had gone the extra mile in terms of developmental programmes for both her learners and herself. There was a remarkable change with learners' level of communication and engagement in scientific investigations. The school management team was superb and engaged a number of initiatives in improving the high quality of mathematics, science and English communication in the school.

The improvements that Gugu had made in both her academic and professional qualifications moved her to level three. She was the only one who had a formal qualification in science education. She operated at level one with regards to physical resources, learner factors and school ethos and management. Very little or nothing was done to provide learners with the support that could address their diverse background needs and the school management team was not very keen in providing any science equipment to enhance the teaching and learning of science because of a high rate of burglary facing the school. The school buildings as well as the environment were not conducive to learning.

All the above factors, together with the teachers' understanding of the curriculum influence the way they implement the curriculum. Again Rogan and Grayson's framework enabled me to analyse the data with regard to class interaction, science practical work, science and society and assessment.



Thulile operates at level one with regard to all four factors of the profile of implementation. In spite of her indication that she poses open-ended questions to her learners, there was little evidence of this. Learners do not raise questions during lessons, neither was her chalk board work helpful to learners as it was disorganised and terms were spelt incorrectly. Although Thulile attempted a demonstration, her lack of content knowledge let her down and it is doubtful that learners understood the concepts she was attempting to teach. She made no reference to the relationship between science and society and no formal assessment activities were observed. Her use of reward for achievement is questionable.

Maria was placed at level two for all factors except for the science practical work which was at level three. Learners were given the opportunity to develop a number of appropriate science concepts and were actively involved in a practical investigation. Furthermore learners were introduced to the notion of writing up their observations. Maria's use of resources, both practical and in the form of flash cards assisted learners in learning both science processes and content. Her questions included both higher and lower order questions. Maria's lesson was also strongly focused on the relationship between science and society as learners learnt how scientific knowledge could assist communities when developing food gardens. Her assessment strategies required learners to write instead of giving verbal answers.

Gugu operated at level two for classroom interaction as she used the textbook effectively and asked relevant questions. However, she was at level one with regard to science practical work, science in society and assessment. The way in which Gugu approached the topic made practical work very difficult, but she could have used examples from the learners' environment to discuss habitats. She made no reference to the relationship between science and society as her examples were not appropriate to develop the understanding required. Although her assessment activity was relevant, it did not require higher cognitive thinking and this placed her at level 1.

### **5.2.3 Why teachers interpret and implement the curriculum in the way they do**

While the previous three questions focused on the teachers' interpretation and implementation, the fourth research question attempts to explain why teachers act as they do with regard to the natural sciences curriculum. This question, why teachers implement the curriculum in the way they do, can be answered by considering all the factors pertaining to their teaching that emerged from the study.

The first aspect that ostensibly has an impact on the way teachers implement the curriculum is their view of the curriculum. Coppola (2000) is of the view that the beliefs and values that teachers bring to their classrooms during the implementation of the curriculum may influence their interpretation of the meaning of science, the outcomes of their teaching, the teaching styles and approaches. This is especially true if teachers do not identify with a new curriculum. This was evident in the teachers' attitude to learning outcomes and assessment standards. All three teachers were honest in admitting that they had very little or no understanding of what the outcomes and assessment standards meant. Even if teachers understood what the outcomes entailed, outcomes one and three are foreign to these teachers' own experiences and notion of what science entails. They were exposed to a school curriculum that focused on science content, and changing to view science as a process rather than a product and furthermore understanding the relationship between science and society requires a paradigm shift that not all teachers are able to accomplish. It is commendable that Maria was able to implement the curriculum in the way she did. This ability speaks directly to Maria's positive attitude. This was evident in the way she sacrificed her time as she motivated her learners to spend extra hours in school engaging in their school work.

