Foundation Phase Teachers' Interpretation and Implementation of the Natural Science Curriculum in the Life Skills Learning Programme: A case study

By

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DECLARATION

I, Saritha Beni, hereby declare that this thesis: Foundation phase teachers' interpretation and implementation of the Natural Science Curriculum in the Life Skills Learning Programme: A case study is my original work and has not been submitted for assessment or completion of any postgraduate qualification at any other institution. All sources used and quoted, have been acknowledged in the text and in the list of references.

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S. Beni Date

We hereby declare that this thesis has been submitted for examination with our approval.

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Dr Michèle Stears Date

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Dr Angela James Date

DEDICATION

This study is dedicated to my father, Mr Ishwarlal Teeruth,
who passed away during the course of my study.
This would not have been possible
without his guidance and love.
The memory of his quiet insistent manner urged me on
to complete my studies and be who I am today.

This is for you Dad.

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For everything you have done for me, there are not enough words in the world to express my appreciation.

My sister, Vanitha and brothers, Vikesh and Avinesh,

For being an influence in my life.

My sons, Nirav and Advik

For being my inspiration. Remember we can do anything we set our minds to.

My husband, Laren

For your love and support which has been my pillar of strength through the challenging times.

ABSTRACT

Since 1994, Early Childhood Development has been acknowledged and recognised as an essential focus theme for South Africa's social and economic transformation and development. Early learning is an imperative for the growth of an educated South African society. The focus of the study is on teachers' abilities to interpret and implement a new innovative curriculum. This interpretative, qualitative, case study attempts to explore foundation phase teachers' interpretation and implementation of the Natural Science Curriculum within the Life Skills Learning Programme in South Africa. The study was prompted by personal observations of how teachers and students viewed the purpose of Natural Science in the Foundation Phase. Four foundation phase teachers, one from each Grade (R to Three) participated in the study. The learning environment was selected as the unit of analysis since this is where the learners, teachers, curriculum and educational resources meet. The theoretical framework for this study is entrenched in the relationship between the prescribed and the implemented curriculum and was developed by adapting the theory of implementation proposed by Rogan and Grayson (2003). It served as a guide to identify factors that influenced the way foundation phase teachers implement the Natural Science Curriculum in the Life Skills Learning Programme. The Zone of Feasible Innovation (ZFI) is the proposed theory of implementation. The ZFI is a hypothetical construct, which suggests that innovation should not exceed current practice by too large a gap between existing practice and the demands of the innovation. It provided the lens for positioning teachers at particular levels with regard to their capacity to implement a curriculum. The theoretical frameworks were used to answer the research questions and design the data collection instruments: a questionnaire, semi-structured interviews schedules, document analysis, classroom observation schedules and a rating scale were used to analyse the data. The levels for each teacher were determined for each construct of interpretation and implementation and subsequently used to determine their respective ZFIs. The teachers were located at relatively low levels of interpretation and implementation, resulting in very narrow ZFIs. The implications are that these teachers' current practices are too far removed from that which the curriculum expects of them. Examples of such practices are: emphasis on Numeracy and Literacy; misunderstanding of the meaning of integration of subjects and a lack of science content knowledge and instructional methods used to teach Natural Science. The most significant finding, however, is that teachers have very little chance of expanding their ZFIs due to a misalignment between the Natural Science Curriculum and the Foundation Phase

Curriculum that makes implementation of Natural Science in the Foundation Phase particularly problematic. The outcomes of this finding have resulted in the development of a proposed model which depicts a barrier preventing expansion of the teachers' ZFI. A number of recommendations are proposed as possible actions to remove this barrier. It is envisaged that the findings of this study may provide useful insights for curriculum planners in the design of appropriate, innovative curricula for the Foundation Phase and beyond.

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ACRONYMS

AAAS	American Association for the Advancement of Science
ASTEC	Australian Science, Technology and Engineering Council
CAPS	Curriculum and Assessment Policy Statement
C2005	Curriculum 2005
DENI	Department of Education for Northern Ireland
ECD	Early Childhood Development
FET	Further Education and Training
GET	General Education and Training
HET	Higher Education and Training
NCS	National Curriculum Statement
NQF	National Qualifications Framework
NRC	National Research Council
OBE	Outcome Based Education
RNCS	Revised National Curriculum Statement
UNICEF	United Nations Children’s Fund
USA	United States of America
ZPD	Zone of Proximal Development
ZFI	Zone of Feasible Innovation

CHAPTER ONE

SETTING THE SCENE

1.1 INTRODUCTION

Early Childhood Development (ECD) has been acknowledged as an essential focus theme for "the country's social and economic transformation and development," since the new South African political dispensation in 1994 (Department of Basic Education, 2009, p. 11). The government together with non-government organisations have formed joint affiliations to generate policies and programmes that have facilitated the advancement of ECD services. United Nations Children's Fund (UNICEF) (2006) maintains that for young children to have the best possible "start in life means ensuring them good health, proper nutrition and early learning". South Africa's ECD programme makes provision for the holistic development of children. The main purpose is to protect children's rights and to develop their full emotional, social and physical potential. Hence, the focus of ECD is to develop an "educated and healthy South African society" (UNICEF, 2006, p. 2).

ECD is the initial stage of development from birth to nine years. The Foundation Phase in South Africa constitutes the latter four years of the ECD phase and thus the initial stage of schooling. This is where the "foundation for further learning is laid" (Department of Education, 2003a, p. 19). The learner at this stage acquires skills, knowledge and values, which will form the basis of his or her future learning. Learners in the Foundation Phase, Grades R (reception year) - Three, could "range between five and 10 years of age" (Department of Education, 2003a, p. 19). This is the phase when the learners' love for Science should start and be nurtured so that they may develop a curiosity about the world and also become critical thinkers. It was anticipated in the RNCS (Revised National Curriculum Statement), the school curriculum policy approved in 2002 and implemented in 2004, that the Life Skills Learning Programme was to facilitate young learners to "develop skills, knowledge, attitudes and values" with the purpose of allowing them to "identify and solve problems and make decisions" (Department of Education, 2003b, p. 74).

1.2 BACKGROUND TO THE STUDY

Preceding 1994, South Africa's education system was openly segregated along racial lines. While most white learners were advantaged by a highly resourced education system with well-qualified teachers, African, Indian and Coloured[1] learners were forced to accept an inferior system with few resources. Most white teachers received pre- and in-service training at well-equipped urban universities or colleges of education, while "most black teachers started teaching without even completing their own secondary schooling, much less the tertiary education that they needed" (Keevy, 2006. p. 2). The South African education and training sector started to experience momentous changes in the early 1990s due to increased pressure from the global community for transformation. According to Keevy (2006), "these developments set in motion significant systemic transformations that were formalised with the advent of the new political dispensation in 1994" (p. 2). Under this dispensation, extensive transformations were "necessary to systematically redress the inequalities that apartheid had conceived" (Keevy, 2006, p. 2). Some of the inequalities that needed to be redressed included funding, capacity building, resources, education, including teacher education.

After the 1994 elections in South Africa, the key role players in the education sector believed that an innovative curriculum that developed citizens with an elevated level of skills; an elevated level of knowledge and the attitudes and values essential to rebuild our country, was required (Department of Education, 2001). The South African government, after the 1994 elections immediately began to expound an outcomes-based curriculum comparable to curricula implemented in countries such as New Zealand, Australia and the United States. This curriculum, known as Curriculum 2005 (C2005) was "committed to OBE" (outcomes-based education) (Maphalala, 2006, p. 2). OBE is a learner-centred education model, which focuses on the achievement of outcomes. These outcomes were similar for all grades but were defined by range statements for different grades and assessed through assessment criteria.

The Minister of Education proposed that a new schooling curriculum be introduced in 1995. Implementation was planned for all Grades (One - 12) by the year 2000. Although the curriculum was introduced in March 1997, the implementation timetable was revised several times to take place between 1997 and 2005. For this reason, the new curriculum became known as C2005. By 2000, C2005 was implemented in Grades One, Two Three and Seven. The

[1] African-a person from Africa, especially a black person or a black South African
Coloured-a person of mixed descent.
Indian- a person of Indian descent living in South Africa.

target was to initiate C2005 in Grades Four and Eight in 2001 with the intention that this curriculum would be implemented in all Grades by 2005.

From its inception, complications plagued the process of implementation of C2005. It seemed that financial, physical and human capability were insufficient to ensure that implementation continued as per schedule. Although well-resourced schools seemed to manage, they found the paperwork extreme. Insufficiently resourced schools were faced with additional challenges related to the large classes which were inadequate teaching and learning resources and meagre infrastructure. Within the teaching community the C2005 innovative curriculum was viewed as being overly ambitious and the expectation was that it would be overwhelmed with implementation complications. The values that underpinned OBE were also criticised by some academics (Jansen, 1997; Jansen & Christie, 1999).

To understand the difficulties pertaining to its implementation, it is important to consider the history behind the commencement of C2005. According to the Review Committee on Curriculum 2005, "Its roots lie deeper than the transition to democracy in 1994, but its specific form began to take shape in this context" (2000, p. 12). C2005 stemmed from an association of processes intended to guarantee incorporation of education and training through the National Qualifications Framework (NQF). As an assessment, qualifications, competency and skills-based framework, it encouraged the development of a curriculum model aligned to the NQF in theory and practice (Review Committee on Curriculum 2005, 2000, p. 12). C2005 was executed in a "context of immensely complex social inequalities and realities and diverse educational politics" (Review Committee on Curriculum 2005, 2000, p. 12). These incorporated, for the most part, an extensive history of fundamental and transformative educational ideas and practices.

The Report of the Review Committee was organised and arranged on the foundation of a comprehensive reassessment of "research reports and papers, interviews with teachers, principals, managers, trainers, publishers and departmental officials, as well as public submissions made by a range of individuals, organisations and institutions" (Review Committee on Curriculum 2005, 2000, p. 8). According to the Review Committee, "Implementation was not always carefully thought through, properly piloted or resourced and enormous stresses and strains were consequently placed on already over-burdened principals and teachers in widely-divergent educational contexts" (2000, p. 15). The 'overcrowding' of the curriculum led to insufficient time for the development of effective reading skills, basic Mathematics and science concepts in learners (Review Committee on Curriculum 2005, 2000).

The curriculum review process also highlighted the huge jump from the Foundation Phase to the Intermediate Phase. Mahomed (2004) stated that this huge jump "is a change for learners as well as teachers". He further stated, "The grade four curriculum programme requires greater challenges for assessment of higher level skills compared to that of the primary grades where foundational skills are basic and fundamental" (p. 3). In addition, learners moved from three Learning Programmes to eight Learning areas when they entered the Intermediate phase. In the Foundation Phase, the curriculum was constructed around three Learning Programmes, namely Literacy, Numeracy and Life Skills. There were six Learning areas incorporated in the Life Skills Learning Programme, namely Life Orientation, Natural Science, Technology, Social Sciences, Arts and Culture and Economic and Management Sciences. In the Intermediate Phase, the eight Learning areas were Languages, Mathematics, Natural Science, Social Science, Arts and Culture, Life Orientation, Economic and Management Sciences and Technology. One of the eight learning areas identified by C2005 for Grades One to Nine was Natural Science. Hattingh, Rogan, Aldous, Howie, & Venter (2005) recognised that "the way in which C2005 had been framed was too complex and cumbersome" (p. 13).

By 2000, it was evident that there were difficulties with respect to implementation. Professor Kader Asmal, the then Minister of Education, announced the establishment of a committee in February 2000 to review C2005. The Committee presented a proposal on the "steps to be taken in respect of the implementation of the new curriculum in Grades Four and Eight in 2001. This included the "key success factors and strategies for a strengthened implementation of the new curriculum, the structure of the new curriculum and the level of understanding of outcomes-based education" (Review Committee on Curriculum 2005; 2000, p. 9). The Review Committee recommended that the C2005 curriculum needed to be strengthened by streamlining its design features, simplifying its language as well as aligning curriculum and assessment (Review Committee on Curriculum 2005; 2000). It also highlighted the need to "improve teacher orientation and training, develop learner support materials and encourage provincial support" (Review Committee on Curriculum 2005, 2000, p. 3).

The C2005 review led to the implementation of NCS (1997) (National Curriculum Statements), which were further refined to the RNCS (Revised National curriculum Statement) (2002). The RNCS streamlined and strengthened C2005 and continued to be committed to OBE. For example, in the revised version for Natural Science, the original nine specific outcomes were condensed to three with grade level assessment standards developed for each of the three outcomes. The curriculum (RNCS) stipulated that learners in the Foundation Phase would only be assessed with regard to Learning Outcome One with three assessment standards (Department of Education, 2003a). It was decided that the RNCS would deal with what the curriculum requirements were at various levels and phases and give a clear description of the kind of learner expected at the end of the General Education and Training (GET) band in terms of knowledge, skills, values and attitudes.

The National Department of Education in an effort to provide support for teachers with the implementation of the RNCS launched the *Foundations for Learning* campaign. The focal point of this campaign was to improve learner performance in Literacy and Numeracy. The *Foundation for Learning* documents were created to provide teachers with support to "monitor learner progress in these areas" (Department of Education, 2008, p. 1). These documents provided teachers with milestones with regard to knowledge and skills in Numeracy and Literacy.

In 2009, the Minister of Basic Education, Ms Angela Motshekga appointed a Ministerial Task Team to review the implementation of the RNCS from Grades R-12. Its brief was "to identify the challenges and pressure points that impacted negatively on the quality of teaching in schools and to propose mechanisms that could address these" (Curriculum News, 2011, p. 4). The brief was in response to the widespread remarks; both in writing and verbally that were received from an assortment of role players (teachers, parents, teacher unions, school management and academics) on the implementation of the RNCS.

The Report of the Ministerial Task Team on the Review of the Implementation of the RNCS, October 2009, made several recommendations to improve the curriculum. The Task Team compiled a report that was sympathetic and perceptive to the background context. The Report was presented to the Minister outlining, "a five-year plan to improve teaching and learning via a set of short-term interventions aimed at providing immediate relief and focus for teachers" (Report of the Task Team for the Review of the Implementation of the National Curriculum Statement, 2009, p. 5). Included was "medium and longer-term recommendations which envisioned achieving real improvement in student learning within a five year period." (Report of the Task Team for the Review of the Implementation of the National Curriculum Statement, 2009, p. 5). The intention was to streamline the curriculum documents into single documents for each Grade and each Subject in which content and assessment are specified. The subject learning area by grade guidelines is known as the Curriculum and Assessment Policy Statements (CAPS). The CAPS has now been finalised in line with the recommendations of the 2009 Task Team Report on the implementation of the RNCS.

1.3. THE FOUNDATION PHASE LANDSCAPE

The clarification of what the Foundation Phase, in the South African context, entails, is essential. It is important to mention as I will be referring to two curriculum documents in my discussion, the Foundation Phase and the Natural Science RNCS documents. A brief discussion of the structure of the South African education system follows which provides clarity on the structure of the different phases and locates the Foundation Phase within the South African education system (Figure 1.1)

Grades 000 and 00 are not part of the formal schooling system and are referred to as pre-primary education, which is part of pre-schools and crèches. The formal education system is divided into three main levels, which are the GET band, Further Education and Training (FET) band and the Higher Education and Training (HET) band. The GET band is made up of the Foundation Phase and Intermediate Phase. The Foundation Phase is part of the primary school system and encompasses Reception to Grade Three. The Intermediate Phase is also part of the primary school system and includes Grades Four to Six. The Senior Phase is part of the secondary school system and incorporates Grades Seven to Nine. Most primary schools have Grade Seven even though it is in the Senior Phase. The FET band form part of the secondary school system and encompass Grades 10 to 12. The HET band comprise education received at universities, technical colleges and other higher educational institutions. The FET band culminates in learners obtaining a matriculation certificate, which serves as an entry to higher education studies. The Foundation Phase is the first phase of the formal schooling system in South Africa. The Foundation Phase is the start of the child’s formal schooling. The structure of the South African education system is illustrated in Figure 1.1.

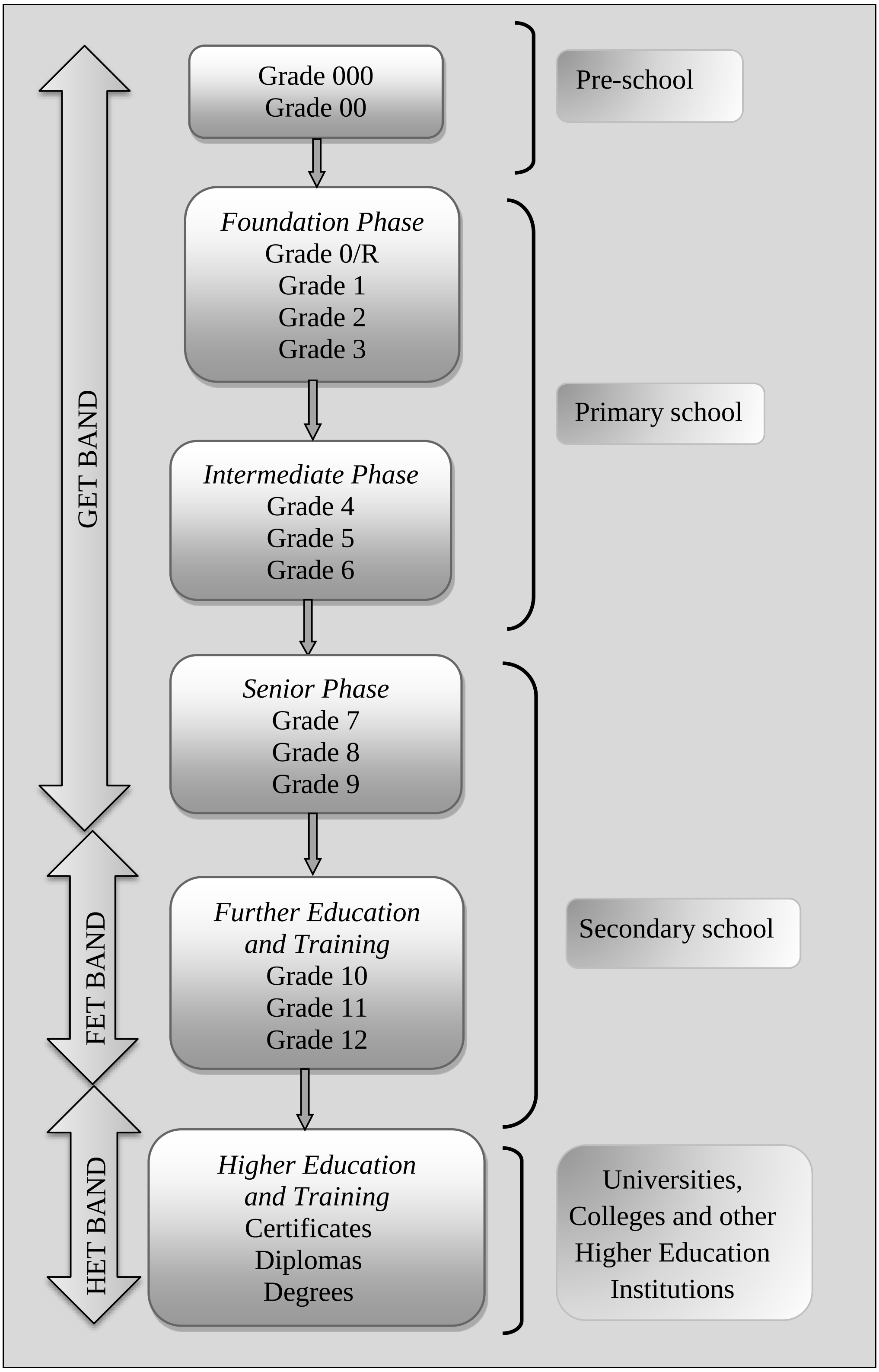

Figure 1.1: A diagrammatic representation of the structure of the South African education system

An explanation of frequently used concepts and terms follows.

1.3.1 The Foundation Phase

Historically, schools were classified as either primary or secondary schools. The primary school is also known as an elementary school or middle school in other countries. In South Africa, a primary school caters for learners for the first eight years of schooling. Grade R to Three is referred to as the Foundation Phase and it is the first phase of the GET band.

The three Learning programmes in the Foundation Phase, namely Literacy, Numeracy and Life Skills draw from key concepts and skills from the learning outcomes for Languages, Mathematics and Life Orientation Learning Areas. By doing this, the intention is that learners will be provided with the knowledge, skills, values and attitudes that are needed to develop them holistically. According to the Department of Education, these Learning Programmes should provide for the holistic development of the learner by: providing a framework for interpreting Assessment Standards and developing activities required to eventually achieve the Learning Outcomes

- giving guidance on how to plan for knowledge acquisition, skill development and the formation of values and attitudes
- giving guidance on how to assess, record and report on learner achievement against the Assessment Standards
- illustrating learners' progression across the phase. (2003b, p. 28).

It was envisaged in the curriculum documents that the three Learning Programmes would strengthen and support each other by drawing on "the concepts and skills acquired by the other" (Department of Education, 2003b, p. 28). The Literacy Learning Programme in the Foundation Phase focuses on "language acquisition and language development, and various kinds of communication for both Home Language and First Additional Language as from Grade R" (Department of Education, 2003b, p. 28). The Numeracy Learning Programme "recognises the power of symbols and creates opportunities for all learners to develop the mathematically-related knowledge, skills, attitudes and values necessary for their daily lives" (Department of Education, 2003b, p. 28). The Life Skills Learning Programme "involves many social, environmental and cultural issues and topics that will require sensitive mediation" (Department of Education, 2003b, p. 28). As stated in the curriculum documents, Life Skills represents a Learning Programme that encompasses an assortment of life skills that empower learners to:

- develop their full personal potential physically, effectively, socially, cognitively and normatively
- participate effectively within their environment and develop scientific and technological process skills
- become an empowered citizen and to prepare them for the world of work
- be creative thinkers (Department of Education, 1997, p. iv)

From the above account, it is clear that the intention of the Life Skills Learning Programme is to allow learners to "develop the skills, knowledge, attitudes and values that will enable them to identify and solve problems, and make decisions" (Department of Education, 2003a, p. 74). Table 1.1 shows the competency for each of the three Learning Programmes that need to be developed (Department of Education, 2003a, p. 28).

Table 1.1 Competencies for each of the three Learning Programmes (Literacy, Numeracy and Life Skills) that need to be developed (Department of Education, 2003a, p. 28)

Literacy	Numeracy	Life Skills
• Listening • Speaking • Reading and Viewing • Writing • Thinking and Reasoning • Language Structure and Use	• Numbers, Operations and Relationships • Patterns Functions and Algebra • Spaces and Shapes (Geometry) • Measurement • Data Handling	• Health Promotion • Social Development • Personal Development • Physical development and Movement

As is evident from Table 1.1 there is no direct reference to Science in the competencies for the Life Skills Learning Programme. The competencies for the Life Skills Learning programme are the Learning Outcomes for the Life Orientation Learning Programme. This is consistent with the RNCS where it is stated that Life Orientation forms the backbone of Life Skills, which "prepares learners for life and its possibilities, specifically equips learners for meaningful and successful living in a rapidly changing and transforming society." (Department of Education, 2003a, p. 75) In addition, "Learning Outcomes and their related Assessment Standards from other learning areas are also dealt with in the Life Skills Learning Programme" (Department of Education, 2003a, p. 75). This implies that competencies from the Learning Outcomes from the Natural Science and the Technology Learning Areas have to be drawn from. The curriculum explains:

Learning Outcomes that enable learners to investigate people-environment relationships (Life Orientation: Learning Outcome One; and i.e. Technology: Learning Outcome One; Natural Science: Learning Outcome One; and Social Sciences - Geography: Learning Outcomes One, Two and Three), encourage learners to undertake different kinds of investigations to learn about the relationships between people and the environment. This involves developing an understanding of the world as a set of related systems, and using science and technology effectively and critically while showing responsibility for the environment and the health of others. (Department of Education, 2003a, p. 75)

The learner in the Foundation Phase is naturally curious and explores the world by "observing and manipulating common objects and materials in the environment" (Department of Education, 2003b, p. 24). Since the learner in this phase accomplishes learning through exploring, the curriculum needs to afford the learner the opportunity to achieve learning through this method. Osborne (2002) questions what it means to "do science". He further states, "It is rare to hear anybody talking of "doing history". He surmises there is a noteworthy difference with regard to enquiry in Science and humanities (p. 203). The Natural Science RNCS Policy document maintains, "Science in the Foundation Phase should build on the learner's curiosity and ways of knowing, and encourage investigation of the natural world with a sense of wonderment" (Department of Education, 2003b, p. 24).

Together with the competencies for each learning programme, there is a need to investigate the time allocated to each learning programme in the formal school day. In terms of Section Four of the Employment of Educators Act, (1998), the formal school day for teachers will be seven hours (as cited in Department of Education, 2002b, p. 18). In terms of the National Education Policy Act, (1996), the formal teaching time per school week is 35 hours (as cited in Department of Education, 2002b, p. 18). This is set out in Table 1.2 showing the instructional time for each grade in each phase.

Table 1.2 Instructional times for each grade in each phase (Department of Education, 2011, p. 4)

Phase	Grade	Time per week
Foundation Phase	R, 1 and 2	22 hours 30 minutes
	3	25 hours
Intermediate Phase	4, 5 and 6	26 hours 30 minutes
	7	26 hours 30 minutes
Senior Phase	8 and 9	27 hours 30 minutes
	10, 11 and 12	27 hours 30 minutes

According to the RNCS documents, the formal teaching time allocations for the Foundation Phase Learning Programmes is shown in Table 1.3 (Department of Education, 2011, p. 4).

Table 1.3 Instructional times for Learning Programmes in the Foundation Phase

(Department of Education, 2011a, p. 4)

Learning Programme	Grade R, 1, 2		Grade 3	
	Per week	Per day	Per week	Per day
Literacy (40%)	± 9 hours 10 minutes	± 1 hour 50 minutes	± 10 hours	± 2 hours
Numeracy (35%)	± 7 hours 30 minutes	± 1 hour 30 minutes	± 8 hours 45 minutes	± 1 hour 45 minutes
Life Skills (25%)	± 5 hours 50 minutes	± 1 hour 10 minutes	± 6 hours 15 minutes	± 1 hours 15 minutes
	22 hours 30 minutes	4 hours 30 minutes	25 hours minutes	5 hours

Table 1.3 shows that only 25% of the time is spent on Life Skills. As previously mentioned, the Life Skills Learning Programme incorporates six learning areas, which have to be included in the Life Skills Learning Programmes in the five hours and 50 minutes time allocation per week. According to Van Aalderen-Smeets, Van Der Molen, and Asma (2012), "Many initiatives across the world have focused on increasing the scientific knowledge, inquiry skills, and attitudes of primary students by allocating more time to Science Education" (p. 162). Some of these initiatives seem to have been plausibly successful, predominantly with regard to children's enjoyment of science projects (Duschl, Schweingruber & Shouse, 2007). However Van Aalderen-Smeets et al. (2012) are of the belief that a main "problem remains that cannot be solved by simply allocating more time to science in primary education". The problem, according to them is, "Primary school teachers are not adequately trained to teach science" (p. 162).

1.3.2 The Foundation Phase Teacher

In the Foundation Phase, teachers are required to be classroom based practitioners. This means that they are expected to teach all learning areas in their particular grades. This results in teachers teaching learning areas that they may not have studied during their pre-service education. The RNCs views teachers as being "key contributors to the transformation of education in South Africa" and are expected to be "qualified, competent, dedicated and caring" (Department of Education, 2002a, p. 3). These characteristics are required to accomplish the different roles as described in the Norms and Standards for Educators of 2000 (Government Gazette No 20844, 2000, p. 13). Teachers' roles are as mediators of learning, interpreters and designers of Learning Programmes and materials, leaders, administrators and managers, scholars, researchers and lifelong learners, community members, citizens and pastors, assessors and learning area/phase specialists (Government Gazette No 20844, 2000, p. 13). The foundation phase teacher is discussed in detail with respect to the norms and standards for educators in the literature review in chapter two.

1.3.3 The Foundation Phase Learner

The RNCS describes the foundation phase learner as one who should have an "eagerness to learn". They also "bring with them their own experience, interest, strengths and barriers." In addition, "each learner has the need to be recognised and accepted for his/her family and culture to be acknowledged and respected" (Department of Education, 2003a, p. 19). Since the aim of the curriculum is to develop the "full potential of each learner as a citizen of a democratic South Africa" (Department of Education, 2002b, p. 8), it portrays the learner in a particular manner, as being "confident and independent, literate, numerate, multi-skilled, compassionate, with a respect for the environment and the ability to participate in society as a critical and active citizen" (Department of Education, 2002b, p. 3).

Learners are described in the curriculum document as, "The kind of learner envisaged is one who will be imbued with the values and act in the interests of a society based on respect for democracy, equality, human dignity, life and social justice" (Department of Education, 2002b, p. 8). From my experiences, these characteristics are what are needed to develop young scientists or at least to instil the love for Science in learners.

1.3.4 The Life Skills Learning Programme in the Foundation Phase

According to the RNCS, the Life Skills Learning Programme in the Foundation Phase includes the promotion of scientific literacy. The promotion of scientific literacy is achieved by developing and using "science process skills, critical thinking skills and problem solving skills in a variety of settings, developing and applying scientific knowledge and understanding and appreciating the relationships and responsibilities between science, society and the environment" (Department of Education, 2003a, p. 4).

The Natural Science Curriculum "has been shaped by the search to understand the natural world through observation, codifying and testing ideas, and has evolved to become part of the cultural heritage of all nations" (Department of Education, 2002b, p. 28). The RNCS also maintains, "The Natural Science learning area must be able to provide a foundation on which learners can build throughout life" (Department of Education, 2002a, p. 5). The Natural Science Learning Area Statement promotes scientific literacy by focusing on "the development and use of science process skills in a variety of settings, the development and application of scientific knowledge and understanding and the appreciation of the relationships and responsibilities between science, society and the environment" (Department of Education, 2002a, p. 6).

The Natural Science Learning Area Statement foresees a teaching and learning environment that distinguishes the citizens of South Africa as having a diversity of learning styles, in addition to culturally subjective perceptions. This learning area begins with the basis that all learners should have "access to a meaningful Science Education" (Department of Education, 2002a, p. 7). Meaningful education is explained as being "learner-centred" and it has to help learners to "appreciate not only scientific knowledge and how it is produced but also the environmental and global issues." (Department of Education, 2002a, p. 7) Complimentary to this, it is at the primary school level that this foundation has to be laid for the future.

There are three learning outcomes in Natural Science, viz.

- Learning Outcome One: 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 (Scientific Investigations),
- Learning Outcome Two: the learners will know and be able to interpret and apply scientific, technological and environmental knowledge (Constructing Science Knowledge) and
- Learning Outcome Three: the learner will be able to demonstrate an understanding of the interrelationships between science and technology, society and the environment (Science Society and the Environment). (Department of Education, 2002a, p. 6)

In the Foundation Phase, although the first learning outcome dealing with scientific investigations is assessed, the second and third learning outcomes have to be taught whether explicitly or implicitly. Learners cannot perform investigations without acquiring and applying scientific and technological concepts, working within, and understanding the relationship between Science, society and the environment. By accomplishing this, an understanding of the environment will be nurtured and promoted.

Both the National Curriculum of the United Kingdom and the National Science Education Standards of the United States of America have given much precedence to scientific investigations (NRC, 1996). In the South African context, the one learning outcome in the Foundation Phase is scientific investigations, which is described, as mentioned previously, in the RNCS when "the learner will be able to act confidently on curiosity about natural phenomena, and to investigate and solve problems in scientific, technological and environmental contexts" (Department of Education, 2003b, p. 6). The RNCS describes competency in this learning outcome of scientific investigations as being evident when "the learner searches for information from books and resource people, generates products and questionnaires, collects data and materials from nature or industry, creates testable questions and fair tests, and explains conclusions" (p. 8). Four kinds of practical problems are illustrated in the curriculum documents, namely problems of making, problems of observing, surveying and measuring, problems of comparing and problems of determining the effect of certain factors. There is overlap between the four kinds of problems but the problems call for "conceptual knowledge of science as well as creative thought and systematic testing of ideas" (Department of Education, 2003b, p. 9).

A scientific investigation is also portrayed as a process, which takes place in phases. These phases are identified by the RNCS according to the following assessment standards, which serve as indicator that this learning outcome has been achieved at the end of the Foundation Phase:

- Planning investigations, where the learner uses materials selected by the group in order to communicate the group's plan.
- Conducting investigations and collecting data, where the learner participates constructively in the activity with the understanding of its purpose.
- Evaluating data and communicating findings, where the learner explains and reflects on what action was intended, and whether it was possible to carry out the plan. (Department of Education, 2003b. p. 16)

An investigation would therefore involve the use of process skills such as formulating questions and hypotheses, predicting, planning, observing, measuring, recording, interpreting data, generalising, and making conclusions.

In the Intermediate Phase, Grades Four to Six, as well as the Senior Phase, Grades Seven to Nine, all three learning outcomes are taught and assessed. The Natural Science Learning Area comprises a wide variety of fields of inquiry. The RNCS groups the four main content areas as Life and Living, Energy and Change, Planet Earth and Beyond and Matter and Materials, which are outlined as follows:

- Life and Living focuses on life processes and healthy living, on understanding balance and change in environments, and on the importance of biodiversity.
- Energy and Change focuses on how energy is transferred in physical and biological systems, and on the consequences, that human needs and wants have for energy resources.
- Planet Earth and Beyond focuses on the structure of the planet and how the earth changes over time, on understanding why and how the weather changes, and on the earth as a small planet in a vast universe.
- Matter and Materials focuses on the properties and uses of materials, and on understanding their structure, changes and recreations in order to promote desired changes. (Department of Education, 2002a, p. 61)

These statements form the core minimum knowledge for Learning Programmes in the Natural Science learning area. Learning Programmes are expected to draw content from all four strands over a phase. The Natural Science Learning Area is subsumed in the Life Skills Learning Programme and as such not pertinently discussed in foundation phase documents.

1.4 RATIONALE FOR THE STUDY

Science and its related fields of study are viewed as a scarce skill in South Africa. According to Boshoff and Mouton (2003), “there appears to be a gradual ageing of the publishing scientific workforce with a low level of new entrants into the science system (especially Natural Science)” (p. 231). Braund and Reiss (2006) recognise the problem exists in many developed countries of the world as well where fewer learners are choosing to study Science at higher levels and as a career. Rocard et al. (2007) maintain, “The decline in vocational careers in science has become somewhat worrying in many countries” (p. 61).

According to Campbell and Chittleborough (2004), “by creating the role of science specialists in primary schools, and investing in science as a specialised knowledge area, science can be promoted, science teaching resources better managed, and teachers who are not confident in science, mentored" (p. 19). They further explain, "In this way, the impact of promoting and improving the teaching of science can extend from the science specialists to other teachers, to students, the school and the wider community" (Campbell & Chittleborough, 2014, p. 19).

A universal consciousness of the significance of science prevails internationally and nationally. The chairman of the United States of America National Commission on Mathematics and Science Teaching for the 21st century, John Glenn stated in his forward to the commission's report, "the future and well-being of our nation and people depends not just on how well we educate our children generally, but on how well we educate them in mathematics and science specifically" (Glenn Commission, 2000, p. 7). India has also realised "the only way to improve the nation's competitiveness is through better and more productive science and technical education and flourishing scientific research and technological development" (Pursuit and Promotion of Science, 2001, p. 74). Peers (2006) concurs when she says "High quality teaching of science in Australian primary schools is a national priority in order to develop citizens who are scientifically literate and who can contribute to the social, environmental and economic well-being of Australia and achieve their own potential" (p. 1). The solution to increasing the number of science graduates lies within the schooling system.

Science is compulsory for learners from Grade R to Grade Nine. Science is incorporated in Life Skills from Grades R-Three and the Natural Science Learning Area from Grades Four-Nine. Learners select the subjects they want to study from Grade 10. I believe that what needs to be ensured is that more learners elect to study Natural Science when they have the option to choose. This will depend on the type of Science learnt, the relevance of the Science taught and the manner in which it was taught in the GET band. To achieve the goal of ensuring that more learners choose to study Science, the manner in which Science is taught in the GET phase should inspire learners to develop an interest in the subject. The study of Van Aalderen-Smeets et al. (2012) of attitudes toward Science revealed that, "Researchers, educators and policy makers are expressing increasing concern at the decreasing interest of young people in pursuing scientific careers" (p. 162). Learners' lack of interest in Science is noticeable in secondary school when learners have to choose subjects in their grade ten year. This lack of interest commences in the primary school years as most learners have already decided not to select Science as a subject (Osborne & Dillon, 2008, Tai, Liu, Maltese, & Fan, 2006; Young & Kellogg, 1993). Researchers recommend that it is of utmost importance that awareness be given to developing learners' "interest toward science and this should take place beginning at the primary school level" (Haney, Czerniak, & Lumpe, 1996; Tobin, Tippins, & Gallard, 1994; Van Driel, Beijaard, & Verloop, 2001). This interest and love for Science has to be developed and nurtured from the time the child enters the schooling system from Grade R. This is essential not only to make daily decisions but also to meet the demands of the global economy.

The curriculum documents describe the foundation phase learner in detail. As mentioned earlier, among the descriptions it is vividly apparent that the foundation phase learner must be actively involved in the "solving of problems, constructing of objects and measuring, comparing and reasoning activities and they need to explain their actions and thinking at their level" (Department of Education, 2003b, p. 19). Inherent in this description are skills that learners acquire in Science. However, the learner does not acquire these skills if Science is taught using traditional methods instead of an inquiry approach. There is a need for science learning to start early and for learners to be taught in such a way that they are engaged in critical thinking.

As mentioned earlier, the South African education system is based on the NQF, which consists of three bands, GET, FET and HET. The Foundation Phase is the first phase of the GET band and includes Grades R, One, Two and Three (Department of Education, 2003a). Since Natural Science forms a one in sixth part of the Life Skills Curriculum (Refer to Table 1.1), it is often not given much attention at the foundation phase level and may be an indication of the low prominence given to Science in the South African curriculum.

In the Intermediate Phase, which is the second phase of the GET band, Natural Science is a key learning area and as such forms an integral part of the curriculum. In both the Foundation and Intermediate Phases, Natural Science has four core knowledge areas, which provide the context in which teaching, learning and assessment take place. At Intermediate Phase level, the core knowledge concepts can be incorporated in teaching Science, as there is time set aside on the timetable for the Natural Science Learning Area. In the FET Phase, Physical Science is organised around six core knowledge areas, which provide the content to be taught, while Life Sciences is organised around four core knowledge areas.

In the Foundation Phase, Natural Science has not traditionally been seen as a focus of instruction as it forms part of the Life Skills Learning Programme and does not stand alone as a learning programme. Many reasons could be attributed to this. Not exposing foundation phase teachers to the Natural Science Curriculum, teachers' lack of content knowledge, the issue of unavailability of resources, large class sizes, teacher identity and teacher confidence are some of the reasons that could be given. Other problems that may well contribute to this could be the background of the teachers and the fact that Science is integrated in the Life Skills Learning Programme. In turn, Life Skills is expected to be incorporated into the Numeracy and Literacy learning programmes. Natural Science for the Foundation Phase, according to the RNCS has only one learning outcome, i.e. scientific investigations (Department of Education, 2003b). As mentioned earlier, this is Learning Outcome One and is prevalent as a learning outcome throughout the GET and FET bands. The teaching of scientific investigations needs to start at Grade R level.

The RNCS emphasises that "Science in the Foundation Phase should build on the learner's curiosity and ways of knowing, and encourage investigation of the natural world with a sense of wonderment" (Department of Education, 2003b, p. 23). The document further explains, "Learning science as investigation provides the learner with the opportunity to develop the process skills so fundamental to scientific enquiry" (Department of Education, 2003b, p. 23). My interest in this study stems from my experiences as a natural science teacher in the Intermediate Phase as well as lecturing students studying towards a Bachelor of Education degree, specialising in foundation phase studies. Whilst teaching Natural Science at the Intermediate Phase level, I had numerous instances where learners arrived in my class without having any or very little experience of Natural Science. This was evident in their level of curiosity and enthusiasm, as well as their reservations when presented with practical hands-on activities during natural science lessons. In addition, during my experiences interacting with Professional Practice of foundation phase student teachers I became aware that Natural Science was not a priority area in the Foundation Phase. In fact, student teachers were often adamant that Natural Science is not taught in the Foundation Phase. When visiting student teachers during Professional Practice, I observed them teaching science lessons in the way they were instructed to do so by their mentor teachers. This involved for example, the students integrating Natural Science in a Literacy lesson by reading a story on cats. My experience of working with foundation phase schoolteachers confirms this. Teachers were heard to say, 'The basic thing in our school is Mathematics and Literacy...no one speaks of Science...Science can be rowdy...it is neglected but what can we do....' This prompted this study, as I was curious to find out how Natural Science is conceptualised by teachers in the Foundation Phase.

Whilst there are a number of studies focusing on the teaching of Natural Science in the Intermediate and Senior Phase, both nationally and internationally, there continues to exist a scarcity of information in local (South African) research on Natural Science in the Foundation Phase. The dearth of local research is another compelling reason for this study. This study will focus on how foundation phase teachers in a government school in Durban view the Natural Science Curriculum and how they externalise these understandings and views in their class contexts.

This study was conceptualised while the RNCS (Department of Education, 2003b) was the official policy document with the result that reference is still made to learning outcomes and assessment standards. The Curriculum and Assessment Policy Statement (CAPS) came into effect in January 2012. This document attempts to facilitate interpretation of the RNCS and does so by removing learning outcomes, assessment standards and Learning Programmes from the curriculum. The implications for the Foundation Phase are the consolidation of six learning areas into study areas under the umbrella of Life Skills (Department of Education, 2011, p. 5). In this configuration, Natural Science is included as a component of Beginning Knowledge. While this may appear to be a major change, the fact is that emphasis in science learning is still on inquiry learning and problem solving, with limited focus on the learning of concepts. As is the case with the RNCS, very little time is devoted to Natural Science in the CAPS, making this study as relevant now as it was when it was conceptualised. Beginning Knowledge draws its content and concepts from Social Sciences (History and Geography), Natural Science and Technology.

While CAPS is currently the official policy, the core knowledge contexts for Science are the same in the RNCS and CAPS. Thus, while the RNCS is the context for the study, the focus of the study is on the ways in which teachers interpret and implement a science curriculum in the Foundation Phase. The significance of this study lies not in what the policy contains or prescribes, but in the reasons why teachers implement a new curriculum that is very different to any previous curriculum which with they may have engaged.

1.5 THE PURPOSE OF THE STUDY

The progress in Science Education in South Africa echoes the international transformation movement in Science Education. In the United States, the American Association for the Advancement of Science (AAAS) and the National Research Council (NRC) endorse science curricula that enthusiastically engage learners using an inquiry based approach (American

Association for the Advancement of Science, 1993 and National Research Council, 1996). In the United Kingdom Target One for Science in the National Curriculum has assigned a great deal of precedence to scientific investigations (Department of Education and Employment, 1999). The New Zealand Curriculum Framework maintains that Science is essential to understanding our world and active participation in Science fosters this understanding (Ministry of Education, 2009).

Although there are numerous studies on curriculum implementation in the schooling sector this study is unique as it focuses on the Foundation Phase and more specifically the Natural Science Curriculum within the Life Skills Learning Programme in the Foundation Phase. The purpose of my study is to understand foundation phase teachers' interpretation and implementation of the Natural Science Curriculum within the Life Skills Learning Programme.

1.6 PROBLEM STATEMENT

The Life Skills Learning Programme has as its backbone the learning outcomes, with their related assessment standards from the Life Orientation Learning Area. The RNCS suggests that the learning outcomes and their related assessment standards from other learning areas are integrated in the Life Skills Learning Programme (Department of Education, 2003a). The intention is that the concepts and skills needed for further learning in the GET band are developed in the Foundation Phase, in addition to those proposed in the Literacy and Numeracy learning programmes. The RNCS only uses the learning outcomes from the Life Orientation Learning Programme as an example in the curriculum documents to explain how teachers would deal with different competencies, as "it is not possible to give an explanation on all the learning outcomes." (Department of Education, 2003a, p. 75) This is problematic, as teachers are not given adequate guidelines on how to incorporate the other learning areas within the Life skills Curriculum.

The RNCS (Department of Education, 2003b) has Natural Science as a mandatory component of the Life Skills Learning Programme, with scientific investigations being the only outcome in the Foundation Phase. It fails to clearly define how scientific investigations may be integrated within the three foundation phase programmes. According to the Teacher's Guide for the development of Learning Programmes in the Foundation Phase, assessment of learner performance in Grades R - Three in the three Learning Programmes should mainly focus on the learning outcomes and assessment standards defined in the Languages, Mathematics and Life Orientation learning areas. The learner's level of competence in the Natural Science, Social Sciences, Technology, Art and Culture and Economic and Management Sciences learning areas should be planned for, taught and assessed in an "integrated manner within the three Learning Programmes offered in this phase" (Department of Education, 2003a, p. 10-11). The implementation of this is not clearly explained in the curriculum documents. Hence, my study attempts to discover how foundation phase teachers interpret and implement the Natural Science Curriculum within the Life Skills programme.

The main research question that frames my study is: How do foundation phase teachers interpret and implement the Natural Science Curriculum within the Life Skills Learning programme? The sub-questions which guided the study, are:

1. What are foundation phase teachers' interpretation of the Natural Science Curriculum?
2. How do foundation phase teachers implement the Natural Science Curriculum?
3. Why do foundation phase teachers interpret the Natural Science Curriculum the way that they do?
4. Why do foundation phase teachers implement the Natural Science Curriculum the way that they do?

1.7 OUTLINE OF THE THESIS

My study is presented in ten chapters including this introductory chapter. The introduction is intended to acquaint the reader with the motivation and background to the study. In this chapter, I presented a backdrop for the study in terms of developments in the curriculum in South Africa. I explain frequently used terms and concepts within the Foundation Phase in the South African context. The rationale presented my personal interest and reasons based on my experiences with teaching Natural Science that motivated me in conducting this study.

The literature review in chapter two links the theoretical background to local and international research already done in areas related to my study. I have reviewed the literature pertaining to curriculum, the foundation phase teacher and learner, issues in Science Education and factors that influence the implementation of the curriculum.

The theoretical framework is discussed in chapter three. The theoretical framework for this study is entrenched in the relationship between the prescribed and the implemented curriculum. The Zone of Feasible Innovation (ZFI) is the proposed theory of implementation.

The ZFI is derived from Vygotsky's zone of proximal development (ZPD) (Rogan & Grayson, 2003, p. 1195). In applying, the theoretical framework to answer the research questions, the learning environment is selected as the unit of analysis since this is where the learners, teachers, curriculum and educational resources meet. I developed an analytical framework for this study by adapting the theory of implementation proposed by Rogan and Grayson (2003) which was be used to collect and analyse the data.

I present the research methodology in chapter four, which describes in detail the reasoning behind the way my research was conducted. This includes the paradigm in which the study is located, as well as the applied approach. Furthermore, I discuss the design of the study as well as the methods of data collection I employed.

In chapter five I explain how the data was analysed. In chapters six, seven, eight and nine, I present the findings as narratives based on the analysis of the data pertaining to each teachers' interpretation and implementation of the curriculum. In chapter ten, I draw on the findings presented in the preceding chapters and I link the findings to existing literature in an attempt to answer the research questions. Furthermore, I present a number of recommendations based on the findings.

1.8 CONCLUSION

In this chapter, I have set the scene for the study by introducing the Foundation Phase of schooling. The background of the study provides a historical overview of the issues pertaining to C2005 and the NCS that lays the foundations for this study. I further expound the foundation phase landscape by clarifying the key concepts related to this study. The concepts that I discussed were the foundation phase, the foundation phase teacher, the foundation phase learner and the Life Skills Learning Programme in the Foundation Phase. In the rationale, I provided the justification of the study against the backdrop of the issues with curriculum implementation. In the problem statement, I explored the issues and area to be investigated. I revealed the key questions that guide the study within the purpose of the study. I conclude this chapter with the outline of thesis by providing a brief synopsis of each chapter that follows. In chapter two, I present a discussion of the literature pertaining to my study.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

In Graeme Bloch's (2009) book entitled *The Toxic Mix: What's wrong with South Africa's schools and how to fix it*, he examines the limitations and challenges which confront the South African education system. He recommends precautionary and intervention methods to find possible solutions to the situation. In his quest, he recognises some probable causes for the inadequate accomplishments of South African learners. He states that teachers play a pivotal role in enhancing the quality of education and for this to be achieved they should be acquainted with their role function in the teaching and learning process. Bloch (2009) draws attention to the interaction between teacher and learner in the classroom as the foundation for what transpires in education. Fancett and Hawke (1982) suggested that the teacher is the key to the actual classroom experiences of learners. This study focuses on the teacher and the curriculum, with particular focus on its implementation in the classroom.

The literature review synthesises and analyses the body of research that has contributed to the body of knowledge on the teaching and learning of Science in general and in the Foundation Phase in particular. This review focuses on four key aspects, the curriculum, the foundation phase context, Science Education and the factors that influence the implementation of the curriculum. I begin by defining curriculum then explore the types of curricula before reviewing models of curriculum theories. I review research in the foundation phase context by considering the teacher and learner as significant elements in the teaching and learning process. I then discuss Science Education globally and locally with a focus on the integration of Natural Science in the Life Skills Learning Programme, including scientific investigations and hands-on practical work. A discussion on the research into the factors that influence the implementation of curriculum, physical resources, school ethos, school management, assessment, language, learner support, professional development and the nature of classroom interaction is also presented.

2.2 CURRICULUM

The changes in the curriculum that formed part of the South African education landscape were discussed in chapter one. In this chapter, I review literature on certain key aspects of the curriculum. These include definitions of the curriculum, types of curriculum, curriculum theory and models.

2.2.1 Definitions of Curriculum

Curriculum may be viewed from diverse points of view and its meaning is varied. It is not easy to define curriculum, as there have been many definitions over the years (Marsh, 2004; Marsh & Willis, 2003). A useful definition is given by Marsh (2004), "A curriculum framework can be defined as a group of related subjects or themes, which fit together according to a predetermined set of criteria to appropriately cover an area of study" (p. 19). Smith (2000) concurs, "The idea of curriculum is hardly new, but the way in which we understand and theorise it has altered over the years and there remains considerable dispute as to its meaning" (p. 1).

A curriculum framework positions the subjects within this broader perspective, and demonstrates the way in which learning objectives within the subjects should add to the achievement of the broader goals. It is my view that all teachers should participate in the planning and development of the curriculum in order to ensure accountability and sustainability. According to Ornstein and Hunkins (1993), "curriculum as a field of study is elusive and fragmentary and what it is supposed to entail is open to a good deal of debate and even misunderstanding" (p. 1). Lovat and Smith (2003) are of the view that "the word 'curriculum' itself is used in many different contexts by principals in schools, by teachers, by curriculum writers in education systems, and increasingly by politicians. It can mean different things in each of these contexts" (p. 6).

Marsh and Stafford (1988) draw attention to three notions of curriculum, which provide a broad perspective on what constitutes a curriculum. Firstly, they explain that curriculum, in addition to the course outline and content, also comprises of a comprehensive breakdown of fundamentals such as aim, objectives, learning experiences and evaluation, including suggestions for interconnecting them for most advantageous results. Secondly, they explain that the curriculum consists of premeditated or intended learning, drawing consideration to unforeseen circumstances, which are unavoidable in classroom interactions.

Thirdly, they explain that the curriculum and teaching and learning are inexplicitly linked. Lovat and Smith (2003) concur that a “Curriculum is part of teaching, not separate from it” (p. 16). Consequently, the most agreed perception of the curriculum is that it refers to a plan for learning (Lovat & Smith, 2003; Marsh, 2004; van den Akker, 2003).

Marsh (2004) provides various definitions of curriculum which offer a concise summary of all aspects of a curriculum. He maintains that the curriculum is the ‘permanent’ subject that represents crucial knowledge that is most beneficial for present-day living. The school is accountable for all the purposeful learning that is required by the curriculum. According to Marsh, the curriculum is the totality of learning experiences, which enable learners to attain general skills and knowledge at a variety of learning sites. For example, he believes that the curriculum is also what learners construct from working with a computer and its various networks, such as the Internet. In addition, he views the curriculum as the questioning of authority and the searching for complex views of human situations. Finally, he considers the curriculum to be all the experiences learners have while at school and during the course of living.

2.2.2 Types of Curriculum

There are, according to Hirst (1974) seven distinguishing types of knowledge, each with its own exclusive concept and characteristics, which is the consequence of the method in which humans have made meaning of their experiences over the years. The seven types of knowledge identified are mathematics, the physical sciences, human sciences, history, religion, literature, fine arts, philosophy and moral knowledge. Although there has been criticism of these types of knowledge (Barrow, 1976; Pring, 1976; Watt, 1974), Hirst (1974) argues that the nature of knowledge should form the foundation of the curriculum. According to Hirst (1974), it is imperative for children to obtain these types of knowledge, as this gives them a framework with which to understand their world. Content knowledge is the focus of this type of curriculum. Kelly (1999) presents two points of view on the choice of knowledge to be included in a curriculum. The first viewpoint considers knowledge in the curriculum, which is meaningful and has inherent importance and therefore its presence does not need to be justified. The second viewpoint is that the culture of a society should provide the basis for the content for the curriculum. This may be very challenging in a society such as South Africa, which is culturally diverse.

A fundamental examination pertaining to curriculum development encompasses three types of curriculum, namely “intended, implemented and attained curriculum” (Akker, 2003, p. 2). The overt, explicit, intended, official or written curriculum is the written curriculum as it appears in curriculum policy documents and forms the key element of official teaching and learning in school (Posner, 2002). At the level of the classroom, this intended curriculum may be changed during a series of multifaceted classroom interactions. In fact, what is eventually delivered, may be believed to be the implemented curriculum. The curriculum in use, implicit or delivered curriculum is the actual curriculum that is taught by the teacher. The received or learned curriculum is what the learner in reality acquires from the classroom interaction, which is the information that they will retain (Cuban, 1992).

A number of other curriculum types has been described. Examples are: the rhetorical curriculum which encompasses information from key stakeholders such as policy makers, politicians and school officials; the societal curriculum, defined by Cortes (1981) as “the massive, ongoing, informal curriculum of family, peer groups, neighbourhoods, churches organizations, occupations, mass, media and other socializing forces that educate all of us throughout our lives” (p. 25). The concomitant curriculum is the curriculum that is emphasised at home, which is approved by the family. The phantom curriculum is that which is portrayed through the media. The hidden or covert curriculum is the curriculum that learners acquire from the school environment (Longstreet & Shane, 1993). Eisner (1994) described and defined another type of curriculum, referred to as the null curriculum. The null curriculum is that which schools do not teach and Eisner is of the view that this curriculum may be as important as the curriculum that is taught. Certain stakeholders have the power to consciously decide what is included or excluded from the school curriculum.

Walker (1990) uses the word ‘naturalistic’ when describing the types of curriculum he examined because he wanted to represent the way curriculum development essentially takes place in practice. His three-step sequence of ‘platform-deliberation-design’ has since been used at various levels of curriculum development (1990, p. 23). Walker (1990) used the term ‘platform’ since it offers a point of reference or foundation for the prospective dialogue. Walker (1990) maintains that the essential concepts of curriculum include content, purpose and organisation. The content may be represented with concept maps, themes or topics. The purpose is frequently considered as intellectual, social and personal. The organisation or planning is arranged on a continuum, which may be organised stringently or flexibly.

The political history of South Africa influenced the amalgamation of the different departments of education into one department of education. The instrumental and expressive cultures, which formed part of school's rituals, had their foundation in the different education departments. With this amalgamation, learners from different cultural backgrounds had no choice but to follow the instrumental and expressive cultures, which resulted when a common curriculum was established. In exploring curriculum, it is important to distinguish between the intended and implemented curriculum to be able to understand the curriculum of South Africa. According to Graham-Jolly (2003) even though schools have a common curriculum to follow, "any notion of commonality is undermined by the legacy of apartheid, which has ensured the continuity of vast inequalities between schools previously divided according to race" (p. 5). He cites an appropriate example to make the point:

> A simple science lesson taught in a school in a rural environment with no laboratory, equipment or other resources, and by a teacher who is minimally qualified to teach the subject, is likely to provide learning experiences, which are qualitatively very different to those, which might be gained by a similar lesson taught in a well-resourced school in a middle class suburb with the benefits of a laboratory and a well-qualified teacher (Graham-Jolly, 2003, p. 5).

Even though schools in South Africa follow a common curriculum, learners' experiences vary, as the actual or implemented curriculum is context driven with the school and the teachers providing learners with culturally diverse contexts.

2.2.3 Curriculum Theories

According to Pinar (2008), "curriculum theory is the interdisciplinary study of educational experience" (p. 2). Beauchamp (1982) states that curriculum theory may be "construed as an organised explanation for an observed set of events or phenomena that demand explanation but immediately is confronted with the meanings to be associated with explanation" (p. 23). Giroux (1991) and Ornstein and Hunkins (1993) argue that the creation of innovative terminology, language or descriptions is essential to enable the process to proceed. Although many curriculum authors are dissatisfied with the progress made in conceptualising curriculum theories they do emphasise the value of employing curriculum theories. Marsh (2004) supports this and is of the view that these curriculum theories may direct the efforts of all stakeholders concerned with curriculum development and progression by assisting "researchers to analyse data and provide a much-needed impetus and direction for curriculum research with the benefits flowing on to classroom teachers" (p. 199). He suggests setting up essential questions to which a curriculum theory will have to respond. Kliebard (1977) suggested that the primary question for any curriculum theorist is 'What should we teach?'

The intention of curriculum theories should be to reinforce and steer the manner in which curriculum is developed. Beauchamp and Conran (1975) advocate for curriculum theories to "support and guide the development of curriculum policy, practice and research" (p. 392). According to them, the difficulties with which schools are confronted, arise from the unsuccessful attempt to apply more thorough regulations in theory development and more refined procedures in research design in the area of curriculum. It seems that one of the most important challenges for curriculum theorists is the formation of exact meaning related to a fundamental theory of curriculum. Vallance (1982) provides an alternative solution 'to shift focus from the end product (the curriculum theory) to the process by which a theory is sought (the process of theorising)' (p. 8).

Marsh (2004) believes that it is essential to sort and classify the contributions made by theorists to be able to understand what has been accomplished in the field of curriculum theorising. He suggests three broad categories to highlight their unique importance. In the first category, prescriptive theorisers endeavour to produce "models or frameworks for curriculum development that improve schools practices". In the second category, descriptive theorists endeavour to "identify how curriculum development actually takes place, especially in school settings". In the third category, critical-exploratory theorisers endeavour to "understand deficiencies in past practices of curriculum development and to replace them with more adequate practices, particularly by considering curriculum in the broadest possible intellectual and social contexts" (p. 201).

Curriculum theory is valuable to teachers as it can provide them with assistance to arrange, plan and focus their teaching and learning. Barone (1987) maintains that curriculum theory should assist teachers developing and implementing the intended curriculum. This embraces the idea of providing learners with the chance to have an influence on the curriculum being taught. Cornbleth (1985) studied the influence the context of a society has on the curriculum that is actually taught in class. Later, she considered how teachers responded to life changing events (such as the terrorist attacks of September 2001 and other dramatic events) by adapting their classroom curriculum practice. Her view is of, "Teachers, both individually and collectively, as mediators or interpreters (or negotiators) of various social conditions, trends, events, and national-state-local priorities" (Cornbleth, 2008, p. 165). Cornbleth (2008) mentioned that to change the problem of learners not learning enough is to adapt the curriculum to include what learners want to learn. This could be done by making changes to the course sequence, materials and procedures. However, it is realised that the major curriculum decisions have already been made (Kliebard, 1979; Reid, 1978).

The range of different types of theories must be accepted and recognised to be important. Walker (1982) asserts that we should use the plural when we have discourses on curriculum theory. Since each type of theory has essential variances, which may address certain issues, the variety of theories should be embraced. Walker (1982) maintains, "We must learn to cherish variety in curriculum theory, to nurture it, to celebrate it, to cultivate it" (p. 65). He goes on to say that the most significant function of theory in curriculum is perhaps to assist us understand things in a different way to what we are accustomed.

The South African curriculum professes to be a manifestation of "the nation's social values and its expectations of roles, rights and responsibilities of the democratic South African citizen as expressed in the Constitution" (Department of Education, 2003a, p. 5). The principles underpinning the curriculum are social justice, a healthy environment, human rights and inclusivity. It therefore defines itself as a curriculum that is based on a particular philosophy and underpinned by theory. However, although preamble to the curriculum mentions the contributions of many stakeholders, the role played by teachers in the design of the curriculum is not clear. Some researchers are of the view that the teachers' involvement in the curriculum development process should be extended beyond the school and the classroom (Fullan & Hargreaves, 1992; Kirk & Macdonald, 2001)

2.2.4 Curriculum Models

A theory and model cannot be thought of as the same thing as a theory is a thought, and planned idea or concept, whereas a model is an expression of that thought used to test the theory's feasibility. Since curriculum theory has been difficult to develop, it has been suggested that it be discarded in favour of a focus on models of curricula (Marsh, 2004). Vallance (1982) and Posner (1989) further support the development of curriculum models. They advise that models are able to recognise the fundamental thought that needs to be taken into consideration for curriculum decisions to be made and that they show the interrelationships between concepts.

Curriculum models assist curriculum designers to methodically and transparently plan the underlying principles for the use of specific teaching, learning and evaluation strategies. Ornstein and Hunkins (2009) caution that even though curriculum development models are helpful in principle, they frequently neglect the personal features such as attitudes, beliefs, morals and ethics involved in the creation and development of curriculum. For this reason, they suggest that curriculum models should not be a used as a replacement for drawing on a person's professional and personal judgement on what is the best approach or strategy to improve and develop learning.

Although there are many curriculum models, the discussion that follows will consider two models of curriculum i.e. the curriculum as a product model (Bobbitt, 1928; Tyler, 1975) and curriculum as a process model (Barrow, 1984; Newman & Ingram 1989; Stenhouse, 1975). The reason for focussing on these models is that the RNCS mirrors a change in Science Education in South Africa from a product model to a process model (Department of Education, 2003b). The change needs to be considered in teacher education programmes. Curriculum developers could get involved in discussions around the different models, which could be applied to support the planning and implementation of curriculum programmes so that appropriate teaching and learning experiences may be accomplished.

The two models have been developed and modified over the years. The product model of curriculum development is often referred to as an objective curriculum model and considers the curriculum as a technical exercise (Neary, 2003). Neary (2003) describes the product model as one which emphasises "plans and intentions" and the process model as one which emphasises "activities and effects" (p. 39). In the product model, knowledge is viewed as similar to a product that is constructed. It is assumed that initially the learner knows nothing and knowledge needs to be transmitted to the learner for learning to take place. The curriculum is designed according to a sequence of actions to ensure the learners attain a certain level. These steps involve identifying the need, devising objectives, choosing content, arranging the content, choosing learning activities, arranging of learning activities and establishing what and how to evaluate. The product model of the curriculum deals primarily with what learners learn. A concern of the product model is that the learner is excluded from the scenario as attention is on following the plan and focusing on teaching.

Stenhouse's (1975) contribution to the process model of curriculum is widely cited. He defined curriculum as, "an attempt to communicate the essential principles and features of an educational proposal in such a form that it is open to critical scrutiny and capable of effective translation into practice" (p. 142). He argues against the use of behavioural objectives and puts forward an inquiry-based approach to teaching and learning. Although he accepts the value of having knowledge as a basis, he highlights the need to learn through inquiry and discovery, which allows the possibility to attain “unintended Learning Outcomes” (Stenhouse, 1975, p. 147). The process model is closely associated with Hirsts’ (1974) forms of knowledge. For the process model, what is important is that learners make use of suitable procedures and concepts within the selected content. Consequently, the intention of the process model is to make available opportunities for learners to make use of the procedures and concepts to construct knowledge and not to teach specific subject matter/content (Bertram, Fotheringham & Barley, 2000).