A second aspect is that of science content knowledge as well as science PCK. Only Gugu had some kind of qualification in science while the other two had none. So while the teachers may have some pedagogic knowledge, without science content knowledge, there can be no PCK (Trowbridge, Bybee & Powell, 2004). Gugu's science background did not appear to support development of the necessary PCK as she selected inappropriate examples in her teaching. Sound content knowledge provides the teacher with the expertise to simplify and contextualise science concepts so that the teacher is able to address misconceptions, learner difficulty and misapplications identified during baseline assessment (Ball, 2000). Basista and Matthews (2002) also regard the content knowledge as a requirement for teachers to enhance performance in their teaching for successful learning of science. PCK will allow teachers to develop various strategies that will assist them in presenting scientific knowledge and skills in methods that are relevant to different learner needs (Ball, 2000). Alonzo (2002) recommends a stronger content knowledge to assist teachers in providing effective guidance on scientific investigations to clarify concepts and to broaden the teachers' understanding of science to impart to learners, thus increasing their performance. Dawson and Alkinson (2012) claim that thought provoking questions that assist learners in their investigations requires

sound PCK to have an impact on successful implementation of the curriculum. Science content knowledge coupled with PCK plays a vital role in providing the teacher with strategies to promote effective implementation (Trowbridge, Bybee & Powell, 2004). Rohaan, Taconis and Jochems (2010) affirms that the accumulated experience in the teaching of the subject content through a variety of strategies to address learner needs and create opportunities for them to take responsibility for their own learning contribute to a rich PCK.

Clark (2000) claims that teachers need to empower themselves in developmental programmes where they will be presented with practical activities using material of their context. As these teachers have very little experience of practical activities and investigative processes, it may be very difficult for them to adopt these strategies in their teaching, in spite of what the curriculum prescribes. Fisher (2010) is of the view that primary science teachers should think of alternative ways in which they could engage their learners in practical work for different topics because they normally do not conduct practical work because of various reasons they mention. This is most probably the case in this study as well, where teachers do not have experience of practical work to draw on.

Assessment also presented a problem as teachers interpreted the different strategies differently as well as the purpose of assessment. None of the teachers have the expertise to implement the complex types of assessment strategies required by the RNCS, although Maria had more expertise than Thulile and Gugu. Assessment poses challenges for science teachers in classroom practice as it involves what ought to be learnt and what learners will do to show that they have learnt. In the RNCS, understanding of the assessment standards with regard to the levels at which questions ought to be set per grade is essential. Without this understanding, assessment becomes a challenge. The DoE (2002) states that assessment is part and parcel of teaching and learning, hence teaching and assessment activities must be planned concurrently as these offer skills for designing significant science lessons. Assessment is vital to establish if learners have gained any knowledge and skills from the content learnt and to plan activities to promote teaching and learning (DoE, 2002).

Poor physical resources also contributed to challenges teachers face with regard to implementing the curriculum. Small and overcrowded classrooms cannot accommodate practical approaches and neither can dusty and bare schoolyards accommodate environmental activities. While Grubb (2008) believes that the strategies employed in the usage of physical

resources will have a great impact on the outcomes of the lesson, this becomes an impossible task in the types of environments the teachers in this study operate in. Lastly, good management of the school supports the teaching and learning of science in a very special way as it facilitates the provision of resources to enhance the quality of science teaching. Only Maria's school made an effort to enhance science teaching. If this kind of support is lacking, as is the case in Thulile and Gugu's schools, teachers struggle to implement a curriculum as required.

### **5.3 Recommendations**

Rogan and Grayson (2003) present six propositions which they believe should be considered when a new curriculum is introduced. Curriculum 2005 (C2005) is a curriculum that is very different to any curriculum these teachers experienced in their own schooling or during their earlier training.

To expect these teachers to embrace a system that is so radically different to their earlier experiences is unrealistic. If any change is to occur, these changes need to be gradual and occur in small steps. The introduction of CAPS is an effort to streamline the RNCS and enable teachers to interpret and implement the curriculum more effectively. However, this alone will not assist teachers in improving their profiles of implementation. While this research is a case study of three teachers in which the findings cannot be generalized, I do believe that many teachers experience teaching NS in the same way as the teachers in this study and the following recommendations may therefore apply to a wider group than the three participants of this study.