The process model, in contrast to the product model deals with how learners learn and with their personal development. In the process model, learners are seen as being involved in creating knowledge and are not seen as being passive recipients of knowledge. Hence the process model is associated with cognitive and constructivist theories of learning. Terwel (1999) confirms the effect constructivist theories have on curriculum studies. He declares, “Constructivism undoubtedly has a valuable contribution to make to curriculum theory and practice” (Terwel, 1999, p. 198). There will be repercussions for curriculum theory and practice if teachers and learners construct their own curricula. The constructivist movement reiterates the dynamic position of the learner in attaining knowledge and the social construction of knowledge.

Some important characteristics of the process model indicate that there is a move from objectives to providing learners with choices; the curriculum is viewed as involving teachers, learners and knowledge working together. There is a deliberate shift in focus from teaching to learning with the curriculum being viewed as dynamic. Knight (2001) favours a process model of curriculum planning in comparison to the product model. He says it is logical to plan curriculum in this instinctive way, “reassured by the claim from complexity theory that what matters is getting the ingredients - the processes, messages and conditions - right and trusting that good outcomes will follow” (p. 379). This implies that when operating from a process model of learning outcomes, it may be more important to initially think about what it is you are actually attempting to accomplish in the teaching/learning activities and to then write the curriculum or module learning outcomes.

Some of the concerns with the process model relate to the need for having uniformity and standardisation in the content. As the learner is an active participant in his learning, this could change the dynamics of classroom interactions and allow for an assortment of content being taught. Another key issue is the quality of the teacher who is at the centre of the process model, which could be seen as a strength or a weakness.

As mentioned in chapter one, when the South African NCS was introduced in 1997 it was confronted with significant challenges which resulted in it being reviewed, thus the RNCS emerged. The RNCS is built on the principles of C 2005, which uphold the principles of OBE. OBE is not structured around subjects but around integrated learning areas. This integration was achieved through "replacing vast collections of facts and concepts with broad critical outcomes and specific outcomes, which could be achieved by a variety of routes" (Hoadley & Jansen, 2009, p. 173). OBE considers the process as important as the content. The learners have a set of outcomes to attain through which the process and content of education may be achieved. These outcomes "encourage a learner-centred and activity-based approach to education" (Department of Education 2002a, p. 1). C2005 is therefore considered to be an example of a process model of curriculum.

2.2.5 Curriculum in Action

In schools, the syllabus receives the most attention from the curriculum which takes the form of subject content. A syllabus identifies a list of content areas for study and tends to follow the "traditional textbook approach of an order of contents" or a sequence approved by a rational approach to the subject (Curzon, 1985, p. 11). With the emphasis on this part of the curriculum, content is fore-grounded. The content knowledge is seen to be delivered to learners, rather than developed with learners. Blenkin, Edwards, and Kelly (1992) concur, "Education in this sense is the process by which these are transmitted or delivered to learners by the most effective methods that can be devised" (p. 23). It is because of this view that Kelly (1999) claims, "Many teachers in primary schools have regarded issues of curriculum as of no concern to them, since they have not regarded their task as being to transmitting bodies of knowledge in this manner" (p. 7). Thus, this could result in teachers viewing curriculum design as being of minimal significance to them, which, in turn, could lead to them selecting content of their own choice, instead of being guided by the curriculum.

A school's ethos and structure influence the curriculum. Schools have aims and objectives that form part of the school's ethos. Eisner (2000) maintains, "Curriculum development and teaching are fundamentally practical activities" (p. 354). Therefore, to enhance the educational experiences of learners these factors have to be taken into consideration. In addition, the role of the teacher in curriculum planning is crucial. Teachers form part of the stakeholders in school planning and decision-making. According to Eisner (2000), "Teachers are central to the improvement of schooling and need to have a substantial role to play in shaping the direction, content and form of the changes being proposed" (p. 347). The role of the teacher in curriculum development and planning has been promoted extensively (Handler, 2010; Ornstein & Hunkins, 2009; Young, 1979). Handler cautions, "It is unreasonable, if not unfair, to place teachers into roles for which they do not have the prerequisite competencies." She goes on to explain, "If teachers are to be put into such leadership roles, they must have a deeper understanding of education as a whole than is currently evident through evaluation of teacher preparation program content and standards" (2010, p 38). Researchers like Leithwood and Jantzi (2000), Ryan (1999) and Weiss (1993) supports Handler's view. Cothram and Ennis (1997) findings suggest that "teacher curricular freedom is a double edged sword" (p.12). Their study showed that although the teachers in their study had the liberty to design curricula, they continuously chose to function within curricular frameworks that were in existence. Teachers' curriculum decisions are grounded in their educational principle and value underpinnings (Eisner & Vallance, 1974; McNeil, 1990). Ennis (1992) mentions that there are contextual factors which influence the process of curriculum development. I believe that by including teachers in curriculum planning, they become accountable and involved in the content to be taught, which can only have a positive effect on the general ethos of the school.

A point for consideration is the location of teachers in the curriculum reform process. In this regard, Bernstein's (1990) work on the social production of pedagogic discourse offers a perspective to comprehend the character and intricacy of educational reform and the role teachers may play within it. Bernstein (2002) further explains pedagogic discourse as a 'principle' or 'rule' that brings a range of discourses into conjunction with each other in educational settings (p. 99). For teachers to be considered as collaborators in the reform process, Kirk and MacDonald (2001) maintain that it is vital they "have opportunity to be agents within the re-contextualising field, involved in the production of instructional discourse, as well as agents in the secondary field charged with receiving and delivering instructional discourse" (p. 555). In their study of two curriculum reform projects in Australia they concluded, "The majority of teachers did not operate as agents in the re-contextualising field, even though the potential to do so was present in each project" (Kirk & MacDonald, 2002, p. 564).

2.3 SCIENCE EDUCATION

There are many issues related to Science Education, both globally and locally. Some of these will be deliberated on from a global perspective. Science Education will also be considered from a local perspective and aspects around scientific investigations, integration of Natural Science and hands-on science will be discussed.

Globally, the main aim of Science Education is to produce a scientifically literate citizenry that are able to think critically and solve problems. South Africa is no exception. The Natural Science Learning Area is intended to encourage scientific literacy in foundation phase learners. Goodrum, Hackling and Rennie (2001) confirm that Science Education ought to prepare learners with scientific knowledge/concepts, scientific process skills and scientific values and attitudes, in order to stimulate scientific literacy so that learners can manage in a scientific and technological world. Science Education is essential to prepare learners for the world of work, which require scientific competence and the ability to be active participants in a society, that requires learners to make decisions based on contingent scientific knowledge. Science Education is essential for the future of the world as well as for people understanding themselves, their selection of vocation, and for their personal prospects (Abd-El-Khalick & Lederman, 2000). Harlen (2000) points out, "Learning Science is important for the future lives of all citizens and it is a required part of primary and secondary education in practically all countries" (p. 1). Science generates knowledge, which helps us to understand the world. In Science Education we are concerned with laying the foundation for this understanding.

International reviews have raised concerns with regard to primary science, in some instances highlighting a difference between the intended and the actual curriculum as experienced by learners (Australian Science, Technology and Engineering Council, ASTEC, 1997; Department of Education for Northern Ireland, DENI, 2002; National Research Council, NRC, 996). Primary science has the ability to be a catalyst in developing learners' interest in the Sciences. In doing so, it could supply learners with opportunities to expand their inherent curiosity about the natural world (Driver, Leach, Millar & Scott, 1996; Harlen, 2000; Roccard, Csermely, Jorde, Lenzen, Walberg-Henriksson, Hemmo, 2007). The decline in learners' enthusiasm for Science is a concern, both globally and locally. A media release on 26 June 2013 (Australian Council of Learned Academies, 2013) associated with Science, Technology, Engineering and Mathematics, reported that to improve Australia's opportunities in the global market, three aspects need to be considered. Firstly, there is a need to ensure that learners in primary school devote adequate time to Science and Mathematics. Secondly, the quality of Science, Technology, Engineering and Mathematics teaching at all levels of schooling needs to improve to ensure learners appreciate and are stimulated by Science and Mathematics. Thirdly, beneficial, significant and high quality resources are effortlessly available to make provision for and to maintain Science, Technology, Engineering and Mathematics (Australian Council of Learned Academies, 2013). The importance of an effective primary science curriculum, particularly a foundation phase curriculum, which does achieve the outcomes stated above, cannot be underestimated.

Although Science is a fundamental learning area in the Australian Curriculum, “it is not always a priority in Australian primary schools” (Campbell & Chittleborough, 2014, p. 19). However, the findings from Campbell and Chittleborough’s (2014) study revealed that the “allocation of time, professional development and resources contributed to building the teacher's capacity to be a science specialist” and thus should contribute to making Science a priority in Australian primary schools (p. 29). Petre’s (2013) research promotes the implementation of “direct cognition of nature to Science Education to support learners’ inherent interest in nature” (p. 262). He maintains that using appropriate teaching instructional methods and resources may contribute to developing and maintaining a constructive association between the learners and their natural environment. This in turn will encourage learners’ interest in Science Education.

Consequently, the emphasis appears to be on the importance of appropriate instructional methods. At the foundation phase level the teacher’s role is crucial as she has to judge the extent to which her learners are able to engage in inquiry-based learning activities by determining how the experiences are to be structured. In structured experiences, the teacher selects the activity for the learner and provides a certain amount of influence to the learner’s experience. Structured experiences are “planned learning experiences or lessons controlled by the adult” (Charlesworth & Lind, 1999, p. 25). The teacher arranges the setting and activity and guides the learner’s involvement to explain precise concepts and skills. Lederman, Lederman and Antink (2013) maintain that although doing Science is the first step, more importantly learners need to “reflect on what it is they are doing” (p. 144). To do this they should be involved in collaborative talks about the nature of science investigations.

Early childhood practitioners are viewed as having a specialised body of knowledge, which includes knowledge about children, teaching, learning and the curriculum that can be translated into meaningful practice. The teacher must plan learning experiences that engage and challenge children in thinking that is conceptually rich, coherently organised, and persistently knowledge building (Garbett, 2003). An effective early childhood teacher is one who can facilitate and extend children's learning within the holistic nature of the early childhood curriculum without being overcome by the conventional notions of teaching. In the curriculum area of Science, this is particularly difficult since teachers often do not have the requisite content knowledge or appropriate pedagogy.

Hattie (2003) is of the view that although experts and experienced teachers may not differ in the amount of knowledge they have about curriculum matters or knowledge about teaching strategies, they do differ in how experts organise and use this content knowledge. According to him, "experts have knowledge that is more integrated, in that they combine new subject matter content knowledge with prior knowledge; can relate current lesson content to other subjects in the curriculum; and make lessons uniquely their own by changing, combining and adding them according to their students' needs and their goals" (p. 7). This is what Shulman (1986) refers to as pedagogic content knowledge. South African foundation phase teachers may experience the challenge of teaching Science competently, as they are not experts or experienced natural science teachers.

While foundation phase teachers in South Africa experience similar challenges with regard to science teaching as those discussed above, a further challenge facing them is the curricular model implemented in South Africa. Curriculum 2005 is an outcomes-based curriculum of which the basic aspects are foreign to many teachers. According to the Department of Education (2002b), "The principle of integrated learning is integral to outcomes-based education" (p. 12). The skills, knowledge, attitudes and values are interlinked across the learning areas. By integrating, there is assurance that there is synergy between all the learning areas. There is conceptual progression in the assessment standards in each learning area Statement from grade to grade in the RNCS. The Department of Education (2002b) advises, "Learners should not deal with assessment standards in isolation" and that "links must be made within and across Learning Outcomes and Learning Areas" (p. 12). A vital aspect of the curriculum is to achieve the best possible correlation involving integration across learning areas and conceptual progression from grade to grade. This is a daunting task for many South African teachers.

Currently there is a strong move in South Africa towards improving basic reading, writing and mathematical skills. As a result, the time spent teaching Natural Science in the Foundation Phase has been reduced. In the Foundation Phase, Natural Science forms a one-sixth part of one of the three learning areas, namely Life Skills. The very idea that Natural Science has to be integrated within the Life Skills Learning Programme, which in turn has to be integrated in the foundation phase curriculum, which includes Numeracy and Literacy, adds to the uncertainty and confusion with regard to the implementation of the curriculum. This state of affairs requires urgent attention as it may impact on science learning throughout the different phases of schooling. To ensure learners continue with Science throughout their schooling, it is important that much emphasis is placed on the time and resources devoted to Science Education in the early years of schooling. As Lamanauskas so rightfully maintains, "Only high-quality natural Science Education acquired in primary school can guarantee proper continuation of natural Science Education in basic and secondary school." (2009, p. 7)

2.3.1 Scientific Investigations

Inquiry-based approaches to Science encompasses scientific investigations. The term *scientific investigations* is used here because the RNCS uses this term to include all activities pertaining to the acquisition of process skills. The ability to carry out scientific investigations is the only learning outcome for Science in the Foundation Phase; it is a crucial aspect of this study. From a global perspective, the degree to which primary school learners are given opportunities to investigate and discover solutions to their individual questions is an area of concern. (De Boo & Randall 2001; Department of Education for Northern Ireland, 2002). Even at this level, investigations have to be designed to develop learners' procedural knowledge and not just to repeat lower level skills (Tamir & Lunetta, 1981). While the emphasis on procedural knowledge could be at the expense of conceptual knowledge (Lunetta, Hofstein & Clough, 2007, p. 403), the RNCS has elected to focus only on procedural knowledge in the Foundation Phase.

When Science is taught at primary school level, teachers need to ensure that it is taught using methodology that is relevant and at learners' cognitive level of understanding. Harlen (2008) maintains, "To achieve the aims of Science Education at the primary school level it is important to consider not just the subject matter that is suitable for the development of scientific understanding, but also the pedagogy that is required for meeting these aims" (p. 17). A study conducted by Roccard et al. (2007) revealed that inquiry-based methodologies have a positive effect on learners' achievement in Science. Further research indicated that learners from disadvantaged backgrounds with low levels of self-confidence have benefitted from inquiry-based methodologies (Driver et al., 1985; Roccard et al., 2007).

As mentioned earlier, the reasons for the importance given to scientific investigations may be drawn from the emphasis it has been afforded in the foundation phase science curriculum. By including scientific investigations from an early age, learners are emulating the way scientists work. Consistent with this, Roth (1995) is of the view that by conducting investigations learners are presented with prospects for genuine inquiry with "some degree of resemblance to what scientists actually do in their laboratory work" (p. 110).

Drawing from the statement for Learning Outcome One, learners engaging with scientific investigations "will be able to act confidently on curiosity about natural phenomena" (Department of Education, 2003b, p. 8). Research supports the assertion that scientific investigations are a way to understand the world (Llewellyn, 2002; Millar, 1998; National Science Foundation, 1999). Scientific investigations afford learners the opportunity to apply science process skills, which is a distinct feature of the Learning Outcome. Examples of science process skills include observing, measuring, classifying data, inferring and formulating questions for investigations (Department of Education, 2003b, p. 13). Martin (2006) agrees that process skills embodies the heart of scientific investigations.

Johnston (2005) maintains that it requires less effort to arrange science activities in groups than individually. There is a social context to doing investigations as the learners discuss and share new ideas (Pappas & Tepe, 2002). Children discuss plans and work collaboratively in carrying out inquiry activities. For younger children, Johnston (2005) advises that teachers may need to "model cooperative behaviour" (p. 98). Llewellyn (2002) maintains, "Group work during inquiry can allow the members to learn from each other, share and challenge their ideas, and distribute the work in an equitable fashion" (p. 57). Johnston (2005) agrees, "The sharing of ideas and efforts should be encouraged where appropriate" (p. 99). However, she cautions that learners have to consider the safety of others when working in groups (Johnston, 2005). The programmes and the practices in other countries prove that young children are also capable of performing certain scientific procedures, for example scientific inquiry (Department of Education, England, 2013; Ministry of Education, Singapore, 2013). Scientific inquiry, as an instructional method, aligns itself well with cooperative learning, an established approach in foundation phase classrooms.

2.3.2 Hands-on Science

In this study, hands-on science is taken to indicate any practical or investigative work in which the learners themselves manage the living things, materials and/or equipment. As mentioned earlier from the study conducted by Muwanga-Zake (2000) the absence of science equipment and laboratories contribute to teachers not teaching Science through hands-on practical activities. Lind (1999) declares, “As any scientist knows, the best way to learn science is to do science” (p. 1). By doing Science, learners can engage with and gain experience of scientific methods of doing hands-on science. Osbourne (2002), in her analysis of what it means to do Science suggests that practical activities where learners are actively involved are the fundamental aspects of learning Science. In the primary phase and specifically the Foundation Phase, practical hands-on activities may be designed without the use of laboratories and expensive science equipment.

With foundation phase learners, ‘doing Science’ may be achieved by conducting scientific investigations about natural phenomena. Opportunities should be created for learners to ask questions, carry out investigations and solve problems. Inquiry-oriented Science Education has been regarded in a number of ways over the years and endorsed from a range of perspectives (Collins, 1986; DeBoer, 1991; Rakow, 1986). The dynamic quality of learner participation correlates investigation with hands-on science (Haury, 1993). All practical teaching should have clear outcomes (White, 1996) that will prevent the practical exercise from becoming a series of routine, recipe like activities or disorganised actions. The choice of practical activity must be relevant to the learner and not be beyond the learners’ intellectual and practical ability (Muwanga-Zake, 2000).

While the value of scientific investigations was emphasised by research reported above, the study conducted by Murphy, Varley and Veale (2012) reveal that while most Irish learners in their study are optimistic about learning Science, using hands-on inquiry and group work, not all learners engaged in hands-on activities. Furthermore, although learners are given opportunities to carry out experiments and participate in hands-on science, frequently these practices are inclined to be teacher rather than pupil focussed (De Boo & Randall, 2001; Department of Education for Northern Ireland, 2002).

As seen from the above discussion, I am attempting to make a case for using hands-on methodology for teaching Science. However, it should be noted that adjustments are required depending on the level at which learners are. For example, grade R learners cannot read and the nature of instructions for them would differ substantially from instructions given to grade three learners. Lind (1999) in the article, Dialogue on Early Childhood Science, Mathematics, and Technology Education presents an synopsis of teaching and learning Science in the primary years, accentuating the significance of choosing science content that matches the intellectual capabilities of learners.

If we expect children to become scientifically literate, suitable science content and activities should be selected equivalent to the child's cognitive competence throughout the different stages of the child's development. Cowan (1978) emphasises the significance of this configuration, accentuating that alignment of the content and age-related levels is essential, to avoid misconceptions and frustrations for teacher, parent, and learner. According to Covington and Berry (1976), the consequence of misaligned content and cognitive capabilities results in learners being unable to comprehend, implement, or construe an in-depth understanding of the content, which may result in a decrease in their attentiveness and attitude towards Science. Although science content is not assessed in the RNCS, it still forms a crucial part when teaching Science using Learning Outcome One. Teaching science-by-doing involves teaching learners content knowledge as well, although this knowledge is not formally assessed.

2.4 THE FOUNDATION PHASE

The foundation phase landscape was briefly discussed in chapter one. In this section, I propose to discuss pertinent literature on the Foundation Phase with regard to the foundation phase teacher and the foundation phase learner. In addition, literature on general science teaching will be discussed.

2.4.1 The Foundation Phase Teacher

The foundation phase teacher is the critical feature of the foundation phase classroom. Hattie (2003) asserts that to understand learners' success we need to identify the most important aspects that influence success. By doing this it will enable us to make improvements in these areas to boost learners' achievements. He identifies these areas as the learners themselves, their homes, schools, principals, peer effect and the teacher. Some of the reasons Bloch (2009) cited for learners' underachievement were, amongst others, that "teachers had low content knowledge; teachers lacked the vital skills and understanding in planning, phasing the work they have to teach, and deciding how to get through the important and core aspects of the year's work" (p. 28). I will now discuss the issues pertaining to the critical role of the teacher in terms of science teaching and teachers' workloads, teachers' worldviews and Science, teaching Science and the foundation phase teacher in the South African context.

2.4.1.1 Science Teaching and Teachers' Workloads

Teachers and learners seemingly experience Science as difficult and consequently portray it as an unfavourable subject. Ogunniyi (1996) is of the view that science teachers have low confidence levels due to being overworked and underpaid. The study conducted by Atieno (2000) on the factors influencing the overall performance in Science in Nairobi, mentions some factors affecting performance as poor training, negative attitude and large workloads of teachers. Oginniyi (1996) also emphasises, "Teaching Science at school requires more input than other subjects, because the teacher has to prepare for practical work and to care for the equipment and the laboratory" (p. 97). Teachers' workloads are strained when they are required to incorporate the teaching of hands-on science into their already busy workloads, which requires time for planning and preparing for the lessons. Fitzgerald and Schnieder (2013) concur from their study with the implementation of the Australian curriculum, "Dealing with a crowded curriculum is not an uncommon experience for primary school teachers with competing demands from different learning areas, national assessment priorities and extra-curricular expectations" (p. 9). In a curriculum where no time is dedicated specifically to science teaching, as is the case in the Foundation Phase, teachers may neglect Science due to their full workloads.

2.4.1.2 Teachers' Worldviews and Science

A frequent theme in much of the literature about primary Science Education has been the degree of preparedness and noticeable reluctance of many teachers to teach Science (Abell & Roth, 1992; Appleton, 2003; Mellado, Blanco & Ruiz, 1998 and Smith & Neale, 1991). Research conducted in schools has identified the fact that science teaching is challenging with teachers either depending on a 'specialist' teacher to teach science lessons, or avoiding science teaching because of feelings of inadequacy in themselves as teachers of Science (Appleton, 2003; Buxton, 2010; Hackling, Peers & Prain, 2007; Southerland, Sowell, & Enderle, 2011; Tosun, 2000; Tytler, 2009). Appleton (2003) is also of the view that the main reason that significant numbers of primary school teachers avoid teaching Science, is because they are not knowledgeable about Science and lack confidence to teach it. This section is will consider these issues and other factors that may affect foundation phase teachers' interpretation and implementation of the Natural Science Curriculum.

As a result of teachers' perceived inadequacy they seem to resist change. Sachs (2001) provides a possible reason for teachers resisting change when he puts forward that 'policy images' of teachers make demands that conflict with their 'personal identities' as practitioners (p. 153). For example, foundation phase teachers may see themselves as general practitioners in this phase and not as science specialists and as a result will not easily change their identities. Jansen (2001) maintains, "This identity conflict might lie at the heart of the implementation dilemma in educational reform" (p. 242). He proposed a theoretical plan that endorsed a profound examination of the 'personal identities' of teachers in the "context of developing countries, given the complex problems associated with teacher education reform in such contexts" (Jansen, 2001, p. 242). Bybee (1993) maintains that teachers are the 'change agents' of educational reform and that teachers' beliefs must not be ignored (p. 45).

Henze, van Driel and Verloop (2007) claim that teachers' knowledge, to a large extent determines, how they respond to educational innovation and it is therefore necessary for innovators to take this knowledge into account when implementing educational changes. They investigated how teachers' pedagogic practices changed in response to a curriculum innovation and what factors affected the ways in which they changed. It explored how physical and social factors interacted with aspects of teachers' own personal histories, such as their experience and training for teaching Science, and how these factors affected how they adopted or adapted the curriculum innovation. Hattie (2003) emphasises the role teachers play in learner achievement when he says, "It is what teachers know, do and care about which is very powerful in the learning equation" (p. 3). He claims, "Teachers have the power" (Hattie, 2003, p. 3).

A study by Liu and Lederman (2007) on prospective teachers' worldviews and conceptions of the nature of Science, found that "people with different worldviews are likely to have different understandings about the nature of science" (p. 1300). Bayraktar (2009) concurs and cautions that teachers, just like their learners, have alternative conceptions of phenomena. It is important that these conceptions are not passed on to the learners and that they are elicited and discussed for accuracy, relevance and implementation. Hence, each teacher's interpretation of the curriculum and consequently their understanding of Science may be heavily influenced by their worldview. Having one curriculum for teachers having different worldviews to follow implies that the curriculum may be interpreted in a variety of different ways. This needs to be taken into consideration when curriculum developers develop new curricula and expect teachers to teach without adequate training. Failure to do so may result in the curriculum perceived in many different ways depending on teachers' worldviews. The consequence of this will be that learners are taught different versions depending on the teachers' interpretation of the curriculum.

From the above discussion, it is evident that the way in which one approaches the world, influences one's knowledge, ideas, identity, practice or environment and community (Sessums, 2006, p. 263). The context in which learning takes place has to be considered as well as the way in which it influences the learning process. Doing this is crucial to facilitate comprehension on how teachers think and learn as well as how this influences their classroom practice (Sessums, 2006, p. 265). Consequently, investigating the associations between teacher thinking and teacher practice in context is central to understanding teacher knowledge.

2.4.1.3 Teaching Science

Teachers' science knowledge is framed by their views on the nature of Science and their experiences with Science. Both the way that they were taught as well as the manner in which they studied Science contributes to their knowledge of Science. Teachers' negative attitudes more often than not stems from negative experiences they had through their own education which continue throughout their pre-service teacher training (Palmer, 2001; Tosun, 2000; Young & Kellogg, 1993). Mellado et al, (2008) concur, "Prospective teachers have beliefs, attitudes, and emotions about themselves, towards their learners, and towards the teaching and learning of their different subjects which are the result of the many years they themselves spent in school and which may influence their future teaching" (p. 41). Teaching and learning in a classroom are influenced both by what occurs in the classroom and by factors outside the classroom. Similarly learners' learning is influenced by sociocultural factors and so is the learning of teachers.

Teachers' content knowledge can also affect their confidence levels. Foundation phase teachers may lack confidence in their abilities to teach Science because of incomplete content knowledge (Akerson & Flaningan, 2000; Borko, 1993; Smith & Neale, 1989). Those lacking confidence tend to engage in avoidance behaviour, such as not teaching Science at all or teaching a version of Science that more closely resembles such subjects as language and social studies (Appleton, 2008). This is confirmed in the action research study conducted by Waters-Adams (2006) with four English primary teachers' understanding of the nature of Science and their practice. Teachers reported that they acknowledged the success of their science teaching only when they felt confident in it.

Research involving teachers of older children revealed that the less the teacher knows the more often discussions with the children will be dominated by the teacher (Carlsen, 1991). The result is that children are given fewer opportunities to interact. A reason for this is that the less competent the teacher, the more difficult it is for him/her to follow the child's lead and explore topics by asking the right questions, initiating the appropriate activities or directing the line of inquiry with confidence (Carlsen, 1991). Planning becomes inadequate and defined by what the teacher knows rather than a meeting of knowledge between teacher and learner. Children bring a series of understandings and interests into the early childhood setting that needs to be identified by the teacher in order for appropriate planning to occur. Approaching the curriculum in this way becomes more difficult for the teacher with a limited subject content base (Driver, Guesne & Tiberghien, 1985).

The purpose of Sherman and MacDonald's (2007) study was to describe the experiences of pre-service teachers who participated in a ten-week teaching module in Canada. They found that in addition to having limited content knowledge in Science, many of the pre-service teachers had a wariness about the teaching of Science, believing they do not have the content knowledge needed even to teach lower grades. One of the greatest challenges they had to overcome was the teachers' attitude towards what constitutes appropriate science teaching. Poor experiences with Science and/or a general lack of engaging science experiences, affects the perception that each pre-service teacher has about her/his own science teaching. Waters-Adams (2006) concurs that what a teacher knows will influence what he or she does in the classroom and suggests that to improve teacher effectiveness is to ensure that teachers have the "right" knowledge (p. 919). Previous science experiences are very influential on pre-service teachers' abilities to be confident in the teaching of Science. This suggests that the provision of typical science experiences within the context of pedagogy will help pre-service teachers develop an understanding from the perspective of a learner of Science and as well as a teacher of Science. Van Aalderen-Smeets, Van Der Molen and Asma (2012) reiterate that it is critical for "foundation phase teachers to extend their own positive attitudes towards Science if continuous progress in primary Science Education is to be attained" (p. 161).

It seems that the strategies teachers use to teach Science in the Foundation Phase is as important as having the content knowledge. Yilmaz-Tuzun (2008) elaborates, "Teachers content knowledge can influence what they teach as well as how they teach." (p. 188). In a large scale study conducted by Rennie, Goodrum, and Hackling (2001) that investigated the quality of teaching and learning in Science in Australian schools, it was found that the minority of teachers who feel confident with Science seem to teach it frequently and attempt to use teaching strategies consistent with recent science curricula. It has been reported that "teachers who lack content knowledge often resort to lecture instead of using learner centred teaching techniques that produce real student understanding" (Grossman, Wilson & Shulman, 1989, p. 27). Research has also revealed that teachers with high self-efficacy employ an assortment of teaching strategies (Koray, 2003; Riggs & Enochs, 1990). It was realised that teachers inability to teach Science in a practical hands-on manner was due to the "teacher's lack of understanding of science concepts and processes" (Muwanga-Zake, 2000, p. 1). Teachers develop teaching materials making an allowance for individual differences and expand their teaching knowledge and experiences (Brand & Wilkins, 2007; Pajares, 1992; Smylie, 1988 as cited in Pajares, 1996). Martin (2006) found that this situation affects learners' achievement and motivation significantly. Yilmaz-Tuzun (2008) concludes from his study with pre-service teachers from three different United States universities that if "teachers knew the content well it will be easier for them to choose the appropriate pedagogical activities and teaching methods" (p. 197).

A study by Cho, Kim and Choi (2003) with ECD teachers on teachers' attitudes to science teaching, found that these teachers were of the view that "science teaching in early childhood education usually does not require much content knowledge of science." They appear to agree with this view: "What early childhood teachers need is not the knowledge but rather practical approaches that correspond to young children's characteristics" (p. 39). This finding is in contradiction to most research regarding the science content knowledge teachers need to be able to teach Science. This is a study of ECD learners and perhaps teachers with limited science knowledge think they can manage in this phase.

Shulman (1986) as well as Clandinin and Connelly (1995) recognise the different types of knowledge that teachers require: content knowledge, pedagogical content knowledge, knowledge of aims and purposes, knowledge of learners and knowledge of educational context, settings and governance. Shulman (1986) describes 'pedagogical content knowledge' as teachers trying to use a range of pedagogical strategies to transform their knowledge of the subject content into a form that can easily understood by learners. (p. 7). Park and Oliver's (2008) study indicate that pedagogical content knowledge is developed "through reflection-in-action and reflection-on-action within instructional contexts" (p. 262). Pedagogical content knowledge has also been described as the knowledge used to "transform subject matter content into forms more comprehensible to learners" (Grossman, 1990; Shulman, 1987). To attain this, Shulman (1987) suggests there needs to be a remarkable change in teachers' understanding "from being able to comprehend subject matter for themselves to becoming able to elucidate subject matter in new ways, so that it can be grasped by learners" (p. 13).

Barnett and Hodson (2000) make use of Clandinin and Connelly's (1995) image of knowledge as a backdrop to proposition a model called 'pedagogical content knowledge', which expands on the four types of knowledge that teachers make use of in their classroom practice. Firstly, academic and research knowledge comprise science content knowledge which includes concepts, facts and theories, knowledge about the nature of Science and the relationships among Science, technology, society and environment; knowledge about how and why learners learn. Secondly, pedagogical content knowledge consists of knowing how to design lesson outcomes and be able to systematise the progression of lessons to meet these outcomes by relating them to the learners' prior knowledge. Thirdly, professional knowledge involves the teacher consciously or unconsciously drawing on their knowledge of teaching. Fourthly, classroom knowledge is context driven and focuses on the teacher having knowledge about his or her own classroom and learners (Barnett & Hodson, 2000). A noteworthy feature highlighted here is that teaching is a multifaceted and delicate activity that necessitates numerous types of knowledge.

Appleton's (2003, 2008) claim that primary school teachers are normally hesitant to teach Science is confirmed by Tytler (2007). Further research provides two reasons for this: limited knowledge of science content as well as a limited science pedagogical content knowledge (Appleton, 2008; Appleton, 2003 Scholtz, Watson & Amosun, 2004; Sherman & MacDonald, 2007). Garbett (2003) concurs that early childhood student teachers' subject knowledge in Science was poor. From her research with early childhood student teachers in New Zealand it emerged that the teachers were unaware of how little they knew and how this might affect their ability to provide appropriate science experiences for young children. Teachers' subject knowledge impacts on their pedagogical content knowledge. This in turn affects their ability to make new ideas and understandings accessible to young learners. The depth of subject content knowledge can affect the ability of the teacher to ask meaningful and appropriate questions.