I will frame my recommendations in terms of four of Rogan and Grayson's (2003) propositions:

These are:

- Innovation should be just ahead of existing practice. Implementation should occur in manageable steps.
- The capacity to support innovation should be concurrent with efforts to enrich the profile of implementation.
- All role players need to reconceptualise the intended changes in their own terms and context.

- Changing teaching and learning is a change of culture not a technical matter.

From the findings discussed above it is evident that the three teachers had challenges with regard to the interpretation of one or more aspects of the curriculum and some lack the capacity to support innovation. All this demands that there be appropriate, stronger and continuous support of curriculum implementation to enrich the teachers' profile of implementation.

### **5.3.1 Innovation should be just ahead of existing practice. Implementation should occur in manageable steps**

As mentioned earlier, the introduction of CAPS is a step in the right direction. Teachers no longer need to grapple with assessment standards and outcomes are now phrased as specific aims which may resonate more with what teachers are familiar with. While teachers are familiar with the notion of science as a product (specific aim one) two of the teachers in the study are not competent with the inquiry or investigative method as applied in LO1 (Specific Aim 1) and they need to be empowered to enable them to understand the different steps of the scientific process and how they are applied in the relevant content for the grade. It might be helpful that they be supported within the context of their school so that they in turn may apply what they have learnt to their learners. Starting with simple practical activities and relevant demonstrations may be the first step before moving to full investigations.

### **5.3.2 The capacity to support innovation should be concurrent with efforts to enrich the profile of implementation**

To enable teachers to improve their profile of implementation requires an improvement in the aspects which influence their capacity to implement the curriculum.

#### ***Improvement of science content knowledge and PCK***

One of the most important factors that will enable teachers to improve their implementation of the NS curriculum is better qualifications. Teachers need to be knowledgeable with regard to the science content they teach to learners especially in Grade four. Continuous professional development in skills and knowledge are recommended.

It may be necessary for teachers to be taken through content workshops on all the content to be taught in a term before the term begins. When they have a common understanding about the content to teach, they can then look at the factors prescribed by their context to develop the variety of approaches that could be used for teaching, learning and assessment. A bank of questions of different cognitive levels could be developed and made available to all, after they have all understood how they are derived.

Teachers like Gugu who has appropriate qualifications but appear to have challenges in their understanding may be further capacitated to improve their classroom practices and enhance their effectiveness as science teachers. This could be done through district support (by departmental officials), through clustering of teachers from the same area or through affiliation to science organisations, e.g. SAASTE. Teachers like Thulile might benefit the most if the Department of Education could re-introduce in-service programmes where science teachers are taught the content including practical activities to teach in a term before the term begins so that they are empowered to teach and assess effectively. Alternatively teachers should be encouraged to register with the tertiary institutions to upgrade their science content knowledge. Grayson (2010) also urges teachers to increase their science content knowledge through studying. Trowbridge, Bybee and Powell (2004) still maintain that science content knowledge and pedagogic content knowledge is inseparable and one without the other will never make a better science teacher.

A further aspect that requires attention is that of placing teachers in positions they are not qualified for. Senior general managers, district managers, circuit managers, principals of schools and all concerned managers should be encouraged to place teachers in positions that correspond to their qualifications and their experience (Darling-Hammond, 2000). Advancement in education will depend on the appropriate placements of teachers depending on their qualifications and the ability to teach effectively. They must be the experts of the subjects they are to teach with the relevant knowledge and skills and these ought to be maintained through further studies, seminars or development programmes.

### ***Physical resources***

While waiting for the provision of basic and other resources by the department it is recommended that teachers be supported and capacitated in clusters so that they will be assisted within their context with classroom management skills. Maria had no science content

but the experience she had accumulated over time made her very innovative and she had improvised a lot to enhance teaching and learning of science in her practice. Grubb (2008) affirms that the availability of resources does not confirm a change in classroom practice but how they are used will impact enormously on the outcomes.

### ***School management***

School managers should also take a stronger stance when liaising with the DBE with regard to class sizes, appropriate furniture and suitable spaces for teachers to work. Furthermore, school yards should be maintained to create a safe environment for learners and teachers.