The teacher's pedagogic style may be influenced by the school's working environment, expectations of the school management and principal and the wider social setting of the school as part of the local education authority, which has its own priorities. These expectations are heavily influenced by policies at a national level, which in South Africa are intended to initiate a transformation of the education system. Teachers bring to this setting their own particular biographies: experience both in and out of school and in and out of educational training. As a result, of the interaction of these factors, teachers develop a range of teaching strategies adapted to the particular environments in which they teach (Scholtz, Watson & Amosun, 2004). Their research shows that rather than adopting a new curriculum or pedagogic strategy, teachers often adapt the strategy in response to an interaction between the new curriculum or pedagogic strategy and the situation in which they work.

Appleton's (2008) study of a professional development programme in Australia revealed that primary school teachers work with pedagogical content knowledge in different ways when compared to secondary school teachers. Primary school science teachers usually start with the idea that Science should be activity based and work from specific activity ideas. He goes on to further explain that it is not surprising that the majority of primary school teachers tend to have limited knowledge in both science content knowledge and in science pedagogical content knowledge, given that few primary school teachers are science discipline specialists. Teachers' limited knowledge of science content has attributed to the teachers' low confidence and low self-efficacy in teaching Science.

Van Driel, De Jong and Verloop (2001) and Veal, Kubasko and Fullagar (2002) examined the development of pedagogical content knowledge in teachers. Their findings correspond with the suggestion by other researchers that development of pedagogical content knowledge depends largely on teachers' subject matter knowledge. In the South African context, the pedagogical content knowledge required by teachers teaching Science would pertain to knowing how to teach scientific investigations in the foundation phase classroom. Only then would this meet the expectations of the Learning Outcome stipulated by the RNCS for this phase.

Research indicates that, "Teachers with strong knowledge of their disciplines and strong pedagogical practices are more capable of using curriculum materials effectively" (Cohen, Raudenbush & Ball, 2003, p. 125). Chinn and Malhotra (2002) claim that teachers who are trained as scientists tend to teach Science more effectively. This is because they give explanations that are comparable to aspects of scientific inquiry. However, Sevian and Gonsalves (2008) argue, "Scientists are more effective at explaining Science if they have training in pedagogy" (p. 1442).

A limitation that grade R teachers have according to Linington, Excell and Murris (2011) is that some of them are not competent to teach in the Foundation Phase, they are challenged due to having no training in foundation phase practices. This, combined with teachers' limited understanding of the curriculum lead teachers to display a dominant role in the teaching and learning process. Walker (1989) maintains that the way teachers teach correlates with their own school experiences. According to her, this is prevalent with African teachers as they enact teacher behaviour as they have experienced it. This behaviour is based on "teacher-talk, drill, practice, and rote learning" (p. 20). Studies report that when new content areas were introduced to the curriculum, teachers frequently experienced insecurity about their content knowledge (Henze, Van Driel &Verloop, 2008; Lee & Luft, 2008).

2.4.1.4 The Foundation Phase Teacher in the South African context

The Department of Education (2002a) maintains, "All teachers and other educators are key contributors to the transformation of education in South Africa" (p. 3). In addition to being "qualified, competent, dedicated and caring," teachers are also expected to accomplish the different roles defined in the Norms and Standards for Educators. The basis of this policy is the seven roles for educators and their accompanying competences. The seven roles include teachers as "being mediators of learning, interpreters and designers of Learning Programmes and materials, leaders, administrators and managers, scholars, researchers and lifelong learners, community members, citizens and pastors, assessors and Learning Area or Phase specialists" (Norms and Standards Educators, 2000, p. 30). A brief discussion on the competencies for each of the norms will be presented as it pertains to the South African teacher.

The educator, as a learning mediator considers the varied needs of learners in a caring and responsive way. The educator displays "sound knowledge of subject content and various principles, strategies and resources appropriate to teaching in a South African context" (Norms and Standards, 2000, p. 12). The educator, as interpreter and designer of learning programmes and materials chooses orders and arranges the knowledge that is going to be taught in a way that considers the special requirements of the learnings areas as well as the learners. As a leader, administrator and manager, the educator is equipped to make decisions as is fitting to perform the responsibilities professionally and competently. As a scholar, researcher and lifelong learner, the educator is expected to pursue further studies and research to increase their academic, personal and professional knowledge. For the community, citizenship and pastoral role, the educator is expected to "uphold the constitution and promote democratic values and practices in schools and society" (Norms and Standards, 2000, p.13).

The educator needs to be capable of establishing a compassionate and empowering situation for the learners. As an assessor, the educator understands that assessment, both formative and summative is a key component of teaching and learning. The educator will be able to interpret the results to inform and enhance teaching and learning. As a learning area/subject/discipline/phase specialist, the educator will be "well grounded in the knowledge, skills, values, principles, methods, and procedures relevant to the discipline, subject, learning area, phase of study, or professional or occupational practice" (Norms and Standards, 2000, p. 13). The Norms and Standards (2000) advocates that the competencies must not be seen as static and should be structured and developed in various ways.

De Witt (2007) emphasises the point that teachers play a pivotal role in raising the standard of literacy in schools. She conducted her research in five provinces in South Africa - Gauteng, Western Cape, KwaZulu-Natal, Limpopo and Mpumalanga. Her concluding remarks were that intervention programmes needed to be put in place to address the teachers' lack of understanding of children in the Foundation Phase. These intervention programmes were to focus on enhancing the teachers' knowledge and understandings of young children and their specific needs, as well as knowledge and understandings of the relevant methodical approaches and implications for teaching. It was expected that teachers' knowledge and understanding of the essential components of pedagogy would lead to an improvement in the quality of teacher engagement and hence of learner achievement.

The foundation phase teacher in South Africa experiences similar challenges as their counterparts all over the world. In South Africa, the foundation phase teacher has to be a generalist as he/she is expected to teach all learning areas and have in-depth knowledge of children and their development stages.

2.4.2 The Foundation Phase Learner

Many studies have recognised the relationship between low socio-economic conditions and learners' academic performance (Dahl & Lochner, 2005; Gershoff, Aber, & Raver, 2003; Hartas, 2011; Mayer, 2002). Findings from research have suggested that as a family's earnings escalate there is an affirmative influence on the learner (Costello, Compton, Keeler, & Angold, 2003; Gershoff et al., 2007; Morris & Gennetian, 2003).

There is a strong correlation between the time and money parents spend on children and their academic performance (Gershoff et al., 2007). This is not necessarily so with direct parental support. For example, parents' support with learners' homework does not necessarily stimulate the learners' general academic progress (Dickinson & Tabors, 2001). Studies conducted by Cooper, Lindsay and Nye (2000) with families from a wide-range of backgrounds showed that parents assist their child with homework when they experience academic difficulty in school.

A study by Reynolds, Mavrogenes, Bezruczko and Hagemann (2008) revealed that children's reading and Mathematics attainment at age twelve was higher if they had parental support between the ages three and four. The research conducted by Martlew, Ellis, Stephen and Ellis (2010) on active learning reported that learners from socio-economically advantaged homes had more 'talk experiences' than learners from less advantaged homes. Talk experiences are opportunities for learners to discuss what happened at home or at school. They recommend that relevant stakeholders take consideration of this when preparing and implementing innovative curriculum reforms so that suitable provision can be provided to those learners' that require it the most (Martlew et al., 2010). It is more challenging to teach learners in the Foundation Phase who do not have the support from their parents as it requires greater effort from the teacher.

Although characteristics such as socio-economic background, ethnic background or sex influences learners' participation in science lessons, Andrée (2012) argues that to understand learners' participation in science lessons the activities that learners are engaged in needs to be analysed. Brophy (1986) established, "Achievement is influenced by the amount of time that students spend engaged in appropriate academic tasks" (p. 1079). Learners need to be actively involved in the teaching and learning process. Andree's study considered how changing the circumstances of classroom activities could increase learners' participation in science learning. Johnston (2005) maintains, "The more child-centred, exploratory experiences children have the greater their scientific development is likely to be" (p. 3). According to Brophy (1986), learners gain knowledge more effectively when their teachers initially organise new information for them and help connect it to their prior knowledge, along with supervising their performance and supplying remedial advice. He maintains that the accomplishment of superior level learning objectives is not easy to attain through discovery learning. Instead, it will require considerable teaching by an experienced teacher, "following thorough mastery of basic knowledge and skills that must be integrated and applied in the process of higher-level performance" (Brophy, 1986, p. 1076).

Charlesworth and Lind (1995) describe precise learning practices with young children as "naturalistic (or spontaneous), informal, or structured" (p. 22). These involvements vary with respect to the person guiding the experience, which could be the teacher or the learner. Naturalistic experiences are those in which the "child controls choice and action" (Charlesworth & Lind 1995, p. 23). Naturalistic experiences are instinctively instigated, as learners are involved in the world around them. According to Charlesworth and Lind, naturalistic experiences are a main method of learning for young children and consequently are appropriate as a way of "defining the learner-controlled science process skill experiences" (1999, p. 23). Learning Outcome One in Natural Science affords the teacher the opportunity to incorporate these learning experiences into scientific investigations.

The function of the teacher in a naturalistic experience is to afford abundant and diverse activities, which relate to the learners' investigations and to do so with encouragement. In informal experiences, the learner selects the activity and action, but the teacher intercedes at a certain stage. Informal experiences are when the learner and teacher "share control of the learning activity" (Charlesworth & Lind, 1995, p. 24). These cooperative communications are impulsive and may transpire after the learner reaches out to the teacher for involvement or once the teacher detects an occasion to support or work in an appropriate concept. The role of the teacher in an informal experience is to observe the learner's experience and choose at what time they ought to give their encouragement to change or improve a learning experience.

The Teacher's Guide for the development of the foundation phase learning programmes provides a detailed description of the characteristics of learners in the Foundation Phase. Since the different aspects of development i.e. physical, emotional and intellectual are not synchronised, this needs to be considered when planning the teaching and learning for children in this phase (Department of Education, 2003a, p. 19). Learning needs to be structured so that it is age appropriate and at the correct level to ensure successful learning takes place. Each learner works at his or her own pace and needs to be allowed time to complete tasks set. Moreover, their attention span is limited and hence they find it difficult to remain quiet for a length of time. Learning that is targeted at a level too low or much higher than their capability could lead to discipline problems (Andrée, 2012). Learners in this phase have a natural curiosity to learn and they come to class with their own prior knowledge, even though it is limited and are enthusiastic about learning (Department of Education, 2003a). In keeping with this, Hattie (2003) declares that what learners bring to the class plays a "very important part in determining the learners' success" (p. 2). Victor and Kellough (2000) concur that teachers not only need to promulgate learners' natural curiosity but they need to find ways to preserve and nurture it so that effective teaching can take place. The main characteristic of the foundation phase learner is their natural curiosity, which provides a platform for teaching and learning to occur.

Throughout the primary years of schooling, learners are enthusiastically involved in attaining essential concepts in addition to gaining essential process skills. Children discover the world with their senses by looking, touching, smelling, hearing, and tasting. They are instinctively inquisitive and want to identify everything in their environment. Johnston (2005) maintains that children should be permitted and stimulated to physically collaborate with their surroundings and discover scientific phenomena. As children grow and are able to move around on their own they become unrestricted to learn further on their own and start to reason for themselves. They start to create ideas and thoughts all through the primary school phase. In addition, children improve the procedures and practices, which allows them to exercise their recently attained ideas, develop current ideas and develop innovative ideas. When children arrive in the Foundation Phase from grade R to Grade Three, they apply their initial, elementary ideas while discovering additional abstract investigations and concepts in Science (Charlesworth & Lind 1995). The learners continue to investigate and explore as the initial stage in understanding the new situation in which they find themselves. They do this by applying fundamental concepts and process skills such as collecting and organising data to respond to a query. Research reported by Lederman, Bartels, Lederman, and Gnanakkan, (2014) with first-grade learners revealed that science teaching and learning must start at an early age to ensure that scientifically knowledgeable people are developed (p. 45). Their study showed that young learners are able to develop an understanding of the nature of Science. The foundation phase teacher should take cognisance of this when planning the teaching and learning experiences for their learners.

2.5 FACTORS THAT MAY INFLUENCE IMPLEMENTATION OF A CURRICULUM

Numerous factors influence the way a curriculum is delivered. Factors that may influence the implementation of curricula in developing countries are elaborated on in this section. Factors included in this discussion are the physical resources required for teaching Natural Science, school ethos, school management, assessment in the Foundation Phase, language and Science, learner support, professional development and the nature of classroom interaction. Due to the dearth of literature on teaching and learning science in the Foundation Phase, my discussion will include literature on general science teaching and learning.

2.5.1 Physical Resources in the Teaching of Natural Science

Learners in the Foundation Phase are understood to be motivated to learn using concrete resources. Therefore, it is essential that resources are made available in the Foundation Phase. Some reasons given for the marginalisation of Science in schools are school contextual factors, such as limited resources for teaching Science and perceived priorities in primary schooling afforded to other subjects compared to Science (Appleton, 2003). These reasons are also inherent in South Africa's education system. Research concurs that other obstacles that inhibit the teacher to implement transformation are the lack of support, funds, and materials (Anderson and Helms, 2001; Johnson, 2006).

Science has to be taught through doing (Lederman & Antink, 2013; Mudulia, 2012; Osbourne, 2002). To be able to 'do' Science, resources are required. There is a compelling underlying association between leaners' achievements and a well-resourced school (Arendse, 2011). Mudulia's (2012) study in Kenya found that having sufficient resources enhances a school's achievements. The Department of Basic Education (2011) endorses this view by acknowledging that an improvement in resources should improve the educational outputs as manifested in the performance of learners.

A survey carried out by Muwanga- Zake (2000) to identify the problems teachers encountered when teaching Science revealed that one of the reasons teachers did not teach Science was because they did not have the necessary equipment. Although teachers insisted on having science equipment, there was proof of equipment remaining unused, as teachers did not know how to use it. The issue it seems is that there is no support for teachers teaching Science and using resources to do so.

Fitzgerald and Schneider (2003) carried out research with three primary science teachers to determine the support that teachers need to execute science teaching in the foundation phase classroom. Part of their findings indicate that teachers require support with resources. All three participants used a variety of resources to support their science teaching. While they believed that resources could be an enabling factor for the teaching of Science, it could also be an inhibiting factor if it was difficult to find relevant resources or if difficulties were encountered with technological aspects or the management of the resource (Fitzgerald & Schneider 2013). According to Fitzgerald and Schneider (2003), complicated equipment is not essential to the teaching of Science in primary schools in order to facilitate significant and valuable learning. Another option would be to obtain resources from learners themselves.

Researchers maintain that a number of schools in South Africa have been ineffective in executing the curriculum due to state resources being inadequate to bring all schools up to the standards that were enjoyed by former Model C schools prior to 1994 (Todd & Mason, 2005; Vambe, 2005; Van Deventer, 2009; Whitaker & Whitaker, 1995). Whitaker and Whitaker (1995) maintain that the implementation of curriculum policy fails because of the lack of management capacity and the scarcity of resources.

The deficiency in resources and the restrictions it enforces on what can be taught is more evident in Science Education than it is with other learning areas such as Mathematics and Languages (Johnson, Hodges & Monk, 2000). The reason cited is that "scientific study of the natural world requires instrumentation as well as conceptualisation" (Johnson, Hodges & Monk, 2000, p. 181). Accessing the natural world and its properties is problematic. They go on to say, "Without equipment, chemicals and specimens, an investigative approach to Science found in school textbooks and national examinations becomes very difficult, if not impossible" (2000, p. 181). Although resources are necessary, the teaching of Science in the Foundation Phase is not dependent on laboratories and sophisticated equipment.

According to Muwanga-Zake (2000), learners are not familiar with science equipment. He carried out trials where learners interrogate the actual science equipment used instead of learning the concepts the equipment was supposed to elucidate. This practice drew attention to the unfamiliar nature of Science and science equipment in schools, and the issues in using equipment that is complex and strange to learners. Learners are seldom given an opportunity to familiarise themselves with the equipment prior to its use as a teaching tool.

Textbooks for Science in the Foundation Phase in South Africa are scarce if non-existent. There appears to be an entrenched practice in other countries as well regarding textbooks for primary schools as preference is given to "texts like short fairy tales, animal tales and descriptive texts about children's everyday activities" (Vaik-Luga, 2013 as cited in Müürsepp, 2013, p. 81). In the South African context, the only books learners receive in the Foundation Phase are workbooks. Müürsepp (2013) mentions that many first grade learners are technologically advanced and this needs to be taken into consideration when planning as traditional methods may not be relevant to the present-day learner. The results of this study concluded that textbook authors should use more modern-day language, known by the children from their daily life. The findings are also important for teacher education to prepare the beginner teachers to manage in a dynamic educational environment (Müürsepp, 2013).

Physical space is an essential aspect in assisting and improving science teaching in the Foundation Phase (Fitzgerald & Schneider, 2013). These authors showed that the importance teachers ascribed to space and how it affects science teaching was different for different teachers. One teacher believed, "the single most important way that Science could be improved in her school would be through the provision of a dedicated science room" (2013, p. 9). Another teacher believed that, "rather than using a lack of dedicated space as a barrier to teaching Science, to instead think more broadly about how school spaces could be utilised." (Fitzgerald & Schneider, 2013, p. 9).

Although teaching Science in the Foundation Phase does not require valuable and complex material and equipment, there certainly is a need for some resources so that teachers may give learners the opportunity to 'do' Science. The important aspect is to make the lesson relevant and interesting to the leaners. Typical resources used in the Foundation Phase when teaching Science include household items and the natural environment. Learners can easily relate to common everyday items and the environment and thus be interested in Science. In addition, teachers are familiar with the household items and would not find it challenging to use. An elaborate science laboratory is not critical to the teaching and learning of Science in the Foundation Phase. However, some schools do not have the basic necessities such as electricity and water to enable teachers to teach Science in a practical hands-on way.

2.5.2 School Ethos

Although research shows that the school ethos and environment contribute to the accomplishment of teaching Science effectively, Hattie (2003) is of the view that the school itself hardly makes a difference to learner achievement. MacDonald and Rogan (1988) disagreed when they said, "Some school environments demotivate learning" (p. 226). According to them, "School environments that could be demotivating include poor physical structures such as dilapidated buildings, environments devoid of examples of school science, and lack of facilities such as science equipment, laboratories and libraries, particularly in rural schools" (MacDonald & Rogan, 1988, p. 226). Curriculum implementation, due to its nature relies on the contribution and support of the whole school community.

Authentic upgrading in schools need to make provision to allow teachers to be lifelong learners. To do this the school has to be dedicated to enhancing the professional development of their staff. Following this, opportunities need to be created for teachers to be "involved in other things without leaving the teaching profession" (Eisner, 2000, p. 349). It is suggested that teachers could during this time mentor other teachers, be involved in curriculum planning, develop innovative assessment and evaluation techniques, be involved in community activities (Eisner, 2000). By doing this and changing the scenery, teachers have the space and time to develop in other areas and can come back to teaching with renewed vigour.

The role of schools is to encourage successful learning by ensuring a conducive and accommodating learning environment within which learners experience being accepted and appreciated. In addition, the curriculum and teaching approaches need to compliment learners' educational preparedness, and educators need to appreciate the individuality of every learner. Education support services should be reinforced and positioned at the heart of teaching and learning to ensure learner success (Department of Education, 2001).

2.5.3 School Management

Within whole school development contexts, all planning and management should be a collaborative effort that involves all role players in a context in which the curriculum plays a central role. The school management has to ensure that the school's infrastructure and resources are well-maintained to support teaching and learning. In addition, the school management is responsible for the professional development of their teachers to keep them abreast of curriculum innovation and of new developments in teaching and learning. In the study conducted in Australia by Fitzgerald and Schneider (2013), one of the teachers alluded to the importance of having strong leadership. He believed, from his experience, that if you do not have strong leadership Science would be overlooked. Furthermore, it now needs to be integrated and not timetabled separately as Science.

As Grade R is a relatively new addition to the primary school in South Africa my experience has shown that principal and head of department often have very little experience of the Grade R environment. This has led to concerns that school managers are unfamiliar with the type of activities in which such young learners engage. However, encouraging results from a survey conducted by Nabors (1999) showed that the majority of primary school principals did not object to learners participating in hands-on science activities. Such activities would result in learners spending time outside the classroom and the support of principals in this regard is essential.

The quality of a school largely depends on the quality of the teaching staff, which includes their skills, knowledge, attitude and commitment. According to the Ministry of Education and Sports of Uganda, "Professional development is the continuous process by which teachers develop their capabilities" (nd. p. 67). School managers play an important role in assisting to maintain an ethos that is supportive of professional development where teachers are able to expand their skills. Teachers can improve their skills by not only attending professional development training sessions but also by observing others as well as through reflective practice.

It is the management's responsibility to ensure qualified foundation phase teachers are employed at their schools. The Editorial in Business day (16 January 2014) reported that sourcing qualified grade R teachers is challenging as a minimal number of grade R teachers qualify every year. The reasons could be attributed to grade R teachers earning less than other teachers do and enjoying a lower status than other teachers. Schools are forced to employ unqualified or underqualified teachers to teach Grade R. These teachers require additional support and mentoring.

2.5.4 Assessment in the Foundation Phase

The study of DeLuca and Hughes (2014) revealed that even though primary school teachers' backgrounds and contexts may vary, they had a shared "mutual approach to assessment in the early years" (p. 455). The common assessment strategies implemented by the teachers included learner-centred assessments, assessing through observations and assessing knowledge and skills. The assumption was that assessments should merge into the teaching and learning processes effortlessly (DeLuca & Hughes, 2014). Gullo and Hughes (2011) agree that assessment should be continuous and integrated in the primary school. According to them two essential concepts formed the basis of primary school teachers' approach to assessment. Firstly, the teachers endorsed "a whole-child teaching approach "and secondly they "engaged in a continuous practice of student observation" (DeLuca & Hughes, 2014, p.456).

Assessment is an important part of teaching and learning and should be incorporated at all stages of planning (Department of Education, 2011). Assessment is essential when making decisions that could impact on a learner's advancement and as such ought to be seen as an important exercise, which occurs logically in the teaching and learning process. This implies that assessment for learners in Grades R-Three should be ongoing to ensure that their development may be monitored.

Assessment in the Foundation Phase is continuous and is concerned with the holistic evaluation of learners. The teacher assesses the learner on a regular basis while normal teaching and learning occur. Assessment of Life Skills in the Foundation Phase is mainly formative and is “largely informal, and is on-going” (Department of Education, 2011, p. 67). According to Looney (2010), formative assessment means that the assessment is done frequently to ascertain the learners’ needs and inform teaching. A few forms of assessment are appropriate for learners in the Foundation Phase. These include observations, written or recorded activities and performance based activities. Teachers in the Foundation Phase are continuously observing learners’ participation in individual, pair and group activities to ascertain how well they grasp certain concepts and how their development progresses.

2.5.5 Language and Science

Researchers concur that Science is prejudiced against culture, and in particular, language (Atwater, 1996; Henderson and Wellington, 1998; Moje, 1995; Ogunniyi, 1996). According to Atwater, “Traditional science teachers view Science as being independent of mind or social context” (1996, p. 828). On the other hand, Osborne maintains, "A core feature of Science is that it is a cultural activity undertaken through the medium of language"(2002, p. 204).

Currently, a major obstacle to the learning of Science is the failure to recognise that language is a central activity to Science. Henderson and Wellington (1998) maintain that for the majority of learners, the main impediment to learning Science is language (p. 35). According to Muwanga-Zake, “The problem is that like many other African countries, South Africa has developed science curricula and content along Western trends and Science is taught mainly in English or Afrikaans”. He explains that the majority of learners who do not understand tend to “resort to memorising” (2000, p. 7). Furthermore, African learners experience added inconvenience, as there is no “direct translation of certain concepts in the vernacular” (Muwanga-Zake, 2000, p. 7). The difficulties that teachers and learners experience with language in Science contributes to Science being seen as a difficult subject to teach and learn and thus tends to be avoided.

It is crucial that learners become literate in Science, that is, be able to talk, read and write Science at the age appropriate level. Having said that, learners in Grade R will not be able to do this at the same level as learners in Grade One, Two and Three. Postman and Weingartner (1971) as quoted in Osborne (2002) also emphasise that “the key to understanding a subject is to understand its language” (p. 207). Therefore from a linguistic perspective, the central goal of Science Education should be to help learners use the languages of Science to construct and interpret meaning.

In South Africa, the problems of learning the language of Science are intensified by the fact that English is the medium of instruction and the second language of most learners. Löfgren, Schoultz, Hultman, and Björklund (2013) recognise that this may be a challenge for foundation phase teachers as the Science taught in primary school is descriptive. However, if the learners are expected to use scientific language then the teacher has to play a crucial role for the "quality of discussion and therefore also the quality of learning" (Löfgren et al., 2013, p. 485). This may be one of the reasons that the RNCS focuses on procedural Science (Learning Outcome One) and not descriptive Science. Morgan (2012) found that when scientific terminology was taught explicitly, the learning outcomes in Science improved (2012, p. 76). Therefore, teachers need to give learners the opportunity to read, discuss, argue, write and communicate if they are to understand the nature of scientific reasoning. Wickman and Östman explain learning as a "discourse change, a border crossing between everyday language and science language" (2002, p. 605).

Learners come to class being able to comprehend and converse in the language that was used at home. According to Brock-Utne (2012), to be able to learn it is important that learners comprehend what the teacher says. Lack of understanding what the teacher is saying could contribute to learners not performing well in the majority of classrooms in South Africa. According to the curriculum documents, learners' home languages should be used for learning and teaching, especially in the early years of learning (Department of Basic Education, 2010 p. 6). This is for the most part vital in the Foundation Phase, as learners ought to learn to read and write in their Home Language. Language in teaching and assessment is important, as it has to be planned wisely to ensure learners are able to make a smooth transition from their home language to an additional language (Department of Basic Education, 2010).

Evans and Cleghorn (2010) advocate that teachers have limited conversational knowledge in the language spoken by most of the learners in their classes. They believe that even a little functional knowledge contributes to cultivating "academic and social understanding in the classroom" (p. 36). In turn, this shows respect towards the learner and the home language. When the teacher uses both the language of instruction and the learners' home language to teach this enhances the teaching and learning experience for the learner and assists with classroom management. Many researchers (Brock-Utne, 2003; Cleghorn, 1992; Cummins, 2003; Eastman, 1992) view the use of both languages or code switching favourably.

2.5.6 Learner Support

Learner support is viewed as being more than classroom- based, it may be extended to creating supportive experiences for the learners. Material support is separated into two groups, “the provision of physical resources such as buildings, books, or apparatus on the one hand, and direct support to learners on the other” (Rogan, 2007, p. 100). The direct support to learners could include providing essential requirements like lunches and places to study, academic needs such as additional lessons, supplementing academic needs such as field trips and academic and personal support such as bursaries (Rogan and Aldous, 2005, p. 320).

Learner support has also been split into factors relating to the home and factors relating to the school. Factors relating to the home include “poor socioeconomic backgrounds of parents, inadequate housing and lack of parental support for education” (De Villiers, 1997, p. 79). Factors relating to the school include learning difficulties and under achievement, which may be linked to poor school management and inadequate staffing of schools (Mashau, 2000). De Villiers (1997) includes “uncommitted and poorly trained educators and other unprofessional behaviours of teachers to school related factors (p. 79).

Although fees are kept at a minimum in public schools in South Africa, many learners are unable to afford the school fees. Hence, schools rely on support from various stakeholders in the community. Support can take different forms and come from different sectors in the community. According to Muwanga-Zake (2000), “The government prefers ‘holistic’ interventions, which normally include school management, English, Mathematics, and Science.” He further explains, “Holistic approaches distribute funds and resources equally among these different fields” (p. 11). Science therefore does not take precedence in receiving more funding, in spite of the fact that equipment may be required to teach Science effectively.

In the study conducted by Bojuwoye, Moletsane, Sindiswa, Moolla, and Sylvester with Western Cape learners, they investigated the availability and use of support services for improving learning. Their study showed that learners received support in different ways from the school, teachers and their peers. This support helped in “meeting learners’ academic, social and emotional needs by addressing barriers to learning, creating conducive learning environments, enhancing learners’ self-esteem and improving learners’ academic performance” (Bojuwoye et al., 2014, p. 1). This is important “for building schools’ capacities to recognise and address several learning difficulties.” In addition, it “creates a conducive learning environment for effective teaching to enhance learners’ academic performance, social and psychological well-being” (Bojuwoye et al., 2014, p. 1). They advise that the support structures need to be cultivated and cherished by all the stakeholders in the education sector (Bojuwoye et al., 2014).

2.5.7 Professional Development

Ogunniyi (1996) declares, "No education system is higher than the level of the teacher." He elaborates that the standards in science classrooms may deteriorate due to the lack of appropriately qualified science teachers. In addition, he claims, "shortfall in practical skills and conceptual understanding are passed on from teacher to learner who then becomes a teacher - from one generation to the next." According to Ogunniyi, this cycle propagates incompetence, which can result in a "deterioration of standards over time" (p. 278).

In New Zealand, there has been concern regarding the inconsistent quality of science teaching. The reason for this has been attributed, amongst others, to the "relatively low levels of Science Education components in initial teacher education programmes" (Bartholomew, Anderson, & Moeed, 2012, p. 103). Their research showed that the teachers still had an optimistic perception of Science in the curriculum. The teachers' self-confidence in their capacity to teach Science and to apply learner-centred strategies increased (Bartholomew et al., 2012, p. 103).

A study conducted by Cochran-Smith and Lytle (2009) suggest that teachers need to be at the focal point of transformation for them to embrace change. Vetter (2012) further elaborates that for change or transformation to be long lasting, practitioners need to "redefine and reposition viewpoints and affiliations (p. 29). To be able to accomplish this, teachers need professional development with regard to the new knowledge before they can implement these changes in their classrooms. With the implementation of new curricula in South Africa, professional development opportunities for teachers were limited. This led to inadequately prepared teachers who, according to Cochran-Smith and Lytle (2009), struggled to implement the new curriculum in the manner that it was envisaged to by the curriculum developers.

In professional development literature, the classroom teacher is viewed as being the solution to improve education through effective professional development. According to Fetters, Czerniak, Fish, and Shawberry (2002), "Professional development literature helps shape and informs practice" (p.104). Professional development programmes need to be designed taking the context of the school into account so that the needs are addressed and teachers can take ownership (Fullan & Miles, 1992, p. 749). Each of the three key areas identified by Fullan and Miles (1992) needs to be considered in the South African context. The

Foundation Phase teachers in some South African schools are unqualified or underqualified. These teachers would benefit from professional development in identified areas of need, for example, the teaching of Natural Science. In my view, professional development for foundation phase teachers in South Africa is lacking, particularly with regard to science teaching in the Foundation Phase.

The findings from a study conducted by Scholtz, Watson and Amosun (2004), describes the changes in pedagogy of six Grade Six primary school teachers in the Western Cape, who were exposed to a training programme designed to develop science process skills in school learners. A wide range of factors, both physical and social, influence what teachers take from a programme of continuing professional development and how they use that in their own classrooms (Scholtz et al., 2004). Physical factors include class size, the size of rooms, and resourcing of the school in terms of paper, books and scientific equipment.

Studies endorse the fact that teachers are critical transformation agents in educational restructuring and that teachers' beliefs are predecessors to transformation (Ajzen & Fishbein, 1980; Battista, 1994; Crawley & Koballa, 1992; Desouza & Czernaik, 2003; Pajares, 1992). Using the assertion that teachers are a crucial transformation driving force, Haney and Lumpe (1995) examined literature on the subject of effective "teacher-based school change models and identified three phases of professional development: Planning, Training, and Follow-up" (p. 188).

All the stakeholders need to be part of the Planning Phase, which will involve initial decisions and implementation. The stakeholders are the teachers, principals and school community members (Fullan & Miles, 1992; Hirsh & Sparks, 1997). A key consideration is to ensure that an adequate number of teachers are trained to enable effective succession. Keller (1995) advises, "A critical mass of 80-90% of teachers per school would provide a needed peer support structure" (p. 12). During the planning of professional development teachers' beliefs concerning curriculum, teaching, learning and assessment must be acknowledged and elucidated (Battista, 1994; Haney, Czerniak, & Lumpe, 1996; Posnanski, 1997; Tobin, Tippins, & Gallard, 1994). This is important because beliefs are strongly linked to performance and action (Bandura, 1986; Bandura, 1997, Riggs & Enochs, 1990).