### ***Learner factors***

While all three schools in this study have made commendable efforts to assist learners from disadvantaged backgrounds with regard to providing meals, programmes where learners stay after school to do homework and improve their skills in the language of teaching and learning would assist teachers in their efforts.

### **5.3.3 All role players need to reconceptualise the intended changes in their own terms and context**

This study has shown that not all teachers or schools are at the same level with regard to their capacity to implement a curriculum such as RNCS. School management teams should take the lead in discussing what innovations may be possible and could be implemented, with all staff members. This would imply taking into account the capacity that exists in the school. This approach does not imply complacency - concrete steps that are possible to implement should be clearly articulated.

### **5.3.4 Changing teaching and learning is a change of culture not a technical matter**

This proposition speaks directly to the attitude of teachers, school management teams and governing bodies. Unless there is a genuine desire to improve teaching and learning, change will not occur. My recommendation is that stakeholders be made aware of contexts similar to their own, where positive change has occurred. This may enable them to want to emulate similar changes in the culture of learning and teaching in their own contexts.

## **5.4 Conclusion**

The aim of my study was described in chapter one as it seeks to explore how teachers interpret and implement the RNCS curriculum. The reasons for embarking on this study were outlined under purpose and rationale for the study. My concern is about the teachers' interpretation of the curriculum and how it is implemented in the classroom.

The main issue that emanated from the literature is that the science content knowledge and the PCK play a major role in coming up with new approaches during curriculum implementation. Rogan and Grayson's framework enabled me to establish each of the teachers' profile of implementation with regard to the NS curriculum. It further enabled me to demonstrate how teachers' interpretation of the curriculum as well as the various factors that influenced their capacity to implement the curriculum impact on their profile of implementation. In conclusion, my recommendations are based on the propositions put forward by Rogan and Grayson(2003) with regard to the implementation of a new curriculum in a developing country such as South Africa.



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# **APPENDICES**

## **APPENDIX: A**

### **ETHICAL APPROVAL LETTER**

13 September 2011

**Ms MN Mpanza (891101189)**  
School of Science, Mathematics & Technology Education  
Faculty of Education  
Edgewood Campus

Dear Ms Mpanza

**PROTOCOL REFERENCE NUMBER: HSS/0836/011M**

**PROJECT TITLE: A case study of teachers' implementation of the Grade Four Natural Science (NS) curriculum**

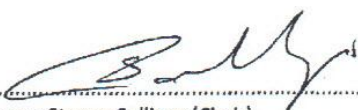
In response to your application dated 6 September 2011, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL**.

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)**  
**HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE**

cc. Supervisor: Dr M Stears  
cc: Mr N Memela/Mrs S Naicker, Faculty Research Office, Edgewood Campus

## **APPENDIX: B**

### **LETTER FROM PROVINCIAL DEPARTMENT**



**kzn education**

Department:  
Education  
KWAZULU-NATAL

Enquiries: Sibusiso Alwar

Tel: 033 341 8610

Ref.: 2/4/8/82

Ms. Mavis Nokuthula Mpanza  
172 Kingklip Avenue  
Newlands East  
4037

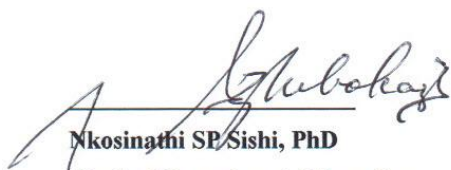
Dear Ms. Mpanza

**PERMISSION TO CONDUCT RESEARCH IN THE KZNDoe INSTITUTIONS**

Your application to conduct research entitled: **A case study of teachers' implementation of the grade four natural sciences (NS)**, in the KwaZulu Natal Department of Education Institutions has been approved. The research and interviews will be limited to the following Schools and Institutions:

1. Hlengisizwe Primary
2. Dabulizizwe Primary

Regards,



**Nkosinathi SP Sishi, PhD**  
**Head of Department: Education**

2/9/11  
Date

...dedicated to service and performance  
beyond the call of duty.

KWAZULU-NATAL DEPARTMENT OF EDUCATION

POSTAL: Private Bag X9137, Pietermaritzburg, 3200, KwaZulu-Natal, Republic of South Africa

PHYSICAL: Office G 25, 188 Pietermaritz Street, Metropolitan Building, Pietermaritzburg, 3201

TEL: Tel: +27 33 341 8610/11 | Fax: +27 33 341 8612 | email:sibusiso.alwar@kzndoe.gov.za

## **APPENDIX: C**

### **LETTER OF PERMISSION FOR PRINCIPAL**

Date: August 2011

From: M.N. Mpanza

172 Kingklip Avenue

Newlands East

4037

To: The Principal

Hlengisizwe Primary School

Folweni

Dear Sir/Madam

**RE: RESEARCH PROJECT: TEACHERS' IMPLEMENTATION OF GRADE  
FOUR NATURAL SCIENCES (NS) CURRICULUM**

I am currently pursuing my Masters Degree in Science Education with the University of KwaZulu-Natal and my research study is: **“A case study of teachers’ implementation of Grade four Natural Sciences (NS) curriculum”**. Following our discussion with you, I would appreciate your permission to conduct this research in your school. I would like to

interview only the grade four NS educators and to observe and tape record two lessons per teacher. There will also be a short questionnaire which I will appreciate if the teachers complete. This will be done to establish the NS teachers' views on the new curriculum, how they implement the curriculum in Grade 4 and why they implement the curriculum in the way they do?

In doing this, I would adhere to the following:

1. No interference with the teaching and running of the school.
2. Should for any reason you find that you wish to withdraw your permission for the research, you may do so without any negative consequence.
3. You, your school and the teachers will be ensured anonymity. All information will be treated in the greatest confidence.

I will conduct interviews and lesson observations with the teachers and they will have the right to withdraw from the project at any time without any negative consequence.

Should you have any queries please contact me at: 082 824 0987 or [nokuthula.mpanza@gmail.com](mailto:nokuthula.mpanza@gmail.com). You may also contact my supervisor, Dr Michele Stears at 031 260 3444 or [stearsm@ukzn.ac.za](mailto:stearsm@ukzn.ac.za).

Yours sincerely

.....

M.N.Mpanza

(Student no.891101189)

---

Declaration of Permission

I....., principal of Hlengisizwe Primary School, understand the contents of this document and the nature of the research project. I hereby permit/do not permit the researcher to conduct her study at my school.

I understand that I am at liberty to withdraw my permission for the school to participate in the study at any time should I so desire without any negative consequence.

.....

.....

SIGNATURE OF PRINCIPAL

DATE

## **APPENDIX: D**

### **CONSENT LETTER FOR TEACHERS**

Date: July 2011

From: M.N. Mpanza

172 Kingklip Avenue

Newlands East

4037

To: Research participant

Dear Participant

#### **RE: REQUEST FOR YOUR PARTICIPATION IN MY RESEARCH PROJECT**

I am Nokuthula M. Mpanza, a student presently enrolled with the University of KwaZulu-Natal for a Masters Degree in Science Education. As part of my studies I am conducting research of which the title is: **A case study of teachers' implementation of Grade four Natural Sciences (NS) curriculum.** I will administer a questionnaire, conduct interviews and lesson observations to provide insight on your views of the new curriculum, how you implement the curriculum in Grade 4 and why you implement it in the way you do.

You are hereby requested to participate in this research project. I also seek your permission to administer a questionnaire, conduct interviews and record lessons during lesson observations for the accurate analysis of data. All information will be kept confidential and neither your name nor the name of your school will be used. Participation is voluntary and you could withdraw from the project without any negative consequence. There are neither foreseeable direct benefits nor direct risks associated with your participation in this study.



If at any point you feel you would like to have more information, please feel free to contact me at 082 824 0987 or at [nokuthula.mpanza@gmail.com](mailto:nokuthula.mpanza@gmail.com). You may also contact my supervisor Dr Michele Stears at 031 260 3444 or at [stearsm@ukzn.ac.za](mailto:stearsm@ukzn.ac.za). We shall endeavour to provide you with any information you require.