Teachers should be engaged in active learning strategies during the Training Phase. These learning strategies should be piloted in their own classrooms (McLaughlin, 1990; Etchberger & Shaw, 1992). Hunsacker and Johnston (1992) stress the need for reflective analysis, which is critical to enable adjustments to the programme being implemented (p. 365).

There needs to be “classroom support structures” in the Follow-up Phase. These structures should comprise of teachers who are leaders who provide “mentoring and peer coaching” (Hunsacker & Johnson, 1992; Shroyer, 1990). Ackland (1991) maintains that teacher leaders “should use non-evaluative, constructive feedback” (p. 25).

Reflective practice is an ideal mechanism to use if teachers in a school are experiencing similar problems. Singh and Singh (2012) maintain, “Teachers, especially pre-service teachers, are increasingly encouraged to engage in reflective practice in order to improve their teaching” (p. 171). In fact, they see reflective practice as a foundation of many teacher education programmes (Singh & Singh, 2012, p. 171). Teachers could try out innovative practices and then meet to reflect on them and decide what works best. Professional development could also be structured within the school to meet precise requirements of staff. Outside support could be included by bringing in people who have knowledge and skills to develop staff members. Three phases of professional development, planning, training, and follow-up is a phased approach to professional development involving all teachers and ensuring they take ownership. Foundation phase teachers will gain from this type of professional development.

According to Fetters et al. (2002), “The beliefs and dispositions that teachers and institute facilitators bring to the professional development experience shape how they make sense of, interpret, and implement the curriculum reform efforts” (p. 127). In relation to this, it is not easy for convenors of professional development programs to completely comprehend how teachers are interpreting the experience. Teacher reflections provide insight into how they are thinking about the change process (Fetters et al., 2002, p. 127). The key to any successful professional development regardless of what structure it takes is the offering of advice and feedback. Feedback should rather be directed at the lesson plan or the teaching method, as teachers need to be persuaded to continue with their professional development.

2.5.8 Nature of Classroom Interaction

In his study of pedagogy in American schools, Brophy (1986) showed that a positive classroom climate, together with a well-managed classroom, structured lessons and a range of different kinds of questioning had positive effects on learners’ achievement. He also suggested that the more involved teachers are in the teaching and learning process the greater will be the learners’ accomplishments (Brophy, 1986).

Hayes, Mills, Christie, and Lingaard (2006) acknowledge four dimensions of classroom practice that made a difference to learning. These are intellectual quality, supportive classroom environments, engagement with a difference, and connectedness to the world beyond the classroom. For the purposes of this study, I consider all these dimensions. With regard to intellectual quality, the section on the foundation phase teacher discusses this aspect pertaining to the teachers' knowledge.

In this dimension of supportive classroom environments there is mutual respect between the teacher and the learner. The learners are committed to pursue the acquisition of knowledge. The contribution by Hayes et al. (2006) is important in that it highlights the significance of social interaction between the teacher and learner in the context of teaching and learning. In this study, teaching Science involves an engagement with a difference as the teaching and learning involves teaching using inquiry-based methodologies. The connectedness to the world beyond the classroom alludes to the type of Science learners are exposed to in schools and their relevance to their world. The study conducted by Stears (2005) in Cape Town with regard to relevance in the science curriculum revealed that learners view relevance as that which incorporates aspects from their daily lives that would assist them in surviving in their context.

Classroom research is inclined to provide explanations of instructional methods. Many of the explanations distinguish between teacher-centred and learner-centred approaches. Notwithstanding this, Alexander (2001) maintains, "it is now generally accepted that cognitively demanding interaction is a fundamental condition for all successful teaching of young children, however it is organised" (p. 394). From the study conducted by Reeves and Muller (2005), the findings revealed that in South Africa it is more important to complete the curriculum as this had a positive effect on grade six learners' achievement in Mathematics than to involve learners in instructional methods that promote learner-centred instruction. It is my view that the manner in which we teach learners in the Foundation Phase is critical to their understanding. In addition, although teaching content knowledge is important, teachers have to take cognizance of the way foundation phase learners learn and incorporate these methods in their teaching. Hoadley (2012) is of the view that "research into pedagogy and its relation to subject-specific knowledge signal a deeper engagement in making sense of classrooms" (p. 198).

Although I have alluded to the notion of the time spent on teaching Natural Science in the foundation phase, I now present evidence from the literature regarding the nature of the time allocated to teaching and learning in the Foundation Phase classroom. It seems that the allocation of time to Science Education in the Foundation Phase is not adequate to meet the learning outcomes. Albion and Spence (2013) concur when they say, “Many teachers in Australian primary schools do not allocate Science Education sufficient amounts of time to achieve these outcomes” (p. 501). From the data, more than half of the 216 teachers reported spending less than an hour per week on Science. The researchers concluded, “Science is not receiving the recommended level of attention in the primary school curriculum” (p. 516|). The findings from Mudulia’s (2012) study revealed that besides advocating for more lessons for Science there was a need to ensure that the time was well spent on Science.

Research showed that the nature of teaching and learning in the Foundation Phase is extremely slow and usually at the pace of the slowest learner (Ensor et al., 2009; Hoadley, 2003; Schollar, 2008). The slow pace disadvantages the completion of the curriculum. The Educator Workload Project was commissioned by the Education Labour Relations Council (ELRC) and was based on a questionnaire-based survey and case studies. The results of the project revealed that teachers in the majority of schools spend considerably less time on teaching than required by policy (Chisholm et al., 2005). Some of the explanations to justify the decrease in teaching time included large class sizes, increase in teacher’s workload because of insufficient administrative support staff and the increase of administrative demands made on teachers (Chisholm et al., 2005).

2.6 CONCLUSION

In this chapter, I reviewed the literature pertaining to a large number of issues in education that either directly or indirectly affect teaching and learning of Science in the Foundation Phase. My review provides a coherent understanding of the viewpoints exhibited by key researchers in their fields. The chapter began by setting the scene on the structure of the literature review.

I present various significant aspects of the curriculum to gain an understanding of the complex nature of the curriculum. I discussed issues in Science Education from a global as well as local perspective. I incorporated expectations of Learning Outcome One into the discussion. I discussed the factors that affect teachers in the teaching and learning of Science in the Foundation Phase in depth. I considered the factors influencing learning in terms of what the curriculum documents envisage the learners at this phase should be capable of.

I then considered the factors influencing the implementation of the curriculum through various aspects. I discussed the physical resources as they pertain to the teaching of Science. The school ethos and school management were subsequently discussed.

I discussed aspects of culture and language as they directly influence the learners' ability to learn Science. I undertook an in-depth discussion on the type of professional development that could be brought to a school context to develop teachers and serve as a source of motivation. The most exceptional education policies themselves are not enough to guarantee that successful teaching and learning takes place.

The literature reviewed served to provide the framework against which my study was conducted. Moreover, it served to allude to some of the possible gaps that might have been present in the broad area of the teacher's role in curriculum implementation and more specifically the implementation of the Natural Science Curriculum, at the time the research study was undertaken. The literature reviewed suggests that teacher involvement in curriculum implementation is immersed in complexity and challenges and a further in-depth involvement with the issues surrounding it would be beneficial. The gaps in the literature were found to be considerable in the South African context and in particular to the Foundation Phase. In addition, research in the area of science teaching in the Foundation Phase in South Africa is lacking. This study intends to fill the gap by providing insight in the areas of the teacher's role in curriculum implementation in the Foundation Phase in South Africa.

In chapter three, I present the theoretical framework pertaining to my study.

CHAPTER THREE

THEORETICAL FRAMEWORK

3.1 INTRODUCTION

The focus of this study is on foundation phase teachers and how they interpret and implement the Natural Science Curriculum in the Life Skills Programme. In this chapter, I present the theoretical framework that frames this research. Curricula may be represented in various forms and defined in various ways. A common broad distinction is between the three levels of "intended", "implemented" and "attained" curriculum (Van den Akker, 2003). Molale (2004) maintains that the implementation of policy does not take place in a vacuum but is influenced by a number of factors.

Since 1994, the South African schooling situation has transformed greatly over the years. Several policies have been formulated which aimed at transforming education at all levels from pre-primary to tertiary. The main aim of most of these policies were to effect redress and equity with the critical goal of providing education for all. According to De Waal (2004), "One of the biggest problems facing the educational transformation process is the fact that there exists a gap between theory (policy) and practice (implementation)" (p. 5). This study focuses on the implemented curriculum as perceived by the curriculum users, i.e. the teachers at the operational level, i.e. the actual process of teaching and learning in the classroom. Foundation Phase teachers' interpretation and implementation of the Natural Science Curriculum in the Life Skills Learning Programme is investigated.

The theoretical framework draws on the work of Lev Vygotsky. Vygotsky (1978) proposed a cognitive theory of learning based on social constructivism. Vygotsky's theories stress the fundamental role of social interaction in the development of cognition (Vygotsky, 1978). Shabani, Khatib and Ebadi (2010) endorse Vygotsky's concept that learners learn best when working together with others during shared collaboration. Vygotsky believed that when children work with others to learn it leads them to use the knowledge and skills to gain independence. As with the case of the learner, a teacher too depends on social mediation to internalise change (Shabani et al., 2010). Therefore, the theory selected considers the teacher as a learner within the context of curriculum change.

Teachers' interpretation of the Life Skills Learning Programme could influence the way it is implemented at the foundation phase level. Factors that could influence teachers' understanding include teachers' backgrounds and experience, teachers' lack of content knowledge, the issue of unavailability of resources, large class sizes and teacher confidence. Rogan and Grayson (2003) are of the opinion, "In view of its potential to improve the quality of life, learning in the Natural Science must be made accessible to all South Africans" (p. 1171). This research considers teachers interpretation and their implementation of the Natural Science Curriculum in an attempt to explain their capacity to implement and innovate with regard to this curriculum.

3.2 A THEORY OF IMPLEMENTATION

I developed the theoretical framework for this study by adapting the theory of implementation proposed by Rogan and Grayson (2003). I used the theoretical framework as a guide to identify the factors that I needed to explore to gain an understanding on how teachers implemented the Natural Science Curriculum in the Life Skills Programme. The theoretical framework (Figure 3.1) explains the structure of the study. It guided the design of the instruments as well as the analysis of the data.

The Rogan and Grayson model has been modified in many ways. In this study the model is used for determining how individual teachers implement the curriculum whereas the original model by Rogan and Grayson considers the curriculum implementation for a school. This study uses the model for relating the way teachers interpreted the curriculum whereas the Rogan and Grayson model concentrated on the enacted and the implemented curriculum in the classroom. This study draws on data from the teachers as they are the focus of this study. The Rogan and Grayson model obtained the data from various sources, like school records. Since this study is focussed on the Foundation Phase, several descriptors of the constructs were adjusted to the foundation phase context. The context determined descriptors usually are defined by the researcher, whereas in this study the descriptors are defined at least in part on the basis of the data collected.

For each of the constructs in the theoretical framework, I identified factors that could possibly be responsible for teachers' interpretation and implementation of the curriculum. These factors were decided on as they pertain to the teachers in Foundation Phase within the South African context.

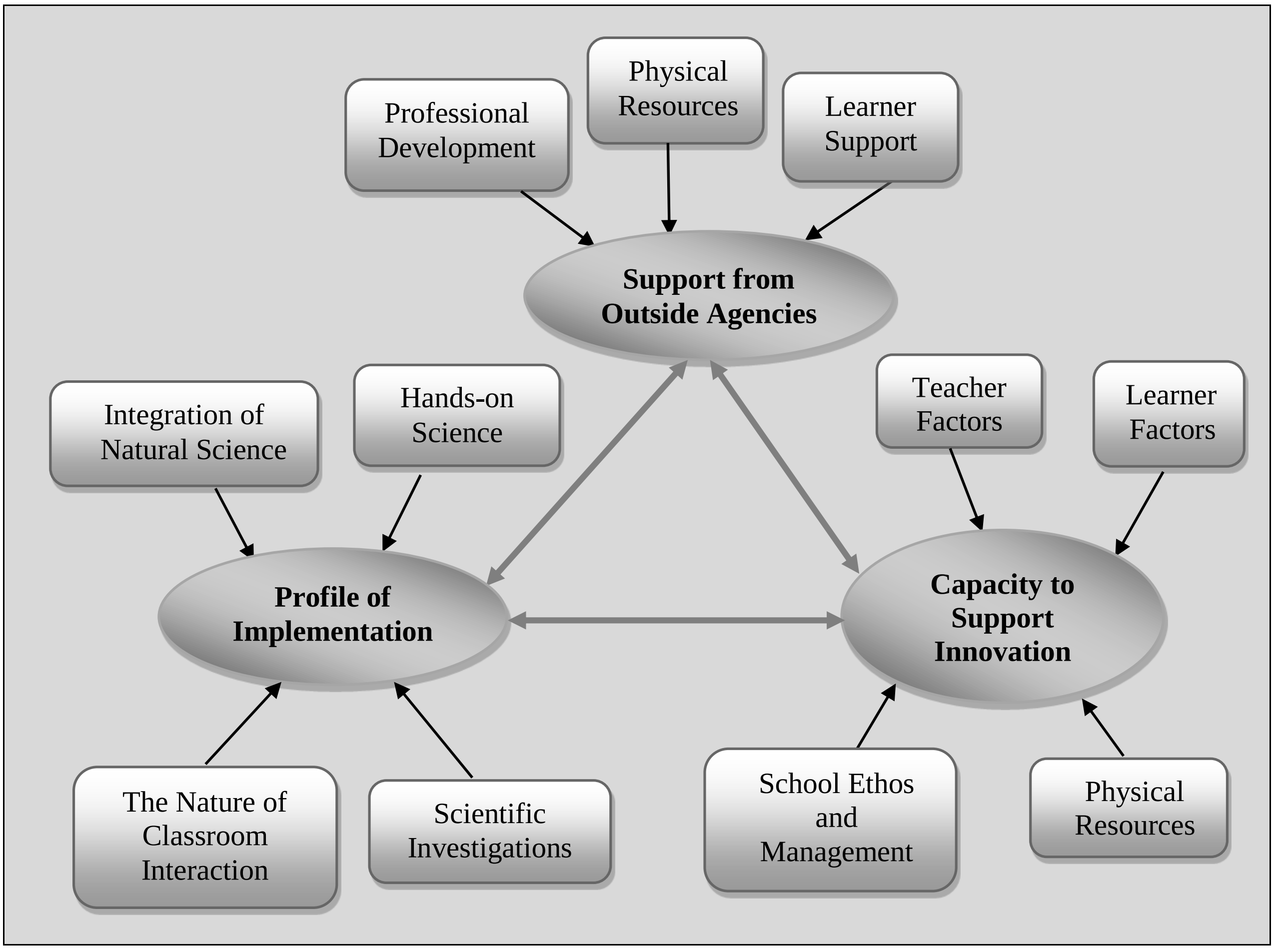

Figure 3.1: A diagrammatic representation of the Theoretical Framework for the study (Rogan 2007, p. 99)

I consulted with the RNCS documents to identify the sub-constructs. I designed the instruments for each of the methods of data collection around the factors that constitute the theoretical framework. I will discuss the design of the instruments using the theoretical framework as an analytical tool in detail in the chapter four.

While Rogan and Grayson (2003) used this framework to evaluate the extent to which schools are able to implement an innovative curriculum such as C2005, which differed drastically from any curriculum implemented previously, this framework will be used to determine the degree to which the individual teachers who participated in the study, were able to implement the Natural Science Curriculum in the Foundation Phase. I will now discuss each of the main constructs and their sub-constructs.

3.2.1 Support from Outside Agencies

For the purposes of this study, I classified outside agencies as organisations outside the school, including departments of education that interact with a school in order to facilitate innovation. Support from outside agencies, in the South African context, comes mainly from the National Department of Education and the provincial departments. Whilst the national department is responsible for developing policy, the provincial departments are responsible for their execution. Other sources of support from outside agencies could be teacher unions as they conduct workshops and training sessions for teachers.

Further to this support from outside agencies are “material and/or non-material support” (Rogan & Grayson, 2003, p. 1192). The material support is the infrastructure, equipment and resources. The non-material support is in the form of professional development and learner support. Professional development, according to Rogan and Grayson (2003) is “the most visible and obvious way in which outside agencies attempt to bring about changes in schools” (p. 11192). Refer to Figure 3.1 for a schematic representation for the support from outside agencies. These kinds of support may be offered at a range of levels. At the lower level, information of the support is merely provided. As the different levels are attained, there is growing importance on implementation of change rather than just providing the information. The levels range from single training sessions to on-going school based development. Some professional developments may provide information on changes and others may provide support structures to assist teachers during the change. The number and length of the support is key to the development of teachers. In the South African context, learner support would include the support learners receive from their parents as well as academic support with respect to their language of instruction.

The construct, support from outside agencies illustrates the types of behaviour or activities outside organisations embark on “to influence school’s practice, either by support or sanction” (Rogan, 2007, p. 100). In addition, it includes the manner in which they make evident their intentions. Such activities could have a profound influence on how the curriculum is implemented.

3.2.2 Capacity to Support Innovation

The construct capacity to support innovation is used to comprehend and extend the elements that are able to sustain or hamper the execution of innovative ideas and practices in a system as a school (Rogan & Grayson 2003). Not all schools have the ability to execute a given innovation to the same degree. Probable indicators of the capacity to support innovation constructs may be divided into four groups, physical resources, teacher and learner factors and the school ethos and management. Refer to Figure 3.1 for a schematic representation of the capacity to support innovation.

Before the discussion of physical resources proceeds, it is important to distinguish between the physical resources as they appear in the construct capacity to support innovation and the support from outside agencies in the theoretical framework. Physical resources as a sub-construct of the support from outside agencies relate to resources that pertain to the school infrastructure, which could directly or indirectly affect the teacher's teaching of Natural Science. These physical resources include the buildings, furniture, electricity, toilets, textbooks, security and the science apparatus that is provided by the school. Physical resources as a sub-construct of the capacity to support innovation considers aspects of resources that relate to the teachers use of available resources in the classroom. These physical resources include charts, chalkboard and workbooks that the teacher uses.

Teacher factors include qualification, experience, confidence, commitment, subject content knowledge and pedagogical content knowledge. Learner factors include learners' home background and their language of instruction. School ethos and management include the timetable, class lists and routines, presence of the principal, school governing body, school functions, school security and parents' role. Teachers are placed at a particular level, which illustrates their capacity to innovate. An increase in the level designates a larger capacity to innovate. The levels correspond to a succession and the critical objective for a school would be to attain level four on all four factors.

The capacity to innovate is aimed at the degree to which the different issues may be considered to afford an improvement and further create an efficient learning experience for the learner. As Rogan and Grayson (2003) point out, "more laboratory equipment in schools should increase the capacity to innovate, but if it remains in unopened boxes then it will have no impact on the learning experience." They go on to say, "Similarly, if teachers attend workshops on learner-centred teaching approaches but do not implement them in their classrooms then the learning experience will not be affected" (p. 1201). These patterns are frequently observed and take place in South Africa and other developing countries (Verspoor, 1989, p. 110). Attempts like these should hypothetically enhance the capacity to innovate, however if they are not linked to "developing the learners then implementation cannot be seen to have advanced" (Rogan & Grayson, 2003, p. 1201). Rogan and Grayson (2003) suggest that these constructs point towards a ZFI within schools, which may increase to accommodate more constructs as teachers develop their own capacity to innovate a new curriculum.

3.2.3 The Profile of Implementation

The construct, profile of implementation, is used to comprehend and articulate the degree to which the principles of a set of curriculum proposals are being put into practice. An assumption is made on what constitutes "good practice" and what it appears as in the classroom. In the context of this study, the assumption is made that good practice involves learners doing Science and teachers teaching Science using inquiry-based methodologies. Furthermore, good practice would entail the ability to integrate Natural Science effectively in the curriculum. There are also different degrees of implementation of the new curriculum. (Rogan & Grayson, 2003, p. 1182)

The profile of implementation is intended to suggest a plan of the learning area and to propose a number of potential paths that could be taken to a number of destinations (Rogan & Grayson 2003, p. 1181). For the purposes of this study, the probable dimensions of the profile of implementation are the nature of the classroom interaction, the use and nature of hands-on science, scientific investigations and the integration of Natural Science within the Life Skills Learning Programme. Refer to Figure 3.1 for a schematic representation of the profile of implementation. The theoretical framework as I have adapted it does not have assessment as a separate construct within the profile of implementation. The reason for this is that assessment is integrated within the teaching and learning in Foundation Phase. It is envisaged that assessment will form part of each of the sub-constructs of the profile of implementation and not seen as being separate. Assessment in the Foundation Phase is elaborated on in the literature review.

Rogan and Grayson (2003) maintain that the dimension "classroom interaction is generic and could, with minor changes be applied to any learning area" (p. 1182). The other dimensions are unique to Science. The reason for the choice of dimensions relates to how Natural Science may, ideally, be taught in the Foundation Phase. Natural Science should be hands-on, which implies there should be more 'doing' Science. Scientific investigation is selected as a dimension since it is the only Learning Outcome in the foundation phase Natural Science Curriculum according to the RNCS (Department of Education, 2003). The dimension, the integration of Natural Science within the Life Skills Learning Programme is chosen as this is prescribed by the curriculum documents. The integration of Natural Science will incorporate

Learning Outcome Three: Science, society and the environment. There would be four levels of interaction from teacher-demonstrations (level one) to open-ended learner-centred investigations (level four). The practices described in level four should be more refined than those at level one. According to Rogan and Grayson (2003), the levels are not dictatorial of what should be accomplished at any given instant, but rather advise the mastery and use of a growing variety of teaching and learning strategies. The shift in the levels also indicates “a rising prominence to learner-centred approaches” (p. 1182).

3.3 THE ZONE OF FEASIBLE INNOVATION (ZFI)

The focus of this study is on teachers’ interpretation and implementation of the Natural Science Curriculum. I used the theoretical framework (Figure 3.1) to explore teachers’ implementation of the curriculum. For the Natural Science Curriculum to be implemented in the way it should be as stipulated in the RNCS for Natural Science, the focus has to be on integration and practical work, which needs to take the form of scientific investigations to attain Learning Outcome One. The constructs and the sub-constructs discussed above all relate directly or indirectly, to integration and practical work.

The notion of a ‘zone of feasible innovation’ was adapted from Rogan and Grayson’s (2003) work to determine if each teacher has the capacity to implement the curriculum as stipulated in the curriculum documents. I will attempt to determine each teacher’s ZFI with regard to integration and doing practical work. It is not my intention to map teacher’s trajectories with regard to improvement of their implementation and in so doing, expanding their ZFI. However, I use the ZFI in chapter ten as a tool for theorising my findings. For this reason I will provide a brief description of the notion of a ZFI.

The ZFI draws on theories of school development, on Vygotsky’s concepts of the ZPD and the importance of social interaction for development, as well as on the zone of tolerance, i.e. the space given to institutions by communities in the change process (Rogan & Grayson, 2003). The ZPD of an individual is the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers (Vygotsky, 1998). The ZPD and ZFI have overlaps as well as differences. The overlap pertains to a certain degree of learning that takes occurs when a new curriculum is introduced. Implementation implies a process of learning new roles for teachers.

Although the ZPD was initially developed to explain the learning potential of children, it also examines ZPD applications to the notion of teacher professional development (Shabani et al., 2010). Similarly, professional development approaches are suitable and valuable when they “proceed just ahead of current practice, but are within the zone of feasible innovation” (Rogan & Aldous, 2005, p. 335). In this study, the focus is on the teachers’ capacity to innovate, which is not only their professional development but encompasses their interpretation and implementation of the curriculum. Davis (2002) maintained this idea by considering it from the perspective of teacher learning. She maintained that teacher learning is slow and steady and can be ‘overwhelming’ for teachers. To assist with this transition, teachers need to be given the time to reflect on the new. Certain key elements have to be taken into consideration before change can occur. These include a well-run school and teachers who are well informed of the intended changes (Davis, 2002, p.23).

The difference between the ZPD and ZFI is that ZPD is concerned with the “appropriateness of learning strategies” for the learners (Rogan, 2006, p. 445). The ZFI is concerned with the appropriateness of the innovation taking into account the context as a whole, including but not limited to the teacher. According to Rogan (2006), a teacher might have “difficulty in implementing the expected innovation in one context but not in another” (p. 445).

The role of the social environment in the learning process is a thread that runs through Vygotsky’s writings (Vygotsky, 1998). The ZPD is strongly influenced by the context in which it operates. The role players in implementing innovation also form an important element of ZFI. Role players that are directly involved in the change require a chance to address the envisioned adaptations within their own situations. According to Rogan and Grayson (2003), “Professional change is brought about by encouraging role players to embrace codes of conduct and standards of teaching and learning” (p. 1194).

In most countries, including South Africa, curriculum is defined at macro-level. According to Rogan (2006), “schools were given no say as to when and to what extent they would comply” with the department regulations regarding implementation (p. 449). Van den Akker (2003) makes a distinction between the various levels of the curriculum. The first level is the system/society/nation/state (or macro) level, the second is the school/institution (or meso) level, the third is the classroom (or micro) level and the fourth us the individual/personal (or nano) level. The ZFI is designed to operate at the micro-level, which is based on the supposition that those accountable for the execution at the classroom level should have the ultimate say as to the rate and degree of the introduction of innovative practices and content (Rogan, 2006). It is agreed that change is needed but the question remains how much change is appropriate and should the implementation of these changes occur in steps (Boone & Kahle, 1997; Clune, 1998; Hargreaves & Fullen, 1998).

Since schools differ from one another in terms of infrastructure, funding, human resources and physical resources, any theory of curriculum implementation will need to consider this diversity. Failure to consider these differences in preparing teachers for a new curriculum would impact on implementation. Rogan and Grayson's (2003) framework as adapted in Figure 3.1 suggest the three possible constructs of a theory of implementation and show how these constructs may be interconnected. These constructs share three important characteristics in that "they can be measured by means of indicators, they are broad enough to encompass a number of related factors and they are narrow enough to include one main idea" (Rogan & Grayson, 2003, p. 1180).

Rogan and Grayson (2003) suggest that research should be conducted in a variety of contexts in order to see the extent to which commonalities in the processes of determining indicators for the constructs, which emerge, may be generalised. Similarly, research is required to see whether any generalisations may be made with regard to the indicators themselves and changes in the relative importance of them over time. Research conducted in different contexts will also shed light on the interplay of the constructs, again showing whether there are commonalities that arise across diverse contexts. These diverse contexts could range from the schools' infrastructure to the teachers' qualifications or to the type of learners. For example, some schools may not have the necessities such as electricity and water and another school might have beautiful buildings with modern technologies. However, it does not have to be at either extreme as there is a range between the two extremities. The school in which this study is conducted lies between these two extremities. It is state funded, it has electricity and water, the building are old but maintained and there is basic technology. The school environment is the same but the teachers are different. Some schools may have qualified teachers and another school might have under-qualified teachers.

The learning environment was selected as the element of investigation since this is where the "learners, teachers, curriculum and educational resources meet" (Rogan & Grayson, 2003, p. 1179). The theory focuses on learning and not really instruction, which is implementation in the classroom. The teacher is responsible for the teaching and to a large extent also responsible for the learning that takes place in the classroom. Figure 3.2 shows the various levels in which the education system in South Africa is organised.

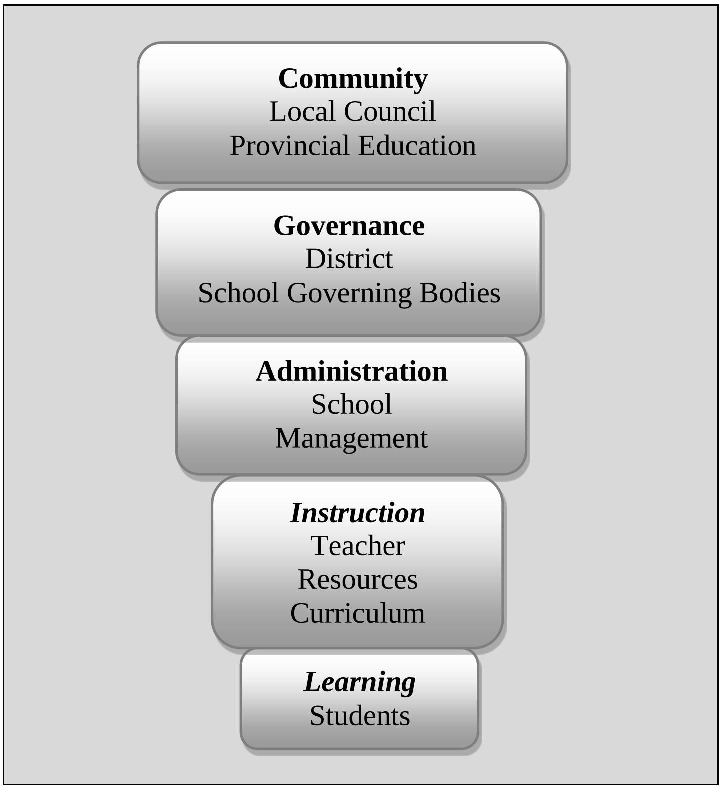

Figure 3.2: The various levels according to which education is organised in South Africa (Rogan & Grayson, 2003).

The ZFI is a hypothetical construct, which suggests that innovation should not exceed current practice by too large a gap between existing practice and the demands of the innovation. Using the ZFI as an additional construct in this study should provide more insight into teacher's implementation of the Natural Science Curriculum on whether they have the capacity to support innovation. The focus of the study is on the teachers' abilities to interpret and implement a new innovative curriculum.

The theoretical framework for this study is entrenched in the relationship between the prescribed (intended) and the implemented curriculum. My application of the framework differs from that of Rogan and Grayson (2003) in that I will apply the framework to teachers and not to the whole school environment. My findings will assist me to understand and interpret teachers' implementation of the Natural Science Curriculum and from this I will attempt to determine the ZFI for each teacher with regard to practical work and integration of Natural Science in the Foundation Phase.

3.3.1 Determining the ZFI

Successions of intended actions are recommended as one probable method of determining and implementing a ZFI. Each of the constructs involves a number of steps. Although they are given as a series of linear steps in reality, their implementation will not be so. Step one involves the construction of a ‘continuum’ (Rogan, 2006, p. 451). A number of aspects need to be well thought-out throughout implementation. The existing practice and capability of the individual teachers needs to be considered. Teachers’ qualifications, experiences, beliefs, confidence, Science knowledge need to be taken into account. The continuum needs to be entrenched in actuality. The emphasis is on the development of the continuum, for example on the “types of hands-on, minds-on practical work that exist and where they fall on the continuum” (Rogan, 2006, p. 450). It is implied that within the notion of a ZFI there is a continuum of practice on which the zone is located. Figure 3.3 shows an example of the location of ZFI on the continuum (Rogan, 2006, p. 450)

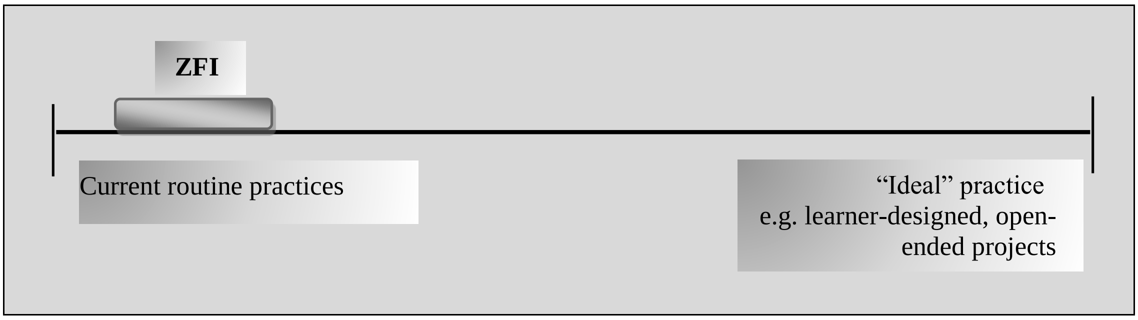

Figure 3.3: An example of the location of ZFI on a continuum

Theoretically, it implies that the ZFI will expand as the capacity is increased. If the capacity to support innovation in a school is inadequate then the amount of innovation will be limited and this will imply that the ZFI will be narrow. In addition, Rogan (2006) cautions, “no single ZFI can be appropriate for all teachers even in the same school” (p. 451).

Step two involves generating a logical series within the continuum. This step involves interpreting the continuum by way of tangible classroom strategies and then to “sequence these strategies using the content of the subject matter as a guide to facilitate implementation within local context” (Rogan, 2006, p. 451). The succession will be determined by achievability: what is convenient now, and what should be delayed until a later stage.

In step three, the amount of innovation (ZFI) that can be achieved must be decided. According to Rogan (2006), “consultations at school level need to occur”, to find out where along the range present practice can be situated and what specific innovations will be attempted by whom in the immediate future (p. 453). With regard to this construct, I will have to decide on the amount of innovation, based on the findings obtained from the data, rather than by consultation.

Step four involves the implementation within the ZFI. School based curriculum managers such as head of department, senior teachers and grade heads maintain a major position as performance strategies are implemented. According to Rogan (2006) although many teachers supported C2005, this support did not automatically transform into effective implementation (p. 454). He maintains that for effective implementation to occur, teachers needed to be professionally motivated (Rogan, 2006, p. 454). I shall therefore have to determine teachers’ motivation levels.

Rogan and Grayson have suggested that a relationship exists between the constructs. However, they realise that research is needed to establish these relationships in a variety of contexts. Research is also necessary to identify appropriate indicators for each of the constructs. They predict that it is unlikely that the indicators will be the same in all contexts or for all time. This study will attempt to determine the relationships between the different constructs and develop the indicators in the Foundation Phase.

3.4 INTERPRETING THE NATURAL SCIENCE CURRICULUM

The theoretical framework discussed above frames the implementation of the Natural Science Curriculum within the Life Skills Programme of the Foundation Phase. As the observation period of teachers’ teaching in their classrooms was limited to a number of days, I also collected data pertaining to teachers’ interpretation of the curriculum. I believe this information enriched my data with regard to their implementation and enabled me to gain a better understanding of their practice. This aspect thus focuses on the ‘intended’ curriculum. A number of constructs were used to probe teacher’s interpretation. Although these constructs are obviously different to the constructs of the theory of implementation, it did guide me as to which categories to use to probe teachers interpretation of the curriculum. The constructs are: time allocated for Natural Science in the Foundation Phase, aspects pertaining to the teaching of Natural Science in the Foundation Phase, natural science content areas and the instructional methods used to teach Natural Science. These are presented in Figure 3.4

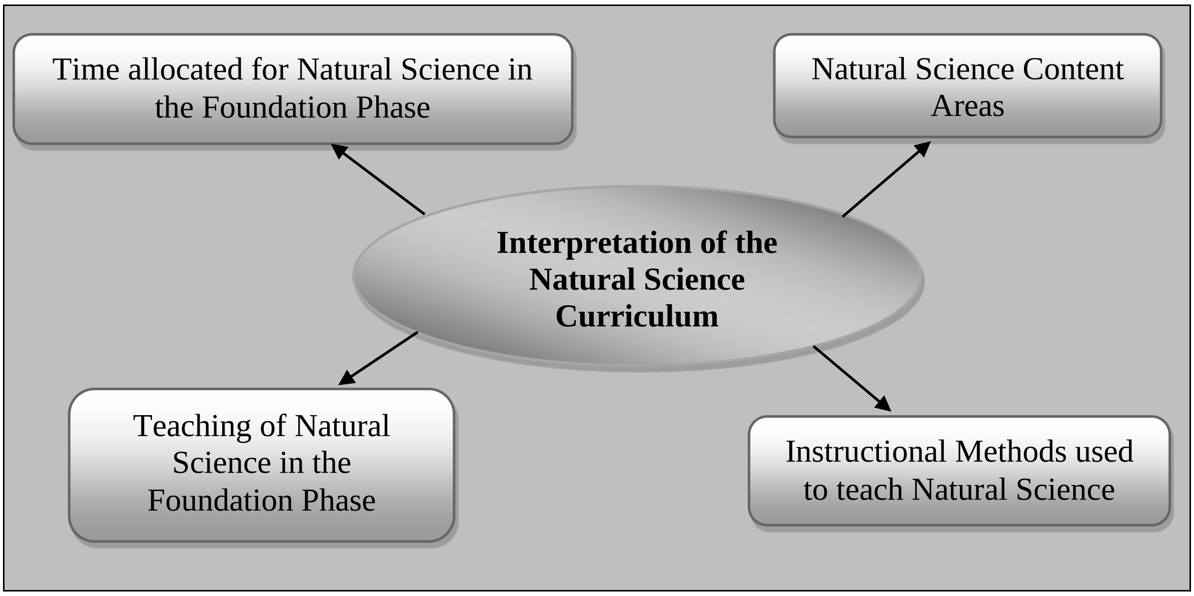

Figure 3.4 Factors, which influence Teachers' interpretation of the Natural Science Curriculum

3.5 CONCLUSION

I outlined the theoretical framework for the study in this chapter. With any change in curriculum, there comes the expectation for teachers to implement the changes without consideration being given to their capabilities and experiences to be able to deliver. The changes in curriculum at schools is a given as the education departments attempt to progress. Therefore, the intention behind the curriculum reforms is good and is aimed at developing the country. However, the reason they often do not succeed lies in the implementation strategies that are not clearly planned. Whether the change is from C2005 to NCS to RNCS to CAPS, thought needs to be given to, and planned for when implementing change. These implementation strategies do not consider the context of the school and the range of multiplicities that may exist within the school context. Such diversity could be factors relating to the school, teacher, learners as well as the outside community that could affect transformation.

With the three constructs, namely profile of implementation, capacity to support innovation and outside support that is central to the proposed theory, consideration has to be given to all phases of the implementation process. As shown, these constructs are interlinked and dependent on each other. Each of the constructs depends on and enriches the other constructs. While doing so the main purpose must always be on the planned curriculum transformation.

For each construct, I will construct levels of engagement from the analytical framework, which will be utilised to analyse the data. I anticipate that this study will further enhance the relationships between the constructs from a different perspective. Furthermore, I envisage that suitable indicators will be determined for each construct.

In the next chapter, I discuss the methodology employed in this study.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 INTRODUCTION

In this chapter, I describe and motivate for my choice of methodology. I begin by setting the scene and establishing the context of the study. The research methodology is described and an account given as to how it is framed by the theoretical framework accompanied with the explanation for the research design from literature. My study is located in the interpretive paradigm. This chapter commences by examining why the interpretive paradigm is most appropriate for my study. I do this by presenting the different paradigms before the research paradigm that is employed in this study is justified. The three different approaches to research are discussed prior to making a case for a qualitative approach. I motivate the choice of the particular case, and then explain why the research design chosen is suitable for answering the key research questions. The case study process and data collection methods during the research process are elaborated on; this includes amongst others data collection strategies, and the selection of participants. I draw on the theoretical framework to inform the design of the instruments used in this study and describe how it pertains to the data collection and the analysis thereof. Research rigour is discussed with special reference to trustworthiness, credibility and crystallisation as it pertains to qualitative research design. Finally, I endeavour to address the ethical issues and limitations of the study, which form the concluding segments of the chapter.

4.2 CONTEXT AND PARTICIPANTS

The focus of this study was on foundation phase teachers' interpretation and implementation of the Natural Science Curriculum. The research questions assisted in setting the scene for the design of this study. The main research question that framed this study was: How do foundation phase teachers interpret and implement the Natural Science Curriculum within the Programme in their respective classrooms? The context for this study will be outlined followed by an explanation of how the participants were selected.

The research site for this study was an urban school in the greater Durban area. Selecting a school in the Durban area ensured accessibility. This was historically a school for Coloured learners. The learner population consists of predominantly Coloured and African learners. The school is on a central public transport route and therefore attracts many learners from the surrounding townships. Most of the learners are from low socio-economic backgrounds. The study focused on foundation phase teachers teaching Grades R to Three. This site was chosen for the study as it is a government school that had Grade R as well as Grades One, Two and Three. As not all government schools have a Grade R class, this school was appropriate. Gender related issues were not the focus of this study and hence the fact that all teachers were female was not a concern. Although there are only female teachers teaching in the Foundation Phase, teachers with different qualifications and years of experience were included in the sample. It was initially envisaged that the head of department for the Foundation Phase would be part of the study. Although the school has two heads of department in the foundation phase section, neither one wanted to be part of the study because of their busy schedules. The study proceeded with the four foundation phase teachers only.

The selection of the sample was accomplished using purposive sampling. After deliberation I also realised that the sampling could be convenient sampling. Convenience sampling is considered to be the "least rigorous technique, involving the selection of the most accessible subjects" (Marshall & Rossman, 2006, p. 523). He further expounded that convenience sampling is the "least costly to the researcher, in terms of time, effort and money, but may result in poor quality data and lacks intellectual credibility" (Marshall & Rossman, 2006, p. 523). However, it should be noted that there is a portion of convenience sampling in many qualitative studies. For this study, purposeful sampling was the dominant method for choosing the sample with elements of convenience sampling.

Purposeful sampling was selected in contrast to probabilistic sampling, as I wanted to understand something about the case without needing or desiring to generalise to all such cases. According to Patton (2002), "Purposeful sampling is a non-random method of sampling where the researcher selects "information-rich" cases for in-depth study (p. 239). Purposeful sampling is when the researcher chooses a sample from which the most can be learned (Merriam, 1998). It is the most frequent sampling strategy in qualitative research and seeks cases rich in information, which can be studied in great deal about issues of central importance to the purpose of the research. The advantage of purposeful sampling is that, "Any common patterns that emerge from great variation are of particular interest and value in capturing the core experience and central, shared dimensions of a setting or phenomenon" (Patton, 2002, p. 242).

The decisions taken with regard to sampling were made to ensure data of a high quality was collected that would enable me to answer the research questions. The sample was chosen because the participants were likely to be knowledgeable and informative about the phenomenon that I was investigating (McMillan & Schumacher, 2001, p. 433). Cohen et al. (2011) agreed that researchers select non-probability sampling with the intention of "using a particular group in the full knowledge that it does not represent the wider population; it simply represents itself" (p. 155). The sample was chosen for a specific purpose and was explicit to my needs as a researcher (Cohen et al., 2011).

In order to obtain data, four foundation phase teachers from Grade R to Three in one school were included in the sample, which was directly related to the purpose of the study. The teachers volunteered to be part of the study. They were all foundation phase teachers in one school teaching Grade R to Three. McMillan and Schumacher (2001) maintain that the insights generated from qualitative inquiry "depend more on the information-richness of the cases and the analytical capabilities of the researcher than on sample size" (p. 404).

A point of concern with the use of purposive sampling is that the data may not be saturated. Maree (2009) advises that to counteract this, "Purposive sample sizes should rather be determined on the basis of theoretical saturation" (p. 178). This means that the point of saturation in the data collection is when new data does not enhance or supplement further understandings to the research questions. To accomplish purposive sampling the re-examining of data and analysis were done concurrently with data collection.

The four teachers in the study are all female and will hereafter be referred to as Karen, Fiona, Carly and Simone (pseudonyms). Karen teaches Grade R, Fiona teaches Grade One, Carly teaches Grade Two and Simone teaches Grade Three.

4.3 RESEARCH METHODOLOGY

According to Mackenzie and Knipe (2000), the "research paradigm and methodology work together to form a research study" (p. 193). The research methodology and all the issues pertaining to it are discussed in detail. The motivation is outlined for the choices of the research methods and data collection instruments. The theoretical framework guided the choice of the research methods and the data collection instruments.

4.3.1 Interpretive Paradigm

The term 'paradigm' may be explained as "a loose collection of logically related assumptions, concepts or propositions that orient thinking and research" (Bogdan & Biklen 1998, p. 22). Paradigms are worldviews or belief systems that are a reflection of and guide the decisions that researchers make (Tashakkori & Teddlie, 1998). Cohen, Manion and Morrison (2011) portray it as the "philosophical intent or motivation for undertaking a study" (p. 23). Mackenzie and Knipe (2006) maintain, "It is the choice of paradigm that sets down the intent, motivation and expectations for the research" (p. 193). They go on to say that, if the paradigm is not selected at the initial stages then the foundation for consequent decisions concerning methodology, methods, literature or research design will not be present (Mackenzie & Knipe, 2006). Some of the paradigms that are discussed in literature are constructivist, interpretive, positivist (and post positivist), transformative, emancipatory, critical, pragmatism and deconstructivist paradigms. A brief discussion on the interpretive, constructivist, positivist and transformative paradigms follows before the most appropriate paradigm selected for this research study is named and justifications are given for it.

Constructivists hold that reality is constructed in the mind of the individual, rather than it being an external single unit. The term, social constructivist is so called because it reveals one of the basic beliefs of this theoretical paradigm, that is, that reality is socially constructed. The fundamental conventions managing the social constructivist paradigm are that people active in the research process socially construct knowledge, and that researchers should try to appreciate the complex world of lived experience from the point of view of those who live it (Schwandt, 2000). The social constructivist paradigm emphasises that research is a creation of the morals and ethics of researchers and cannot be autonomous of them.

The interpretive paradigm is a study of social phenomena that requires understanding of the social world in which people live (Blaikie, 2004). The interpretive paradigm, according to Henning (2004), gives prominence to experience and interpretation. Cohen et al. (2011) described the interpretive paradigm as being "characterised by a concern for the individual" (p. 17).

According to Creswell (2003), the interpretive/constructivist researcher tends to rely upon the "participants' views of the situation being studied" (p. 8). Consistent with this is the implication that "reality is socially constructed" (Berger & Luckmann, 1971, p. 1; Mertens, 2005, p. 12). Mackenzie and Knipe (2006) are of the view that "positivism is sometimes referred to as 'scientific method' or 'science research' and is based on the rationalistic, empiricist philosophy" (p. 197). Mertens (2005) explains that positivism may be applied to the social world on the assumption that "the social world can be studied in the same way as the natural world; that there is a method for studying the social world that is value free, and that explanations of a causal nature can be provided" (p. 8).

According to Mertens (2005), the transformative paradigm arose partially due to discontent with the "existing and dominant research paradigms and practices" but also because of "a realisation that much sociological and psychological theory which lay behind the dominant paradigms had been developed from the white, able-bodied male perspective and was based on the study of male subjects" (p. 17). Creswell (2003) augments, "Transformative researchers felt that the interpretive/constructivist approach to research did not adequately address issues of social justice and marginalised people" (p. 9).

Based on the preceding discussion the pragmatic and interpretive paradigm seemed to be the most appropriate for the study. The interpretive paradigm operates within a qualitative approach and the pragmatic paradigm operates within a mixed method approach. This research initiative used an interpretative paradigm in an attempt to understand teachers' interpretation and implementation of the Natural Science Curriculum within the foundation phase learning programmes. I shall draw on the theoretical framework at a later stage to justify my choice of data collection methods used within this paradigm.

The reasons for selecting the interpretive perspective are based on the assumptions made by this paradigm, which are valid to this study. The focal point is on the teachers' "subjective experience and on how they construct the social world by sharing meanings and how they interact with or relate to each other" (Maree, 2009, p. 59). Research techniques were employed to assist with gaining an understanding of how the teachers interpret and interact within the classroom with regard to the implementation of the Natural Science Curriculum. A primary assumption of interpretivism is that "reality is socially constructed" (Berger & Luckmann, 1971, p. 1; Mertens, 2005, p. 12). In keeping with this, Hussey and Hussey (1997) mention that when people are placed in their societal milieu there is a better prospect to comprehend the insight they have of their own actions. Observing the teachers in their unique classroom contexts was important in understanding and interpreting teachers' implementation of the curriculum and why they implemented the curriculum in the way that they did. The phenomenon under investigation was understood through investigating the richness and profundity of the teachers' knowledge and experiences. Interpretivism argues for multiple realities of the phenomenon that is being studied.

For this study, as with any interpretive research, the final aim is to present a viewpoint of a position and to examine the position that is being studied, to offer explanation about the way in which a particular group of people, in this case the foundation phase teachers, make sense of the Natural Science Curriculum within the Life Skills Learning Programme. Having said this, it is important to remember that for the most part the criticism against the interpretive research paradigm is concentrated at the "subjectivity and the failure of the approach to generalise its findings beyond the situation studied" (Maree, 2009, p. 60). The aim of this study was not to generalise but to attain an in depth knowledge of the phenomenon being researched.

4.3.2 A Qualitative Approach

In conducting research, three different approaches may be used. A brief discussion of each is presented before proceeding to explore the rationale for the use of the selected approach for this study. The three different approaches to research are quantitative, qualitative and mixed methods approaches. In the literature, the terms qualitative and quantitative are often used in two distinct discourses, one relating to what is more commonly understood to be the research paradigm and the second referring to research methods (Armitage 2007; Mackenzie & Knipe, 2006; Maree, 2009). The term 'mixed methods' refers to the use of two or more methods in a research study that utilises qualitative as well as quantitative data (Cresswell, Plano Clark, Guttmann & Hanson, 2007; Greene, 2007; Teddlie & Tashakkori, 2009).

To simplify the explanation of the terms, O' Leary (2004) characterised qualitative and quantitative as "adjectives for types of data and their corresponding modes of analysis." He explained that "qualitative data is represented through words, pictures or icons analysed using thematic exploration; and quantitative data is represented through numbers and analysed using statistics" (p. 99). The strengths of this approach were identified by Maree (2009) as, "the richness and depth of explorations and descriptions it yields". He elaborated further by stating that this meant the "researcher becomes the instrument through which the data is collected and analysed" (p. 55).

Some researchers view both qualitative and quantitative methods as being compatible when selecting appropriate method/s for their research (Creswell, 2003; Krathwohl, 1993; Thomas, 2003). According to Mackenzie and Knipe (2006), "While some paradigms may appear to lead a researcher to favour qualitative or quantitative approaches, in effect no one paradigm actually prescribes or prohibits the use of either methodological approach" (p. 199). In keeping with this, they went on to say that for research to be successful, it is acceptable that both approaches be used. From the literature, it was evident that the positivist or post positivist paradigm favoured the quantitative research approach to data collection and analysis whereas the interpretive/constructivist paradigm usually favoured the qualitative research approach (Cohen et al., 2011; Mackenzie & Knipe, 2006; Mertens, 1998; Silverman, 2000). However, in the literature, these researchers cautioned that the paradigm was certainly not limited to a particular approach (Cohen et al., 2011; Mackenzie & Knipe, 2006; Mertens, 1998; Silverman, 2000). For example, the pragmatic and transformative paradigm is connected to the mixed methods approach, which draws from quantitative and qualitative methods of data collection (Creswell, 2003).

From the preceding discussion, it was proposed that the paradigm and research question should determine which research approach, data collection and analysis methods (qualitative/quantitative or mixed methods) would be most appropriate for a study. Mackenzie and Knipe (2006) maintained, "In this way researchers are not quantitative, qualitative or mixed methods researchers, rather a researcher may apply the data collection and analysis methods most appropriate for a particular research study" (p. 201). The focus in this study was on foundation phase teachers' understandings of the Natural Science Curriculum and how their understandings are translated into classroom practice in the way in which they interpret and implement the curriculum. A qualitative research approach was employed for the purpose of this study, as it provided rich descriptions of the phenomenon under investigation. In keeping with this, the study provided "detailed narrative description, analysis and interpretation of the phenomenon" under investigation (McMillan & Schumacher, 2001, p. 36).

A qualitative research approach was used as it was "concerned with understanding the processes and social and cultural contexts, which underlie various behavioural patterns and is mostly concerned with exploring the "why" questions of research" (Maree, 2009, p. 51). According to Holloway and Wheeler (1996), qualitative research characteristically examined "people or systems by interaction with and observing the participants in their natural environment and focussing on their meanings and interpretations" (p. 28). The intention was to use qualitative research as it is concerned with describing and understanding trends in the teachers' natural context, which in this study is the classroom, with the objective of developing meanings imparted by the teachers so that the phenomena may be described in terms of the meaning that they have for the teachers themselves.

4.3.3 Case Study Design

Within the interpretive paradigm, a case study method was chosen to give in-depth meaning to the phenomenon under study. Bromley (1990) defined case study research as a "systematic inquiry into an event or a set of related events which aims to describe and explain the phenomenon of interest" (p. 302). Yin identified four main types of case studies designs. They were the single-case design, the embedded, single case design, the multiple-case design and the embedded-case design. The embedded, single-case was the design that was employed in this study. Yin described it as "when more than one unit of analysis is incorporated into the design" (2009, p. 54). The entire school was selected as the case with the different foundation phase teachers being used as sub-units.

This case study employed multiple sources of data found in the setting and examined a school which was an enclosed system or case over time, in detail (McMillan & Schumacher, 2001, p. 36). According to McMillan and Schumacher (2001), the focus may be one entity (within-site study) or several entities (multi-site study). However, the more cases of individual sites added, the less depth of any single site. By focusing on an embedded single entity, the data obtained would be rich with information whilst all other factors were kept constant. The purpose of this case study was to understand one phenomenon, which was teachers' interpretation and implementation of the Natural Science Curriculum within the Life Skills Learning Programme in the Foundation Phase.

From an interpretive viewpoint, the distinctive features of case studies is that they endeavour to gain a holistic understanding of how "participants relate and interact with each other in a specific situation and how they make meaning of a phenomenon under study" (Maree, 2009, p. 75). The "how" and "why" questions were answered using the case study design methodology (Cohen et al., 2011, p. 289; Yin, 2009, p. 27).

The unit of analysis is a critical factor in case study research (Maree, 2009; Yin, 2009). In applying the theoretical framework, (Figure 3.1) the learning environment, which is usually the classroom, was chosen as the unit of analysis since this is where the key role players in teaching and learning come together. In this study, the teachers were given a voice, as they are instrumental in curriculum delivery. An in-depth knowledge of the dynamics of the situation was obtained using a case study research style. According to McMillan and Schumacher (2001), the case study design is used in an attempt to increase the participants own interpretation of their practice, and if necessary, to improve their practice as well as to contribute to policy formation, implementation and modification.

An advantage of using a case study is that a number of different sources and techniques may be used to gather data. Case study methodology is dependent on a single case and generalisation is not possible. However, this is not the intention of this study since this study is intended to obtain a thorough understanding of the phenomenon under investigation. The case was selected to gain an understanding of the factors that influence teachers' interpretation and implementation of the Natural Science Curriculum in this particular context.

4.3.4 Data Collection Methods and Instruments

The research questions determined the paradigm, the approach and the design, as well as the methods and instruments employed in this study. The choice of instruments included document analysis, a questionnaire, classroom observations, semi-structured interviews and a rating scale. I analysed curriculum documents, lesson plans and learners' books. I administered a questionnaire and then at a later stage conducted semi-structured interviews with the teachers. After the interviews, the teachers completed a rating scale in which they rated themselves as science teachers. Teachers were required to provide biographical details as well as an overall view of the teachers' understanding of teaching Natural Science in the Foundation Phase in the questionnaire. The teachers were observed in their classrooms for evidence of science teaching. I completed a comprehensive observational schedule for each foundation phase teacher and the classroom observations were video recorded. As mentioned, I used multiple data collection methods to attain pertinent data to answer the research questions.

Before embarking on a discussion of each data collection method, I will briefly explain how the theoretical framework for this study informed the design of the instruments. Chapter three described the theoretical framework with each of its constructs and sub-constructs in detail. I arrived at each of the constructs and sub-constructs after researching the factors that pertain to the South African context and in accordance with the requirements of the curriculum documents. Embedded in the discussion on the data collection methods is the explanation of how the theoretical framework informed the design of the instruments. I achieved this by linking the data obtained from the each data collection method with aspects of the theoretical framework.

I will discuss each data collection method, highlighting the advantages as well as the disadvantages of each before justifying the choice of methods and instruments used for this study.

4.3.4.1 Document Analysis

When documents are used as a means to gather data, the researcher focuses on printed communications that could potentially provide justification and explanations on the phenomenon being studied (Maree, 2009). Document analysis is the methodical inspection of instructional documents such as curricula, assignments, classwork and course evaluation outcomes with the intention of ascertaining instructional necessities and challenges and describes an instructional activity (McMillan & Schumacher, 2001). Mogalakwe (2006) stresses that the emphasis of the analysis should be a critical inspection instead of a simple explanation of the documents. The analysis should interrogate the purpose of the document; investigate how it is being used and if it is contributing to learning.

There are two types of documents that are used in documentary study namely, primary documents and secondary documents (Cohen et al., 2011; Maree, 2009; Mogalakwe; 2006). According to Mogalakwe (2006), “Primary documents refer to eye-witness accounts produced by people who experienced the particular event or the behaviour we want to study” (p. 222). According to Bailey (1994), contrary to this, secondary documents are documents created by persons who were not present at the occurrence but who received reports on what transpired to enable them to compile the documents. Documents range from public through private to personal documents (Mogalakwe, 2006). An example of a public document is curriculum documents. Personal documents would be learners’ workbooks and teachers’ lesson plans. Private documents include minutes of meetings, board resolutions and invoices.

Documents analysed in this study included public and personal documents. I analysed the Curriculum Statements (Appendix A), teachers’ lesson plans (Appendix B) and learners’ books (Appendix C). Analysis of the curriculum documents provided the starting point against which teachers’ interpretation and implementation of the curriculum were measured. As Hopkins (2008) mentions, documents around a curriculum or additional educational issues can explain the justification and intention in a thought-provoking manner. He adds that the central application of documents in classroom research is that they afford a framework for comprehending a certain curriculum or teaching method, in addition to supplying a simple method of gaining additional people’s insights. The analysis of the curriculum is not data but the benchmark for comparing what teachers do. I also used the documents to verify the data obtained from other sources.

Some advantages of document analysis include acquiring an understanding into a teaching and learning activity or method, investigating trends, patterns, and inconsistency in instructional documents. In addition, documents could provide the initial research for an interview, questionnaire or observation. Interview questions, questionnaires, or an observation checklist can be informed by a document analysis (Maree, 2009). The disadvantages or limitations of document analysis could be that the documents may be incomplete or misplaced, data could be limited to what already exists and it does not assess existing learner views, requirements, or contentment (McMillan & Schumacher, 2001).

The explanation of how I used the framework to analyse the data obtained from the analysis of the document will be discussed under the data analysis.

4.3.4.2 Questionnaire

I collected data by administering a questionnaire (Appendix D) to the teachers. A questionnaire consists of a series of questions concerning an aspect or topics administered to groups of individuals to collect data on an issue under investigation (Van den Aardweg & Van den Aardweg, 1990). Nonetheless, the questionnaire has advantages as well as disadvantages. The questionnaire is regarded as one of the most common methods of gathering data (McClure, 2002; McMillan & Schumacher, 2001). According to Cohen et al. (2011) questionnaires are time saving, affordable, and conducive to reliable results. Teachers were expected to write down their responses to the questionnaire. This was the initial method of data collection and I did not want to influence the teachers' responses in any way. According to Cohen et al. (2011) written questionnaires prevent likely interview bias. The manner in which the interviewer conducts the interview may impact on the participant's replies. Such biases can be completely eliminated in the written questionnaire. I administered the questionnaire to all four teachers simultaneously thus saving time.

Some of the disadvantages are that questionnaires do not afford the flexibility of interviews (Van den Aardweg & Van den Aardweg, 1990). During an interview, the participants' answers can be analysed and probed for further elucidation. The participants' reaction to the questions cannot be interpreted as it can be in an interview. There is no way to tell how truthful a participant is being or of telling how much thought a participant has put in to their responses. The way the participants interpret the questions in the questionnaire, if different from the way they were intended, could affect the validity of the information. Participants may not understand the questions and consequently, provide responses that they may not have given if they had understood the question. According to Van den Aardweg and Van den Aardweg (1990), individuals are usually better able to express their views verbally than in writing. Questionnaires can be answered only when they are simple and direct the given instructions and definitions are clear and unambiguous (McMillan & Schumacher, 2001).

There are two key categories, namely open and closed questions (Maree, 2009). Some advantages that open questions afford are that the participants are provided with the opportunity to supply thorough and truthful responses, which could reveal their thinking (Maree, 2009). However, he cautions, "the amount of detail may differ among participants" (Maree, 2009, p.161). Closed questions provide the participants with set responses from which to choose. Closed questions are advantageous as they are quick and easy to answer (McMillan & Schumacher, 2001). The information acquired from closed questions is easier to analyse than those from open questions. There are a number of different types of closed questions, namely, ranking, list, grid, quantity, scale and category (Maree, 2009).

I did not pilot the questionnaire, as it was not administered on a large scale. The questionnaire that was administered to the teachers took the form of a pen and paper interview. It was not a survey as it was only administered to four teachers but served the purpose of obtaining teachers' background and initial viewpoints as teachers answered a set of structured questions. It was easier for the teachers to write down the information. The information obtained from the questionnaire was later interrogated during the interviews. Although I was present when the teachers completed the questionnaire, the teachers were not intimidated or influenced by my understanding of the curriculum and had the opportunity to give their initial response to the questions. The questionnaire supplied data on teachers' interpretation of the Natural Science Curriculum within the Life Skills Learning Programme.

The questionnaire consisted of both closed and open questions. The closed questions provided a range of responses from which the participants could choose (Cohen et al., 2011). Some of the closed questions supplied the participants with choices, for example content areas, frequency or instructional methods where participants needed to select the one most appropriate. I included the open-ended questions to reveal participants' responses by writing freely and explaining their responses. I did not analyse the closed questions quantitatively but used them as a starting point as teachers explained their choices in the open-ended questions. Cohen et al. (2011) caution, "Open-ended questions can lead to irrelevant and redundant information" (p. 382).

I gave the four foundation phase teachers the questionnaire to complete at the beginning of the study. There was an introduction to the questionnaire, which outlined the structure of the questions, which were completed on paper. The theoretical framework determined the choice of the sections in the questionnaire. I asked the participants to answer all questions honestly by ticking (✓) the relevant column or writing their opinions in the space provided. In section A, the teachers' biographical data was established. Along with other personal details, teachers were asked their age, academic and professional qualifications and the years spent teaching in the Foundation Phase. It was envisaged that the biographies could provide reasons for teachers implementing the curriculum the way that they did.

In the first part of section B, the teachers' science content knowledge was determined by having them place a tick in the relevant box where each box indicated the level of confidence to teach a particular topic. The content knowledge listed was obtained from the curriculum documents. Teachers were invited to include any topic(s) that did not appear on the list. In the second part of section B, teachers were asked which science content from the list they taught often and to supply reasons for this. In the third part of section B, teachers were asked which of the science content from the list they never taught and to supply reasons for this.

In section C, teachers were required to place a tick in the column which depicted how often they used a particular instructional method in the teaching of science topics. The list of instructional methods was obtained from the curriculum documents. An addendum was attached to the questionnaire, which clarified what was meant by each instructional method. This was done so that there would be a common understanding of the instructional methods. Teachers could select the frequency of use from daily, weekly, fortnightly, monthly, once a term or never. Teachers could have included any other instructional method that they utilised which was not included in the list. Teachers were requested to give reasons why they used the methods, which they selected.

There were two parts to section D on learner factors. Firstly, teachers had to complete a table providing statistical data on the number of learners and the average age of the learners in their class. Secondly, teachers were supplied with characteristics that could possibly describe the learners in their class. These characteristics were obtained from the curriculum documents. Teachers were requested to first select the characteristics that described the learners in their class and then write a short paragraph to explain the choices they made. Teachers were invited to include any other characteristics that were not on the list.

There were four parts to section E on teacher factors. A list of characteristics that could possibly describe the participants as foundation phase teachers were provided. The list was obtained from the curriculum documents. Teachers had to select the characteristics that best describes them as foundation phase teachers and explain the choices they made. Teachers were invited to include any other characteristics that were not on the list. Teachers were asked to identify their strengths and weaknesses as a foundation phase teacher giving reasons for their answers. They were further requested to identify any professional development workshops that they attended with regard to teaching Natural Science in the Foundation Phase in the previous year.