Sincerely

.....

M.N.Mpanza

(Student no.891101189)

Declaration of consent

I..... (full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I do/do not consent to participating in this research project.

I understand that I am at liberty to withdraw from this project at any time should I so desire without any negative consequence.

.....

.....

SIGNATURE OF PARTICIPANT

DATE

# APPENDIX: E

## QUESTIONNAIRE

### Questionnaire for Grade four Natural Science Educators

The following questionnaire is part of my MEd research project. All personal information provided will be treated as confidential and will not be seen by other advisors or school educators.

Please return this questionnaire to M.N. Mpanza who will collect it personally from you at your school after a week.

### SECTION A

#### 1. General Information

The correct answer must be marked with an "X".

1. Age	<20	20-35	35-50	>50
2. Years of teaching	<5	5-10	10-20	>20
3. Years of teaching Intermediate Phase	<5	5-10	10-20	>20
4. Years of teaching NS	<5	5-10	10-20	>20

#### 2. Qualifications

##### 2.1. Academic qualifications

QUALIFICATION	MAJORS	INSTITUTION	YEAR OBTAINED

Other (specify).....

**2.2. Professional qualifications**

QUALIFICATION	MAJORS	INSTITUTION	YEAR OBTAINED

Other (specify).....

Indicate using X the level of your highest content qualification in natural sciences

Course	Level 1	Level 2	Level 3	Level 4
1. College life science/ biology				
2. College physical science				
3. University physics				
4. University chemistry				
5. Biochemistry				
6. Zoology				
7. Botany				
8. Biology				

### SECTION B

Question	Yes	No	Comment
1. Are there adequate classrooms for all sections?			
2. Are classrooms big enough to conduct group work?			
3. Are classrooms clean?			
4. Are they provided with bins for litter?			

5. Is there a desk for each learner?			
6. Are desks in a good condition?			
7. Does each learner have a text book?			
8. Do they share text books?			
9. Do they take text books home?			
10. Are learners given time to do their homework at school?			
11. Are learners the first language speakers of the language of instruction?			
12. Can they freely communicate in the language?			
13. Do learners struggle in using the language of instruction?			
14. Do learners try to communicate in the language of instruction?			
15. Are learners mostly at school?			
16. Are learners seldom at school?			
17. Are there any broken desks?			
18. Are there any broken windows?			

19. Are there any administration offices?			
20. Are buildings painted?			
21. Is a school library/resource centre available?			
22. Are there books in the library?			
23. Are library books used for projects and assignments by learners?			
24. Are toilets available?			
25. Are all classrooms electrified?			
26. Is electricity in a good working condition?			
27. Are there science apparatus in the school?			
28. Are science apparatus enough for all learners?			
29. Is there a science laboratory/room?			
30. Is the science laboratory/room well equipped?			
31. Is it used for practical work?			

32. Is the school fenced?			
33. Are there plants and flowers on the school grounds?			
34. Is tap water available?			
35. Is there a photocopier?			
36. Are worksheets developed for learners?			
37. Are computers used by all learners?			
38. Are teachers always at school?			
39. Are they always in class?			
40. Are policy documents available for teachers to use?			
41. Is there monitoring of teachers' work?			
42. Do teachers offer extra classes?			
43. Do teachers assist learners with their homework?			
44. Are extra-mural activities conducted during teaching time?			
45. Do parents attend school meetings?			

46. Do parents assist in school programmes?			
47. Is there a school nutrition programme?			
48. Do all learners participate in the programme?			
49. Is there a school governing body?			
50. Is the school governing body functional?			
51. Is the composite timetable available?			
52. Is the school principal always in school?			
53. Does the school principal teach?			
54. Are there regular staff meetings?			
55. Are there extra-mural activities?			
56. Are there different committees in school?			
57. Are these led by different teachers?			
58. Are these led by the principal only?			