In section F, teachers were given a list of resources that could assist them. They had to identify how frequently resources were used in their classrooms. The frequency included daily, weekly, fortnightly, monthly, once a term or never. Teachers could include any other resource that did not appear in the list which they used. Teachers had to respond to questions regarding the use of textbooks they used to teach Natural Science. They were asked if they firstly used a textbook, then what textbook they used and lastly why they used the textbook. Teachers had to identify the type of resources/science equipment they used to teach Natural Science. Finally, in this section, teachers were asked to name the resources they would like to have but they do not have access to now, that they think would improve their teaching in Natural Science.

In section G, on the general ethos and school management, the teachers had to select from a list of characteristics that could describe the school. The characteristics were obtained from the curriculum documents.

In Section H, teachers are asked to firstly identify the proportion of the school day they spend on each learning programme, namely, Literacy, Numeracy and Life Skills. Secondly, to identify ways in which their professional qualification and related field experience have best prepared them to be an effective foundation phase teacher.

As is evident, the questionnaire comprised of eight sections (Section A-H), each of which covered all the constructs and sub-constructs of the theory of implementation. The discussion on how the questionnaire relates to the constructs will be discussed under data analysis. There were questions that were open-ended to allow the participants the freedom to write about what they thought was important. The teachers' responses were drawn into narratives.

4.3.4.3 Classroom Observation

Marshall and Rossman (2006) mention, "observation is a fundamental and highly important method in all qualitative inquiry" (p. 99). Cohen et al. (2011) declare the "distinctive feature of observation as a research process is that it offers the investigator an opportunity to gather ‘live’ data from naturally occurring social situations” (p. 456). The implication is that the actual, direct data is obtainable through observations.

A structured observation is a particular kind of data gathering, in which the researcher directly observes, visually and auditorily, the phenomenon, and systematically records the resulting observations. Marshall and Rossman (2006) concur, “Observation entails the systematic noting and recording of events, behaviours, and artefacts (objects) in the social setting chosen for a study” (p. 98). So do Wilkinson and Birmingham (2003) as they consider observation as a convenient instrument for researchers to apply as it involves an assortment of skills including “listening, participating, contributing, pursuing, questioning, interacting, sharing, refraining, retreating, negotiating and timing”, which at times have to be used concurrently (p.117). I undertook observations to collect data on the nature of teachers’ classroom practice in the implementation of teaching Natural Science in their foundation phase classrooms. Wiersma (2000) upholds that a significant portion of observation relates to the notion of contextualisation. To appreciate behaviour the observer must understand the context in which individuals are thinking and responding.

There are four main of types of observational research, each of which has both strengths and weaknesses (Cohen et al., 2011; Maree, 2009). There is complete observer or non-participant observation, observer as a participant, participant as observer and complete participant observation. Non-participant or complete observation is also known as naturalistic observation where there is no interference by the researcher and no attempt to influence variables (McMillan & Schumacher, 2001). The intention of this type of observation is to accumulate data in a “natural setting” (Schuh & Upcraft, 2001, p. 45). The advantage is that the researcher is observing real-life and it is less obtrusive (Maree, 2009). The disadvantage of non-participant observation is that we do not know if the observation is characteristic of what usually occurs. When the observer is a participant, the researcher is in the situation but is aware of his or her role as an observer in the situation and remains uninvolved (Maree, 2009). When the researcher is a complete participant, he/she is fully involved in the situation and there is no distinction between the observer and the participant (Cohen et al., 2011). Unlike a non-participant observer, in participant observation the researcher is immersed and is involved in the situation. Participant observation research permits the researcher to obtain data to which he or she might not have had access. McMillan and Schumacher (2001) explain that participant observation permits the researcher to validate what the participants anticipate them undertaking while being non-interfering and pursuing different opinions of events from different participants for correctness and validation. The disadvantage of this type of observation is that the participants have not given their informed consent to be part of the research, which may result in serious ethical issues. The researcher could lose objectivity by being so involved in the research (McMillan & Schumacher, 2001).

In this study, I was an observer and not involved in the lessons. In addition, a professional team videotaped the lessons as unobtrusively as possible. The advantage of the classroom observation is that the participants are observed in their natural environment rather than an artificial experimental setting. Predetermined specific categories of behaviour were recorded and what was to be observed was determined before the research was conducted (McMillan & Schumacher, 2001). The classroom observations supplied data on teachers' interpretation and implementation of the Natural Science Curriculum within the Life Skills Learning Programme.

Foundation phase teachers were observed in their classrooms during the planned instruction. The duration of the observation depended on the length of the programmed schedule of work. Since all four foundation phase classes were to be observed concurrently, a professional team was employed to videotape the lessons for the intended observation period. During the week of the planned observation, there was a taxi strike, which resulted in the classes being observed for three days. I completed the observation schedules (Appendix E) for each class whilst watching the videos. I used the three constructs to draw up the observation schedules that were used to analyse the data. The factors associated with each construct were used in the observation schedule when observing the teachers. The information I obtained from the observation schedules provided data on all the sub-constructs within the theoretical framework.

4.3.4.4 Semi-structured Interviews

Hoepfl (1997) explains that an interview is a series of questions about a certain issue that the interviewer wants to understand. He further contends that even though the intention is to obtain comparable responses from all the participants, there are no prearranged responses. Interviews are valuable because they allow the participants to share their experiences, attitudes and beliefs in their own words (McMillan & Schumacher, 2001). Vockell and Asher (1995) maintain that an interview is intended to allow "the participants to supply information to the researcher" (p.133). I used semi-structured interviews for data collection purposes where the informants openly voiced their opinions.

According to Maree (2009), "An interview is a two-way conversation in which the interviewer asks the participants questions to collect data and to learn about the ideas, beliefs, views, opinions and behaviours of the participant" (p. 87). The three types of interviews that I could have selected for this study were open-ended interviews, semi-structured interviews or structured interviews. The open-ended interview is like having a conversation with the participant to explore his or her views. Structured interviews involve the interviewer asking pre-determined questions of the interviewee. My decision to use semi-structured interviews, as opposed to open-ended or structured interviews stemmed from the nature of this study. I used semi-structured interviews as a tool to provide a greater depth of data than the other types of interviews, given their open-ended and qualitative nature (Fontana & Frey, 2003). This type of interview allowed for "the probing and clarification of answers" (Maree, 2009, p. 87). I posed pre-determined questions to each participant in a systematic and consistent manner but the participants were also given the opportunity to discuss issues beyond the questions' confines (Struwig & Stead, 2004).

I interviewed the teachers after I administered the questionnaire which was administered to them and after the classroom observation to discover why they implement the curriculum the way that they do. During the interview, there was direct verbal interaction between myself and the participant. The semi-structured interviews resulted in much deeper and richer responses than the questionnaires. Throughout the interviews, I requested the teachers to provide some explanations to a number of their responses to the questionnaire and of their activities during the classroom observation.

The interview schedules (Appendix F) were different for each teacher as I derived the interview schedules from their responses to the questionnaire on paper and from the classroom observations. Although the interview was based on the responses that teachers provided, the actual questions were unique to each teacher, as each teacher's ideas to their responses varied. The semi-structured interviews contributed to understanding why teachers implement the curriculum the way that they do. These data collection strategies served to enhance design credibility of the study. During the interviews, the teachers discussed and provided explanations for the way in which they implemented the Natural Science Curriculum (Cohen et al., 2011). This technique enabled me to attain several responses to set questions as it allowed for thorough responses. Hitchcock and Hughes (1989) also note that interviews tend to be most favoured by educational researchers since they allow depth to be achieved by promoting the opportunity on the part of the interviewer to probe and expand the interviewee's response.

According to McMillan and Schumacher (2001) "the primary disadvantages of the interview are its potential for subjectivity and bias, its higher cost and time-consuming nature, and the lack of anonymity" (p. 268). To mitigate potential bias, I viewed myself as a neutral medium through which information was exchanged. Since the goal was attained, my presence had no effect on the perceptions or answers of the participants. Another drawback of semi-structured interviews is that there is a tendency to be diverted from the focus of the interview (Maree, 2009). When this occurred, the participants were redirected to the issue that was being discussed.

Narrative inquiry provided a context to examine and write stories from the data obtained from the interviews. Interviewing is essential to narrative research. Using semi-structured interviews allowed opportunities to be created for the teachers to reflect on their responses.

4.3.4.5 Rating Scale

Although rating scales are used mostly in quantitative research, I made the decision to use the scale to assess teachers' attitudes as I believed it was an efficient way to obtain the data I required. Maree (2009) concurs when he says that rating scales measure the strength of how participants feel or think about something. I analysed the rating scale qualitatively. The rating scale (Appendix G) I used was obtained from Cho, Kim and Choi (2003) who developed the scale to measure early childhood teachers' attitude towards science teaching. Although I adapted the scale to be appropriate for this study, the core structure was retained which was designed around four categories with a sum of 34 items. These items will be discussed further in the data analysis section.

I requested the teachers to complete the rating scale after the interview. There was no predetermined reason for this except that it was convenient to have teachers complete it when they were uninterrupted and away from school. The purpose of having teachers fill in the rating scale was to ascertain how they rated themselves as teachers of Science in the Foundation Phase. The responses obtained provide data to two of the three constructs, capacity to support innovation, and the profile of implementation. I used the rating scale itself as a schedule to collate and analyse the participants' responses.

4.4 NARRATIVE ANALYSIS

I selected the narrative inquiry method to present my findings as I envisaged that an in-depth understanding could be achieved by writing a story of each teacher's interpretation and implementation of the curriculum. I used the narrative method as a way of reporting descriptive analysis. Polkinghorne's (1995) definition of narrative as referring "to a discourse form in which events and happenings are configured into a temporal unity by means of a plot" (p. 5) was applied. In deciding to use the narrative inquiry method, I was cognisant of the categorisation of the two types of cognition, namely pragmatic and narrative (Bruner, 1985). Pragmatic functions by identifying features as being of a group and narrative functions by joining the features to form a story (Polkinghorne, 1995). Polkinghorne uses this distinction to categorise two type of narrative inquiry, namely analysis of narratives and narrative analysis. Analysis of narratives occurs when the data comprises stories and common categories are extracted to plot a story. Polkinghorne clarifies that the process of narrative analysis is actually a "synthesising of the data rather than as separation of it into its components" as the term analysis may suggest (Polkinghorne, 1995, p. 18). Of the two types of narrative inquiry, I will use narrative analysis to create a story for each teacher. I will present the narrative in the third person as a story for each teacher.

In this study, I created each teacher's narrative from the questionnaire, document analysis, classroom observations, semi-structured interviews and the rating scales with the intention of making sense of the raw data. As with a typical narrative analysis, the main idea or concept that underpins the narratives in this study is the foundation phase teachers' interpretation and implementation of the Natural Science Curriculum. While the narrative presents the findings with regard to each teacher's interpretation and implementation, the theoretical framework guides the structure of the story as the constructs and sub-constructs determined the types of data produced. Before constructing the narrative summaries, I compiled data obtained from the instruments. I present a further level of analysis by placing each teacher at a particular level for each construct. I explain how this was accomplished for each construct in the following section.

4.5 DATA COLLECTION AND ANTICIPATED ANALYSIS

Data analysis assists in supplying direction, organisation and significance to the large quantity of data that a researcher manages (Marshall & Rossman, 2006). Before embarking on explaining how the chosen theoretical framework informed the data collection instruments, I will draw on the process of data collection, which was employed in this study. The cyclic and iterative process of data collection (Figure 4.1) within the qualitative approach was an advantage as participants were revisited when further clarity was required (Maree 2009, p. 82).

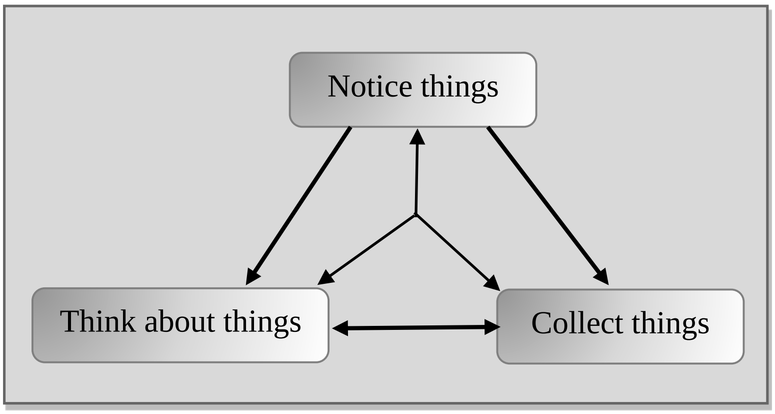

Figure 4.1: The Data Collection Process (Seidel 1998, p. 100)

According to Seidel the "analysing of qualitative data consists of three parts: Noticing, Collecting, and Thinking about interesting things" (1998, p. 1). Figure 4.1 illustrates the cyclic process of qualitative data collection. Seidel argues that when you do qualitative data analysis "you do not simply notice, collect, then think about things, and then write a report". He goes on to say that, the process has three characteristics. Firstly, it is iterative and progressive because it is a cycle that keeps repeating itself. Secondly, it is recursive because one part can call you back to a previous part. Thirdly, the process is holographic in that each step in the process contains the entire process. Siedel's framework for data collection was used in this study to collect data. In this study, I collected the data through an initial interview, classroom observations, document analysis, semi structured interviews and a rating scale. The questionnaire that was completed by the teachers was not detailed enough and did not provide in-depth explanations of what they were questioned about. Hence, at the start of the interviews, aspects of the questionnaire that needed to be clarified were dealt with at the start of the interview sessions. I applied the cyclic approach to data collection.

4.5.1 Data Collection

Table 4.1 summarises my data collection plan for the study by indicating which method and data source could answer each of the key research questions. It should be noted that to answer the third and fourth question: Why do foundation phase teachers interpret the Natural Science Curriculum the way that they do? and Why do foundation phase teachers implement the Natural Science Curriculum the way that they do? I will draw on the theory and literature to provide answers to this question.

Table 4.1: Data Collection Plan

Key Question	Method	Data source
1. What are foundation phase teachers' interpretation of the Natural Science Curriculum?	Document analysis	Lesson Plans
	Questionnaire	FP teachers, Grade R-Three
	Interviews	FP teachers, Grade R-Three
2. How do foundation phase teachers implement the Natural Science Curriculum?	Document analysis	Learners' books
	Questionnaire	FP teachers, Grade R-Three
	Interviews	FP teachers, Grade R-Three
	Rating Scale	FP teachers, Grade R-Three
	Classroom observation	FP teachers, Grade R-Three
3. Why do foundation phase teachers interpret the Natural Science Curriculum the way that they do?	Questionnaire	FP teachers, Grade R-Three
	Classroom observation	FP teachers, Grade R-Three
	Interviews	FP teachers, Grade R-Three
	Rating Scale	FP teachers, Grade R-Three
	This question is answered by considering all the data obtained and theorising the reasons why teachers do what they do.	
4. Why do foundation phase teachers implement the Natural Science Curriculum the way that they do?	Questionnaire	FP teachers, Grade R-Three
	Classroom observation	FP teachers, Grade R-Three
	Interviews	FP teachers, Grade R-Three
	Rating Scale	FP teachers, Grade R-Three
	This question is answered by considering all the data obtained and theorising the reasons why teachers do what they do.	

As I used the constructs and sub-constructs from the theoretical framework to inform the design of the instruments, it also acted as an analytical framework. Figure 3.1 shows a diagrammatic representation of the theoretical framework for the study (Rogan 2007, p. 99) which I used to analyse the data obtained from each of the data collection methods. I will further clarify the instruments used to collect and collate the information for each data collection method. I will provide a detailed explanation of how the sub-constructs were covered in each of the methods in the following section.

4.5.1.1 Document Analysis

I designed document analysis schedules to collate the data from the curriculum documents, learners' books and lesson plans. I provide an explanation of how I designed the schedules and how I used them to analyse each of these documents.

I drew on the sub-constructs for the profile of implementation, namely scientific investigations, hands-on science and integration of Natural Science to design the schedules I used to analyse the curriculum documents. I scrutinised the Foundation Phase and Natural Science RNCS documents (Appendix A) for evidence of each of the sub-constructs. The schedules allowed me to document the information for each sub-construct for each of the curriculum documents. Tables 4.2 and 4.3 illustrate the document analysis schedules for each of the curriculum documents analysed. I analysed the learners' Life Skills, Literacy, Numeracy and Homework Books (Appendix B) as well as each teacher's lesson plans for the duration of the observation (Appendix C). I attempted to work out the time teachers allocated to each of the three learning programmes including time spent on Natural Science by analysing the lesson plans submitted. I examined the Literacy, Numeracy and Life Skills Learning Programmes for content knowledge, instructional methods, physical resources, types of activities and the integration of Natural Science.

Table 4.2: Document Analysis Schedule for Foundation Phase RNCS

Evidence of		
Integration of Natural Science	Hands-on Science	Scientific Investigations

Table 4.3: Document Analysis Schedule for Natural Science RNCS

Evidence of		
Integration of Natural Science	Hands-on Science	Scientific Investigations

I drew on the sub-constructs for the profile of implementation, namely scientific investigations, hands-on science and integration of Natural Science to design the schedules I also used to analyse the learners' books. I scrutinised the learners' Life Skills, Numeracy, Literacy and homework books for evidence of each of the sub-constructs. The schedules allowed me to document the information for each sub-construct for each of the learners' books. Tables 4.4, 4.5, 4.6 and 4.7 illustrate the document analysis schedules for each of the learners' books analysed. I used separate schedules for each grade.

Table 4.4: Document Analysis Schedule for learners' Life Skills Books for each Grade

Evidence of		
Integration of Natural Science	Hands-on Science	Scientific Investigations

Table 4.5: Document Analysis Schedule for learners' Literacy Books for each Grade

Evidence of		
Integration of Natural Science	Hands-on Science	Scientific Investigations

Table 4.6: Document Analysis Schedule for learners' Numeracy Books for each Grade

Evidence of		
Integration of Natural Science	Hands-on Science	Scientific Investigations

Table 4.7: Document Analysis Schedule for learners' Homework Books for each Grade

Evidence of		
Integration of Natural Science	Hands-on Science	Scientific Investigations

I drew on the sub-constructs for the profile of implementation and the capacity to support innovation to design the schedules for the document analysis of the teachers' lesson plans. In the first part of the schedule, the teachers had to document the time allocation for each learning programme. Thereafter, I analysed each teacher's Life Skills, Numeracy and Literacy lesson plans for evidence of each of the sub-constructs. Content knowledge taught and 'instructional methods' are linked to the sub-construct 'teacher factors' of the capacity to support innovation. Furthermore, 'instructional methods' also relates to the each of the sub-constructs for the profile of implementation as the instructional methods provide data on how the teachers implement the curriculum. 'Physical resources' are linked to the sub-construct capacity to support innovation as it was the support that teachers had to teach each learning programme as based on the specific lessons. The 'types of activities' are associated with the profile of implementation as the different activities provide data on the teachers' implementation of the curriculum. The 'integration of Natural Science' is linked to the profile of implementation.

The schedules allowed me to document the information for each sub-construct for each of the teachers' lesson plans. Tables 4.8, 4.9, 4.10 and 4.11 illustrate the document analysis schedules for each of the teachers' lesson plans. I used separate schedules for each teacher.

Table 4.8: Document Analysis Schedule for Lesson Plans for each Grade

Time Allocation (for the grade for the week as per lesson plans)	
Learning Programmes	Time (%)
Literacy	
Numeracy	
Life Skills	
Natural Science	

Table 4.9: Document Analysis Schedule for Literacy Learning Programme Lesson Plans for each Grade

Day	Content Knowledge	Instructional Methods	Physical Resources	Types of Activities	Integration of Natural Science

Table 4.10: Document Analysis Schedule for Numeracy Learning Programme Lesson Plans for each Grade

Day	Content Knowledge	Instructional Methods	Physical Resources	Types of Activities	Integration of Natural Science

Table 4.11: Document Analysis Schedule for Life Skills Learning Programme Lesson Plans for each Grade

Day	Content Knowledge	Instructional Methods	Physical Resources	Types of Activities	Integration of Natural Science

4.5.1.2 Questionnaire

The questionnaire (Appendix D) aimed to gain an understanding of the teachers' interpretation of the Natural Science Curriculum within the Life Skills Learning Programme. Teachers completed the questionnaire on paper by answering the questions. The questions in the questionnaire served as a schedule to collate and analyse the data as the interview was structured around key areas. I used the questionnaire itself as a schedule to collate the teachers' responses. What follows is an explanation of how I used each section of the questionnaire as a schedule to collect the data.

In applying the constructs of the theory of implementation to this study, the questionnaire (Appendix D) incorporated all the sub-constructs for the profile of implementation, the capacity to support innovation and the support from outside agencies. I designed a variety of questions to elicit teachers' interpretation of the Natural Science Curriculum in the Life Skills Learning Programme. I constructed a set of appropriate questions which participants answered in written form (McMillan & Schumacher, 2001). I gave due consideration to the sequence of the questions "so as not to confuse the participants" (Maree, 2009, p. 160).

In Section A, the teachers had to provide information on their personal details, which place the teachers' background in context. Section A provides data on the sub-construct, 'teacher factors', which form part of the construct, capacity to support innovation. The information from section B on content areas provided the data for the teachers' interpretation of the Natural Science Curriculum. It also supplied data on the sub-construct, 'teacher factors', as part of the construct capacity to support innovation.

The information obtained from section C, on the instructional methods teacher used to teach Science provided data on how teachers implemented the curriculum. The schedule for this section provides data for the sub-construct 'teacher factors', which forms part of the construct the capacity to support innovation as well as the profile of implementation. Data from this section also relates to the sub-constructs: nature of classroom interaction, scientific investigations, hands-on science that forms part of the construct profile of implementation. The information obtained from section D on learner factors provided data on the sub-construct 'learner factors' that formed part of the construct the capacity to support innovation within the theoretical framework.

The information obtained from section E on teacher factors provided data for the sub-construct 'teacher factors' for the construct capacity to support innovation as well as for the sub-construct 'professional development' for the construct the support from outside agencies within the theoretical framework. The information obtained from section F on physical resources, provided data on the sub-construct 'physical resources' that formed part of the construct the capacity to support innovation as well as support from outside agencies. The information obtained from section G on general ethos and school management, provided data on the sub-construct 'school ethos and management' that formed part of the construct the capacity to support innovation. Section H had two parts. The first part of this schedule provided data on the 'nature of classroom interaction' for the construct profile of implementation. The second part of this schedule provided data on the sub-construct 'professional development' for the construct support from outside agencies.

As is evident from the above discussion, I designed the questions in the questionnaire using each of the sub-constructs of the theoretical framework. I used the schedule of questions as the instrument to collate and analyse the data as I grouped them according to each sub-construct.

4.5.1.3 Classroom Observation

I transcribed the classroom observations. The data from the classroom observations provided data on the teachers' capacity to support innovation and the profile of implementation. The data on classroom observations did not contribute to the construct support from outside agencies. For the constructs, capacity to support innovation the data served to validate the teacher's view of their capacity with respect to the sub-construct teacher factors. Similarly, for the sub-construct, learner factors the data from the classroom observation authenticated some of the teachers' view of the learners. I obtained data during the classroom observations regarding the physical resources that teachers used for their lessons. For school ethos and management, I obtained information regarding the class routine from the data.

The data from the classroom observations contributed to all of the sub-constructs of the profile of implementation. I scrutinised the data for evidence relating to each sub-construct, nature of classroom interaction, integration of Natural Science, scientific investigation and hands-on science. For the nature of classroom interaction I considered the class routine and the lesson structure, language of instruction, learners' attentiveness, questioning, use of resources, types of activities and instructional methods and managing group activities. I attempted to discover additional science teaching by identifying incidental teaching and learning. I provide more detailed explanations of how I used the constructs and sub-constructs to analyse the classroom observations under application the constructs.

4.5.1.4 Semi-structured Interviews

As mentioned earlier, the semi-structured interview (Appendix F) questions were not the same for each teacher as it drew on the information from the questionnaire and the classroom observations. The transcribed interviews were carefully analysed and the data was viewed through the lens of the sub-constructs of the theoretical framework. The questions related to each of the sub-constructs, profile of implementation, capacity to support innovation and support from outside agencies.

4.5.1.5 Rating Scales

The teachers completed the rating scales (Appendix G) after their interviews. There were four categories, namely, confidence, classroom preparation, managing hands-on science and developmental appropriateness. Each of these categories was linked to more than one sub-construct of the theoretical framework. Figure 4.2 below depicts the relationship between each aspect of the rating scale to the sub-constructs of the theoretical framework.

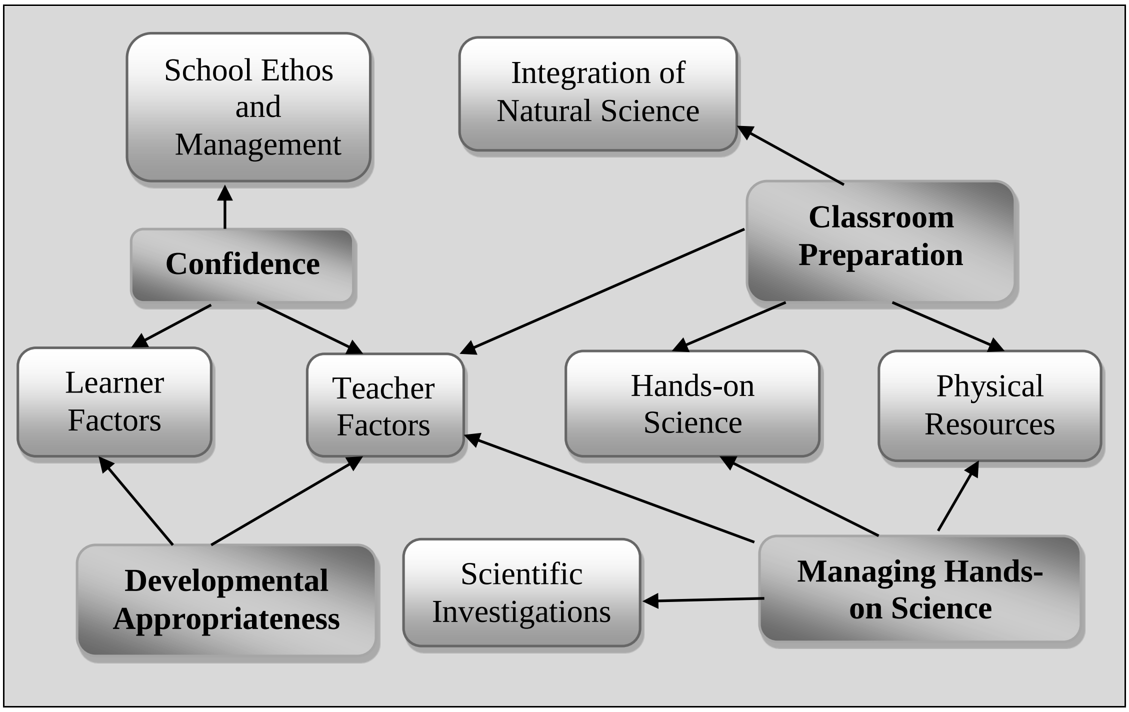

Figure 4.2: Map showing link between categories of rating scale and sub-constructs of the analytical framework

The first category had ten items, which measured teachers' confidence in teaching science content. Some of the statements that teachers had to rate in this sub-construct were: "I have the necessary skills to teach science", "I feel comfortable doing science activities in my classroom" and "I fear science activities would not turn out as expected".

The second category measured teachers' classroom preparation and had 13 items. Some of the statements that teachers had to rate in this sub-construct were "I enjoy reading resource books to obtain ideas about science activities for young children", "I am willing to spend time setting up materials for scientific exploration" and "I am happy to help children construct science equipment for hands-on science".

The third category had six items to measure how teachers' manage hands-on science. Some of the statements that teachers had to rate in this sub-construct were: "I am not afraid of demonstrating experimental procedures in the classroom", "I enjoy collecting materials and objects to use in my science teaching" and "I am interested in handling certain animals and insects to teach Science".

The fourth category measured the developmental appropriateness of the Science Curriculum as perceived by the teachers. Some of the statements that teachers had to rate in this sub-construct were "I do not believe it is appropriate to introduce science to children at an early age", "I am comfortable with determining the science curriculum that is developmentally appropriate for young children" and "I do not feel that young children are curious about scientific concepts and phenomena". Teachers responded to the 25 positive and nine negative items using the three-point Likert Scale from agree to disagree.

4.6 RESEARCH RIGOUR

Trustworthiness, Credibility and Crystallisation

The conventional principles for certifying the integrity of research data, namely reliability and validity, are used in quantitative research since they are often based on standardised instruments and can be measured in a comparatively uncomplicated way. Qualitative research differs, as it is not dependent upon standardised instruments and often smaller, non-random samples are used. Hence, these conventional principles cannot be stringently applied to qualitative research, as the qualitative researcher is mostly concerned with searching for the importance and interpretation of phenomena.

Merriam (1998) is of the view that because the constructs of reliability and validity are quantitative and positivist, they are not necessarily that applicable to qualitative research. Cohen et al. (2011) maintain, "Threats to validity and reliability can never be erased completely; rather the effects of these threats can be attenuated by attention to validity and reliability" (p. 179). In qualitative research, validity and reliability are not considered separately. In qualitative research validity and reliability are replaced with credibility and trustworthiness (Maree 2009). Golafshani (2003) concurs, "Instead terminology encompassing both, such as credibility, transferability and trustworthiness is used" (p. 600). Lincoln and Guba (1985) declare, "There can be no validity without reliability." In view of this fact, they explain, "a demonstration of the former (validity) is sufficient to establish the latter (reliability)” Thus showing validity is enough to ensure reliability. They then explain, “As to how trustworthiness as validity can be assured” for a qualitative study (p. 316).

Although evaluating the correctness or accuracy of qualitative data is not straight forward, there are a few of approaches that may be used to augment the trustworthiness of qualitative research findings. Trustworthiness is the equivalent expression used in qualitative research as a gauge of the quality of research. Trustworthiness is the extent to which the data and data analysis are believable and trustworthy. Researchers propose that the trustworthiness of qualitative research can be determined by means of four approaches: credibility, transferability, dependability and confirmability, which are equivalent to the quantitative criteria of internal and external validity, reliability and neutrality (Creswell, 1998; Krefting, 1991; Lincoln & Guba, 1981).

Credibility in qualitative research is characterised as the degree to which the data and data analysis are authentic and trustworthy. Credibility is comparable to internal validity in that both seek to discover how research findings validate reality. Lincoln and Guba (1985) maintain that ensuring credibility is one of most important factors in establishing trustworthiness (p. 296). However, according to the beliefs fundamental to qualitative research, reality is relative to meaning that people construct within social contexts (Armitage, 2007; Fink, 2000; Hitchcock & Hughes, 1989; Mertens, 2005; Patton, 2002; Richardson, 2000; Schostak, 2003; Thomas, 2003). According to Fink (2000), qualitative research is valid to the researcher and not necessarily to others due to the possibility of multiple realities. The reader needs to evaluate the degree of its credibility based on his/her understanding of the study. Thus, from an interpretive perspective, understanding is constructed together and there is no purposeful certainty or reality to which the results of a study can be compared. Walker (cited in Merriam, 1998) says this involves, “Presentation of material informs where it is open to multiple interpretations” (p. 44). Consequently, detailed descriptions will be provided to allow readers the opportunity to both check the researcher’s interpretations and warrant for the assertions.

According to Lincoln and Guba (1981), research findings are transferable or generalisable only if they fit into new contexts outside the actual study context. Transferability is equivalent to external validity, that is, the degree to which findings can be generalised (Cohen et al., 2011, p. 186). However, case study research is done in order to understand the particular in depth rather than for the purpose of generalisation. Seale (1999) advocates that transferability is achieved by providing a detailed, rich description of the settings studied to provide the reader with sufficient information to be able to judge the applicability of the findings to other settings that they know (p. 468). Hull (1997) and James and Mulcahy (1999) concur that the explanation ought to also contain credible analysis or interpretation. A rich and thick description of this study will allow the reader the opportunity to evaluate the findings of the research and arrive at their own conclusion on the transferability of the research outcomes.