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**SECTION C**

Question	Yes	No	Comment
1. Do you use demonstrations during lessons to develop concepts?			
2. Do learners observe and write scientific reports?			
3. Do you use demonstrations to promote a limited form of inquiry?			
4. Do learners assist with demonstrations?			
5. Do you engage learners in practical work?			
6. Do you allow learners to analyse data obtained from the experiment?			
7. Do you make learners use graphs and tables to communicate data?			
8. Do you design practical work for them to discover information?			
9. Do you promote group work activities?			
10. Do you assist learners in designing their own "open" investigations?			

11. Do you give group work activities?			
12. Do learners participate in the planning and the assessment of their work?			
13. Do you use everyday life examples to illustrate scientific concepts?			
14. Do you use the environment to illustrate scientific concepts			
15. Do you design lessons based on local community problems?			
16. Do you design projects for learners to apply science and technology in their environment?			
17. Do you allow learners to design and make products to meet the people's specific needs?			
18. Do you undertake any field trips with your learners?			
19. Do you expose your learners to various types of assessment?			
20. Do you always give learners closed questions?			
21. Do you develop open questions for your learners?			
22. Do you give learners discussion questions?			
23. Do you assess learners on practical work?			
24. Do you assess learners on community-based projects?			
25. Do learners develop portfolios?			

26. Do you mark and return learners' books promptly?			

## APPENDIX: F

### OBSERVATION SCHEDULE

#### Lesson Observation Guide

Date :

No. of learners present :

No. of learners absent :

Gender composition : Boys = Girls =

Topic of lesson :

Duration of lesson :

Activity :

There are **four levels** of each sub-construct of profile of implementation that will be observed during lesson presentation. The levels will progress from teacher-centred approaches with an increasing emphasis towards learner-centred ones.

SUB-CONSTRUCT	QUESTIONS	COMMENTS
Classroom interaction	Is the presentation of lesson content in relation to a designed lesson plan?  Is the textbook used appropriately?  Were everyday life resources made available for	

	<p>use in the lesson?</p> <p>Were links made between prior knowledge and new material.</p> <p>Were learners actively engaged in the activity?</p> <p>Were learners appropriately guided on their long-term investigation or projects?</p>	
--	---	--

Science practical work	<p>Why was the practical demonstration a suitable method to use?</p> <p>Are all learners able to make observations from the demonstration conducted?</p> <p>What are the learners' roles in practical demonstrations?</p>	

	<p>How is practical work designed?</p>	
--	--	--

	<p>How are the learners participating in practical work?</p>	
--	--	--

	<p>How are the learners participating in "open" investigations?</p>	
--	---	--

Science in society	<p>Are examples and applications from everyday life used to illustrate scientific concepts?</p> <p>Is the lesson addressing specific problems or issues faced by the local community?</p>	



How is science and technology applied in solving the specific needs of the community?

Is the use of indigenous knowledge from members of the local community encouraged?



to high-order).

Are learners able to respond to questions developed?

Is the teacher able to guide learners on the creation of a portfolio to present the work done?

--	--	--

**Questions which could not be answered through the lesson observation will be addressed during the post-interviews using probes as suggested.**

# **APPENDIX: G**

## **INTERVIEW**

### **Semi-structured Interviews**

#### **Pre-observation interview questions**

1. Is the lesson taught for the first time?
2. Is there a lesson plan developed?
3. Are LO and AS addressed and are they appropriately addressed?
4. What are the reasons for the selection of your teaching strategy?
5. In which way are the given assessment standards going to be integrated?
6. How are the learners going to participate in the activity?
7. How are the learners going to interact with other sources of information?
8. Are the hands-on-activities to be conducted individually or in groups?
9. Did you consider how you will assess your lesson?
10. What evidence will show that learners have learnt?
11. What expanded opportunities do you have in place?

#### **Post-observation interview questions**

Questions will be asked based on what will transpire during the lesson using the criteria given under each sub-construct in the table given in APPENDIX E.

Furthermore the interview will serve to probe responses from the questionnaire more deeply.

**I plan on using some of the following probes during both interviews:**

Tell me about...

How do you...?

You indicated/explained/said...Could you please say more about it...?

Can you tell me a little about...?

Comment on...

**APPENDIX: H**  
**TURNITIN CERTIFICATE**



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