Dependability is comparable to reliability, that is, the reliability of observing the same finding in equivalent circumstances. According to Merriam (1998), it refers to the extent to which research findings can be replicated with similar subjects in a similar context. It emphasises the importance of the researcher accounting for or describing the changing contexts and circumstances that are fundamental to consistency of the research outcome. Merriam (1998) argues that reliability in the traditional sense is not practical in a qualitative case study. As a result, she suggests that reliability in this type of research should be determined by whether the results are consistent with the data collected. She proposes different ways in which this can be attained. The researcher must "explain the assumptions and theory behind the study", use multiple methods of data collection and analysis and "explain in detail how data was collected to allow for an audit trail if necessary" (Merriam, 1998, p. 98).

According to Seale (1999), dependability can be achieved through auditing which consists of the researcher's documentation of data, methods and decision made during a thesis as well as its end products. Inspection for dependability necessitates that the data and descriptions of the research should be elaborate and rich. This is attained by means of an audit trail, which involves documentation of the methods, procedures and decisions made; the sample selection; and explanation of the categories used (Hull 1997; Merriam, 2002). James and Mulcahy (1999) affirm that reproducing the findings may be impossible. However, they are of the view that if researchers study the identical community of research participants at a similar time, the data sets obtained by these researchers and their interpretation should be largely analogous.

Confirmability is the degree to which the research findings can be confirmed or corroborated by others. It is similar to objectivity in quantitative research, that is, the extent to which a researcher is aware of or accounts for individual subjectivity or bias. According to Merriam (2002), "The confirmability of findings is based on the researcher's critical self-reflection regarding his or her assumptions, world views, biases, theoretical orientations, values, and epistemological stances" (p. 23). In addition, this reflection should contain the recognition of problems experienced during the course of the research, together with ethical issues (Hull, 1997).

According to Maree (2009), most qualitative research studies aim “to engage in research that probes for a deeper understanding of a phenomenon and not to search for causal relationships” (p. 81). Qualitative research attempts to delve into the person’s interpretations about a phenomenon and how they came to those understandings. Therefore, with qualitative research we are exploring an “emerging reality that we are describing and analysing” (Maree, 2009, p. 81). On this point, Richardson (2000) argues that triangulation is supported on the supposition of a permanent entity that can be triangulated. She dismisses this permanent entity as the aim of a qualitative study and recommends that we should not triangulate but crystallise. Richardson (2000) explains that by using the concept of crystallisation we can move away from observing reality as being permanent and static to seeing the world as a crystal that has “an infinite variety of shapes, substance transmutations, dimensions and angles of approach” (p. 934). She further elaborates that crystallisation therefore provides us with a multifaceted and an in depth understanding of the phenomenon. The emerging reality materialises from a variety of data gathering methods and data analyses, which are used and it corresponds to our own interpretation of the phenomenon under investigation. Maree (2009) clarifies, “What we describe as our findings are those, which crystallise from the data.” He goes on to say, “This crystallisation reality is credible in so far as those reading our data and analysis will be able to see the same emerging pattern and this adds to the trustworthiness of our research” (p. 81). In this study, crystallisation will be obtained by comparing multiple sources of data. Cohen et al. (2011) are of the opinion that the researchers’ confidence will increase if the data from the methods complement each other. If the data from the initial interview, document analysis, classroom observations and interviews complement each other then I will be assured of the findings.

In qualitative research, claims of trustworthiness rest on the data collection and analysis techniques. To enhance trustworthiness in this study multi-method strategy and mechanically recorded data are used. According to McMillan and Schumacher (2001), different strategies may yield different insights about the topic of interest and increase the credibility of findings. The mechanically recorded data was obtained through the use of tape recorders and videotapes to enhance the trustworthiness by providing an accurate and relatively complete record. Independent professionals who were employed to video tape the lessons acted as field workers and were not involved with the interpretation of the data. The study provided a detailed description of the case via multiple data collection methods, an analysis of the themes or issues, and my interpretations or assertions about the case. Concerns regarding trustworthiness of observational techniques were limited, as the participants were observed over a period of time and not at a single sitting (Struwig and Stead, 2004, p.101). Trustworthiness was ensured during observation, as the lessons were videotaped.

The chronological order of the instruments used was deliberate as each instrument provided a greater depth of information. The instruments were sequential as prerequisite knowledge is required for each step. The data collected were analysed qualitatively by organising and categorising the data according to the sub-constructs of the theoretical framework.

4.7 ETHICAL CONSIDERATIONS

According to Brickhouse (1992), in case studies research the researcher is dependent on the participants for data and the research cannot continue without their trust and cooperation. To gain the trust of the participants in this study every endeavour was taken to ensure consent was obtained from all participants who were directly or indirectly involved in the research. Silverman (2011) reminds researchers that they should always remember that while they are carrying out their research, they are in reality entering the personal surroundings of their participants. Creswell (2003) maintains that the researcher has a responsibility to "respect the rights, needs, values and desires of the participants" (p. 202). As such, this understandably brings to the fore a number of ethical issues that need to be considered when collecting data.

Ethical considerations need to be maintained due to the interpersonal characteristics of narrative analysis. Researchers advocate that the researcher needs to adopt an attitude of compassion and not be critical or show doubt when listening to participants' stories (Clandinin & Murphy, 2007; Lieblich, 1996).

Gaining access is a significant first phase in planning educational research (Simons & Usher, 2000). Before I commenced with data collection, I made ethical submissions to the university for approval (Appendix H). Prior to obtaining ethical clearance from the Department of Education, the principal of the school was approached to gain permission to use the school in this study. The Department of Education and the principal gave permission for the research to be conducted and the teachers and learners gave their consent to participate in the research. Once verbal consent was obtained from the principal and the relevant teachers, the pertinent documentation was submitted to the Department of Education for approval of the study in the selected school. Only after receiving ethical clearance from the university and the Department of Education were letters requesting consent given to the principal and the four foundation phase teachers. The Ethical Clearance number for this study is HSS/0922/09D (Appendix I). In addition, consent letters in English and isiZulu were given to the learners to take home to be signed by their parents or guardians to acquire their informed consent (Appendix J). The principal and the learners were not directly involved in the study as the focus was on the foundation phase teachers. However, learners appeared in the videos and their workbooks were analysed. The study commenced once all consent letters were received. The teachers were assured of their privacy by guaranteeing their anonymity. Interview sessions and observation of lessons were scheduled at times and venues most convenient for the participants.

Frankfort-Nachmias and Nachmias as cited in Cohen et al. (2011) suggest the "deletion of identifiers" as one of the techniques to maintain confidentiality (p. 92). To maintain the teachers' anonymity, pseudonyms were used instead of the teachers' real names. In this research study, no participants were put in a situation where they might be harmed as a result of their participation either physically or psychologically (Trochim, 2000). Furthermore, participants were made aware of the fact that they took part in the study voluntarily, and were free to withdraw at any time should they so wish.

4.8 LIMITATIONS OF THE STUDY

Foundation phase (Grade R to Three) teachers were observed during practical teaching sessions with learners during the second week of the second term of school. It was intended that the observation take place for the whole week. Due to an unforeseen taxi strike, observation took place for three days, as learner attendance was very poor. This was not ideal as I would have liked to have observed them for the entire week.

4.9 CONCLUSION

This is a case study of one school in which four foundation phase teachers were selected for this study. In this chapter, I elucidate my research design and methodological position. I explained how the paradigm guided the methodology and determined the type of framework I selected. The theoretical framework and the research questions, guided the methodology during the study. Qualitative data were gathered through a variety of instruments. I gave a detailed account of the research instruments used to obtain the data required for this study, explaining how and where each instrument was used. While data collection occurred more or less chronologically, my analysis and interpretation were done in a reflective cyclic manner resulting in rich description and interpretations, which are grounded in data. I presented the case for employing narrative analysis as a method of analysing the data. In chapter five, I explain how I undertook the analysis of my data to produce a narrative account of each teacher's interpretation and implementation of the Natural Science Curriculum.

CHAPTER FIVE

DATA ANALYSIS AND PRELIMINARY DATA PRESENTATION

5.1 INTRODUCTION

In this chapter, I explain how my data was analysed. The first step involved the development of criteria to assist me to analyse data pertaining to teachers' interpretation of the Natural Science Curriculum. As mentioned in chapter three, this added an additional construct, not included in the theoretical framework. The discussion that follows therefore covers the constructs: interpretation of the Natural Science Curriculum, support from outside agencies, capacity to support innovation and the profile of implementation. The analysed data produced the findings, which were constructed to produce the narratives mentioned in chapter four. Each narrative develops along the lines of the constructs mentioned above.

5.2 INTERPRETATION OF THE NATURAL SCIENCE CURRICULUM

Before proceeding to understand how teachers implemented the Natural Science Curriculum it was important to gain an understanding of how they interpreted the curriculum. The first question in Table 4.1 concerns the teachers' interpretation of the curriculum and factors that may influence the teachers' interpretation. Therefore, a construct on the teachers' interpretation was developed and then incorporated. The key factors that could affect the teachers' interpretation were determined after consultation of the RNCS documents. As mentioned in chapter three, these factors included: time allocated for Natural Science in the Foundation Phase, aspects pertaining to the teaching of Natural Science in the Foundation Phase, natural science content areas and the instructional methods used to teach Natural Science.

The discussion, which follows attempts to explain the underlying considerations for each of the sub-construct, which were used to analyse each teacher's interpretation of the Natural Science Curriculum.

Since Natural Science forms part of the Life Skills Learning Programme, I examined the time allocated to Natural Science in conjunction with the time allocated for the Life Skills Learning Programme. The teachers' interpretation of how Natural Science should be taught in the Foundation Phase was examined in terms of their understanding of the time allocated to the teaching of Natural Science, which was reflected in their lesson plans. A comparison was made of the time allocated to teach Life Skills from the curriculum documents, lesson plans and the teachers' interpretation.

The teaching of Natural Science in the Foundation Phase was considered with regard to each teacher's interpretation of the Natural Science Curriculum. Teachers' interpretation included whether they thought that the curriculum promoted Natural Science and if there were sufficient opportunities to teach it. Teachers' understanding of integration and how it pertained to the teaching of Natural Science was considered. Resources that teachers needed to teach Natural Science, such as textbooks and workbooks were also incorporated within the sub-construct teaching of Natural Science in the Foundation Phase.

For the sub-construct, natural science content areas, I compiled the list of content areas in the questionnaire from the RNCS. This list was comprehensive and included content areas that were not suitable for the Foundation Phase, for example the atom and matter and motion. In addition, some of the content areas could also be taught in Geography, for example water and weather. I requested the teachers to select the content areas they were very confident/confident/ less confident and not confident to teach.

I compiled the list of instructional methods that the teachers used to teach Natural Science from the RNCS. The instructional methods that the teachers selected in their lesson plans to teach Natural Science provided insight into their interpretation of the curriculum.

It was important to note that the lesson plans are only the plans and not necessarily, what was actually taught during the observation lesson sessions. In a further attempt to ascertain teachers' interpretation of the Natural Science Curriculum, they were asked to give their ideas on what aspects needed to be included in a qualification for foundation phase teachers.

5.3 IMPLEMENTATION OF THE NATURAL SCIENCE CURRICULUM

I will now explain the constructs and sub-constructs for implementation of the Natural Science Curriculum (Figure 3.1). This sections considers the second research question: How do foundation phase teachers implement the Natural Science Curriculum?

5.3.1 Support from Outside Agencies

I incorporated the observation schedule, interviews and questionnaire as dimensions that related to types of support and encouragement that were relevant to this study. In the profile of outside agencies, I firstly considered the type of endeavour undertaken by outside organisations and secondly the manner in which they display their intent. The construct, support from outside agencies is examined through sub-constructs, which considers material and non-material support to schools (Table 5.1). The sub-constructs "physical resources" and "support to learners" are the material support, which may be offered at a range of levels. The "professional development" is the non-material support, which outside organisations arrange to support schools. The levels indicate a progression from "being external to being internal" (Rogan & Grayson 2003, p. 1193). For the purposes of this study, I considered learner support in terms of their low socio-economic status and the difficulty they experience with the language of instruction. I clarified the distinction between the two types of physical resources. Physical resources as support from outside agencies is the support the school received with respect to textbooks, workbooks and science equipment. Professional development is the training that teachers receive by either the school, Department of Education, Unions or any other outside agencies.

Table 5.1: Support from Outside Agencies (adapted from Rogan and Grayson 2003, p. 1193)

Level	Types of encouragement and support		
	Learner Support	Physical Resources	Professional Development
1			
2			
3			
4			

5.3.2 Capacity to Support Innovation

I incorporated the dimensions in the observation schedule, interviews and questionnaires that were relevant to the construct, the capacity to support innovation for this study. The sub-constructs were physical resources, teacher factors, learner factors and school ethos and management. This construct was also analysed using four levels (Table 5.2) with each level depicting a hierarchy of achievement with the aim being to attain level four. Since a single school participated in this study, the dimensions, physical resources and school ethos and management may be the same. Learner factors are included, as I believe; it affects the way in which the teacher will implement the curriculum. Learner factors is the sub-construct that may be different as the teachers teach different grades. I extracted the data for the learner factors from the learners' characteristics section of the questionnaire. In developing the questionnaire, I took the information from the RNCS documents on the kind of learner that is envisaged by the Department of Education.

The teacher factors are included as a construct as teachers have different qualifications, experience, confidence, commitment, subject content knowledge and pedagogical content knowledge. Teacher factors considered aspects regarding the teachers' capacity to support implementation of the Natural Science Curriculum. I extracted the teacher characteristics in the questionnaire from the RNCS documents as the kind of teacher that is envisaged by the Department of Education.

Table 5.2: The Capacity to Support Innovation (Rogan and Grayson 2003, p. 1188)

Level	Teacher Factors	Learner Factors	Physical Resources	School Ethos and Management
1				
2				
3				
4				

5.3.3 Profile of Implementation

I examined the construct, profile of implementation with regard to a number of sub-constructs (Table 5.3) which included integration of Natural Science, hands-on science, scientific investigation and the nature of classroom interaction. I obtained the data for the sub-construct of integration of the Natural Science Curriculum in the Life Skills Learning Programme from observations, document analysis of lesson plans and learners' books and interviews with the teachers. Data for hands-on science and scientific investigations sub-construct, respectively, were obtained from lesson observations and document analysis of lesson plans and learners' books. The nature of classroom interaction sub-construct considered the relationship between the teacher and learners in the classroom setting. It was analysed according to class routine and the lesson structure, language of instruction, learners' attentiveness, questioning, use of resources, types of activities and instructional methods and managing group activities. Evidence of integration of Natural Science, hands-on science and science investigation during classroom observations were also considered.

In developing a profile of implementation, each dimension comprising of four different levels were considered. The observations for each sub-construct were analysed across each of the four levels. For example, the four levels of interface range from teacher-demonstrations (level 1) to open-ended learner-centred investigations (level 4). As the practices ascend from level one to level four they become more advanced. I obtained data for classroom interaction from classroom and lesson observations.

Table 5.3: The Profile of Implementation (Rogan and Grayson 2003, p. 1181)

Level	Integration of Natural Science	Hands-on Science	Scientific Investigations	Classroom Interaction
1				
2				
3				
4				

5.4 SUMMARY OF DATA OBTAINED FROM THE INSTRUMENTS

The data obtained from the various instruments were summarised in tables. I used this data to construct each teacher's narrative and compose the composite tables, which served as templates to locate each teacher's ZFI. Table 5.4 shows the content areas out of 20 topics in the Natural Science Curriculum that each teacher was either very confident, confident, not so confident and not confident to teach. Where there are no ticks (✓), there were no responses to that content area.

Table 5.4 Summary of the Content Areas the Teachers are Confident Teaching

Key: K- Karen, F- Fiona, C- Carly, S- Simone

Content Area	Very Confident				Confident				Not so confident				Not confident			
	K	F	C	S	K	F	C	S	K	F	C	S	K	F	C	S
Light energy and colour						✓									✓	✓
Heat energy						✓									✓	✓
Sound energy										✓					✓	✓
Magnetic interactions						✓									✓	✓
Electrical energy										✓					✓	✓
Simple machines														✓	✓	✓
Plants				✓		✓					✓					
Animals				✓		✓					✓					
Nutrition	✓	✓		✓							✓					
Air	✓			✓		✓					✓					
Weather	✓			✓		✓					✓					
Water	✓	✓		✓							✓					
Matter and materials							✓									✓
Reactions and changes of materials							✓							✓		✓
Universe and solar system						✓		✓			✓					
Earth and moon systems						✓					✓					✓
Human body (systems)		✓				✓	✓	✓								
Matter and Motion										✓	✓					✓
Atoms										✓	✓					✓
Ecology										✓	✓					✓
Other																✓

Table 5.5 shows the frequency of the different instructional methods the teachers use to teach Natural Science. Where there are no ticks (✓), there were no responses to those instructional methods.

Table 5.5: Summary of the Frequency of the Common Instructional Methods Used

Key: K- Karen, F- Fiona, C- Carly, S- Simone

Instructional Methods	Daily				Weekly				Fortnightly				Monthly				Once a term				Never			
	K	F	C	S	K	F	C	S	K	F	C	S	K	F	C	S	K	F	C	S	K	F	C	S
Inquiry			✓																					
Lecture			✓	✓																				
Demonstration				✓																				
Laboratory																								
Discussion	✓	✓	✓	✓																				
Role playing	✓			✓		✓	✓																	
Problem-based learning	✓			✓							✓													
Cooperative learning	✓			✓			✓																	
Project-based learning	✓														✓									
Discovery							✓																	
Scientific investigations																								
Problem solving		✓																						
Hands-on	✓		✓	✓		✓																		
Journal								✓																
Learning centres												✓												
Scaffolding															✓									
Simulations						✓									✓									
Case studies															✓									
Graphic Organisers																								
Stories/ narratives	✓	✓					✓	✓																
Others																								

Table 5.6 shows the summary of learners' characteristics as perceived by the teachers. Where there are no ticks (✓), there were no responses to those characteristics.

Table 5.6: Summary of Learners' Characteristics

Learners' Characteristics	Grade R	Grade One	Grade Two	Grade Three
Well-behaved				
Confident		✓		
Literate				
Numerate				
Learners come from a supportive home environment	✓			✓
Enthusiastic	✓	✓		✓
Respects the environment	✓			
Enjoys group work	✓		✓	
Critical thinkers	✓			
Low socio-economic background			✓	✓
Creative	✓	✓	✓	
Problem solvers		✓		
Independent				
Difficulties with the language of instruction	✓		✓	✓

Table 5.7 shows the summary of teachers' characteristics as described by themselves. Where there are no ticks (✓), there were no responses to those characteristics.

Table 5.7: Summary of Teachers' Characteristics

Teachers Characteristics	Karen	Fiona	Carly	Simone
Dedicated	✓	✓	✓	✓
Caring	✓	✓	✓	✓
Well qualified	✓	✓	✓	✓
Experienced	✓	✓	✓	✓
Attends professional development activities	✓	✓	✓	✓
Confident	✓	✓	✓	✓
Approachable	✓	✓	✓	✓
Tries innovative teaching techniques	✓	✓	✓	✓
Plans lessons well	✓	✓	✓	✓
Sound Science content knowledge		✓		
Conscientious attendance	✓	✓	✓	✓
Committed	✓	✓	✓	✓
Make an extra effort to improve teaching	✓	✓	✓	✓
Competent	✓	✓	✓	✓
Sound Science pedagogical content knowledge	✓	✓		

Table 5.8 shows the summary of summary of physical resources used by the teachers. Where there are no ticks (✓), there were no responses to those resources.

Table 5.8: Summary of Physical Resources Used

Key: K- Karen, F- Fiona, C- Carly, S- Simone

Physical Resources	Daily				Weekly				Fortnightly				Monthly				Once a Term				Never			
	K	F	C	S	K	F	C	S	K	F	C	S	K	F	C	S	K	F	C	S	K	F	C	S
Chalkboard	✓	✓	✓	✓																				
Textbook	✓		✓	✓																				
Worksheets	✓	✓	✓	✓																				
Whiteboard	✓						✓																	
Science equipment																								
Nature								✓																
Videos																								
Library	✓	✓					✓					✓												
Computers												✓												
Models						✓																		
Others																								

Table 5.9 shows the summary of the characteristics of school ethos and management as perceived by the teachers. Where there are no ticks (✓), there were no responses to those characteristics.

Table 5.9: Summary of School Ethos and Management

Key: K- Karen, F- Fiona, C- Carly, S- Simone

Characteristics of the school's ethos and management	Strongly agree				Agree				Undecided				Disagree				Strongly disagree			
	K	F	C	S	K	F	C	S	K	F	C	S	K	F	C	S	K	F	C	S
Well- structured timetable	✓		✓			✓		✓												
Strong presence of principal is felt	✓		✓			✓		✓												
Principal is in regular contact with staff	✓		✓			✓		✓												
Strong presence of HoD is felt	✓		✓					✓												
HoD is in regular contact with staff	✓		✓					✓												
Good organisation of extra mural activities	✓		✓					✓												
Regular staff meeting	✓		✓			✓		✓												
School is secure and access is denied to unauthorised personnel	✓	✓	✓					✓												
Colt (culture of learning and teaching) is strongly present	✓		✓			✓		✓												
School governing body is in existence	✓		✓			✓		✓												
Teachers and learners play an active role in management	✓		✓					✓		✓										
Parents play an active role in supporting the school	✓		✓					✓		✓										

Table 5.10 shows the comparison between each teacher's responses to the statements on the rating scale. Where there are no ticks (✓), there were no responses to those statements.

Table 5.10: Comparison between each Teachers' Responses to the Rating Scale

Key: K- Karen, F- Fiona, C- Carly, S- Simone

Items		Agree				Undecided				Disagree			
		K	F	C	S	K	F	C	S	K	F	C	S
Confidence													
1.	I have the necessary skills to teach Science.	✓		✓			✓		✓				
2.	I feel comfortable doing Science activities in my classroom.	✓		✓			✓		✓				
3.	I fear science activities would not turn out as expected.	✓	✓	✓									✓
4.	I understand science concepts well enough to effectively teach science.	✓		✓			✓						✓
5.	I find it difficult to explain to learners some science concepts.		✓	✓	✓	✓							
6.	I am typically able to answer learners' science questions.	✓	✓	✓	✓								
7.	Given a choice, I would not invite the principal/head of department to evaluate my science teaching.			✓		✓	✓		✓				
8.	I have a difficult time understanding science.	✓	✓	✓					✓				
9.	I enjoy teaching science.	✓	✓	✓					✓				
10.	When teaching Science, I usually welcome student questions.	✓	✓	✓	✓								
Classroom Preparation													
11.	I enjoy reading resource books to obtain ideas about science activities for young children	✓	✓	✓					✓				
12.	I am willing to spend time setting up materials for scientific exploration.	✓	✓	✓	✓								
13.	I am happy to help children construct science equipment for hands-on science.	✓	✓	✓	✓								
14.	Teaching science takes too much time.	✓	✓		✓							✓	
15.	I am ready to learn and use scientific knowledge and skills for planning hands-on science.	✓	✓	✓	✓								
16.	I like to discuss ideas and issues of science teaching with my colleagues.	✓	✓	✓									✓
17.	Teaching science takes too much effort.		✓							✓		✓	✓

18.	I am familiar with raising open-ended questions to encouraging children’s scientific exploration.	✓	✓	✓					✓				
19.	I use many hands-on activities to help my learners learn science.	✓	✓	✓					✓				
20.	I am able to take my learners outside the classroom to learn Science.	✓	✓	✓	✓								
21.	Preparation for science teaching generally takes more time than other subject areas.	✓			✓		✓					✓	
22.	I integrate Science into other subject areas.	✓	✓	✓	✓								
23.	I integrate other subject areas into Science.	✓	✓						✓			✓	
Managing Hands-on Science													
24.	I am not afraid of demonstrating experimental procedures in the classroom.	✓	✓	✓					✓				
25.	I enjoy collecting materials and objects to use in my science teaching.	✓	✓	✓					✓				
26.	I am interested in handling certain animals and insects to teach Science.		✓	✓		✓							✓
27.	I am comfortable using any classroom materials (e.g., blocks, toys, boxes, etc.) for science activities.	✓	✓	✓	✓								
28.	I do not mind the messiness created when doing hands-on science in my classroom.	✓	✓	✓	✓								
29.	Teaching of science process is important.	✓	✓	✓	✓								
Developmental Appropriateness													
30.	I do not believe it is appropriate to introduce Science to children at an early age.									✓	✓	✓	✓
31.	I am comfortable with determining the science curriculum that is developmentally appropriate for young children.	✓	✓	✓					✓				
32.	I do not feel that young children are curious about scientific concepts and phenomena.									✓	✓	✓	✓
33.	I am familiar with the processes and ways that young children learn Science.	✓		✓	✓		✓						
34.	I feel that young children cannot learn Science until they are able to read.									✓	✓	✓	✓

5.5 COMPOSITE TABLES OF TEACHERS' INTERPRETATION AND IMPLEMENTATION

I produced a table with the composite levels for the interpretation of the Natural Science Curriculum based on the levels designed by Rogan and Grayson (2003) with regard to implementation of the curriculum. These tables contribute to answering the first and second research questions: *What are foundation phase teachers' interpretation of the Natural Science curriculum and How do foundation phase teachers implement the Natural Science Curriculum.* The table highlights the expected outcomes for each level and sub-construct. Table 5.11 shows the outcomes for the levels. I used Table 5.11 to locate each teacher's level, based on the findings presented in the teachers' narratives in chapters, six, seven, eight and nine.

A table with the composite levels for support from outside agencies was produced which showed the expected outcomes for each level and sub-construct. The table was adapted from Rogan and Grayson (2003) to accommodate the foundation phase context. I used Table 5.12 to locate each teacher's level for support from outside agencies.

A table with the composite levels for the capacity to support innovation was produced which highlighted the expected outcomes for each level and sub-construct. The table was adapted from Rogan and Grayson (2003) to accommodate the foundation phase context. I used Table 5.13 to locate each teacher's level for the capacity to support innovation.

A table with the composite levels for the profile of implementation was produced which highlighted the expected outcomes for each level and sub-construct. The table was adapted from Rogan and Grayson (2003) to accommodate the foundation phase context. I used Table 5.14 to locate each teacher's level for the profile of implementation.

Table 5.11 Composite levels for Teachers' interpretation of the Natural Science Curriculum

Level	Time Allocation	Teaching Natural Science	Content Areas	Instructional Methods
1	Time allocation for all three learning programmes (Literacy, Numeracy and Life Skills) were not indicated	Teacher was cognisant of the fact that Natural Science needed to be taught through integration or as a freestanding subject but there was no evidence of this in her lesson plan *Foundation for Learning* workbook and lesson plans did not correspond to the curriculum Teacher has no knowledge of natural science learning outcomes	Teacher had no knowledge of the natural science content that should be covered in the Foundation Phase	Teacher mentioned instructional methods that was not appropriate for teaching Science
2	Time allocation for all three learning programmes (Literacy, Numeracy and Life Skills) were indicated but was not in accordance with the RNCS	Teacher was cognisant of the fact that Natural Science needed to be taught through integration or as a freestanding subject and there was minimal evidence of this in her lesson plan *Foundation for Learning* workbook and lesson plans did correspond to the curriculum to a certain extent but did need adapting	Certain topics mentioned by the teacher were appropriate for the Foundation Phase	Teacher mentioned a number of instructional methods appropriate for teaching Science, but there was no evidence of this in her lesson plan

		Teacher was unsure of the natural Science learning outcomes		
3	Time allocation for all three learning programmes were clearly indicated together with the time allocated for Natural Science which was indicated but was not in accordance with the RNCS	Teacher was cognisant of the fact that Natural Science needed to be taught through integration or as a freestanding subject and there was substantial evidence of this in her lesson plans *Foundation for Learning* workbook and lesson plans did correspond to the curriculum and did not need adapting Teacher demonstrates understanding of the natural Science learning outcomes	Most of the content topic mentioned correspond with content mentioned in the curriculum	Teacher mentioned a number of instructional methods appropriate for teaching Science and provided suitable examples but there was no evidence of this in her lesson plan
4	Time allocation for all three learning programmes were clearly indicated together with the time allocation for Natural Science which was clearly indicated in accordance with the RNCS	Teacher was cognisant of the fact that Natural Science needed to be taught through integration or as a freestanding subject and there was substantial evidence of this in her lesson plans which was in keeping with the learning outcome for Natural Science	Teacher was knowledgeable with regard to the natural science content in the curriculum and selected appropriate topics from there	Teacher mentioned a number of instructional methods appropriate for teaching Science, provided suitable examples and there was evidence of this in her lesson plan

		Foundation for Learning workbook and lesson plans did correspond to the curriculum and provided activities that was age appropriate and relevant to the learners Teacher included learning outcomes for Natural Science in her plans		

Table 5.12 Composite levels for the Support from Outside Agencies (adapted from Rogan and Grayson, 2003)

Level	Learner Support	Physical Resources	Professional Development
1	No support by parents with regard to language of instruction, finance, or homework No support from teacher to assist learners experiencing difficulty with the language of instruction	No provision of science equipment to teach Natural Science No facility to teach Science, for example classroom space, water, school yard No life skills workbook supplied	No staff development planned by school No non-science workshop attended No workshops on Science offered
2	Minimum support-by parents with regard to language, finance or homework Minimum support from teacher to assist learners experiencing difficulty with the language of teaching, e.g. teacher translates in isiZulu	Limited provision of science equipment to teach Natural Science Limited facility to teach Science, for example any one of the examples listed in criteria one Integrated workbook was supplied	Limited staff development planned involving staff Limited non-science workshops attended Limited workshops on Science offered
3	Support provided by parents with regard to language, finance, homework which extends to attending school and parent meetings Support from teacher assisted learners experiencing difficulty with the language of teaching, e.g. extra lessons in English	Adequate provision of science equipment to teach Natural Science Basic facilities to teach Science, for example any two of the examples listed in criteria one Separate life skills workbook was supplied	Regular staff development planned involving staff Frequent attendance of non-science workshops Frequent science workshop offered
4	Strong parental support in all areas - parents are involved in all areas of schooling and are able to support learners financially	Provision of resources completely covered what was required for innovation	Regular staff development included workshops included specialists in the relevant areas

	Complete academic and personal support was provided by the teacher, school and outside agencies for example bursaries were made available for learners in need, feeding schemes, extra/ remedial classes	Separate workbooks were supplied for Natural Science A dedicated science room available to teach Science	Organising non-science workshops Frequent science workshops offered including classroom support

Table 5.13: Composite levels for Capacity to Support Innovation (adapted from Rogan and Grayson, 2003)

Level	Teacher Factors	Learner Factors	Physical Resources	School Ethos and Management
1	Teacher had a professional qualification but was not qualified to teach in the Foundation Phase Teacher had minimal science content knowledge Teacher had minimal science pedagogical content knowledge Teacher was not able to balance all aspects of her responsibilities Teacher acknowledged that she placed much more emphasis on Literacy and/or Numeracy and very little on Life Skills Teacher was not confident to teach Natural Science as there was no Science taught	Learners were not capable of carrying out scientific investigations Learners did not enjoy scientific investigations Learners did not enjoy working in groups	Teacher used no Science equipment Teacher did not use workbooks for Life Skills Programme Teacher did not use science textbooks	No timetable No visible presence of principal and/or HoD Staff meetings were seldom held No extramural activities School was not secure No evidence of Colt (culture of learning and teaching) No school governing body was in existence Teachers and learners played no role in management Parents played no role in supporting the school
2	Teacher had a professional qualification appropriate for the Foundation Phase but which did not include Natural Science	Learners were capable of carrying out scientific investigations with guidance Learners enjoyed some scientific investigations	Teacher used minimal resources to teach Science which were mostly inappropriate	Timetable existed but was seldom adhered to

	Teacher had limited science content knowledge Teacher had limited science pedagogical content knowledge Teacher was able to balance some aspects of her portfolio but finds it difficult with the large class size Teacher acknowledged that she placed much emphasis on Literacy and/or Numeracy and very little on Life Skills Teacher was confident to teach some aspects of Natural Science	Learners enjoyed working in groups	Teacher used integrated workbook but received no support on how to use it. Teacher used a science textbook	Principal and/or HoD was present at school most of the time Staff meetings irregular and poorly planned Extramural activities were organised in such a way that they often interfered with scheduled classes School was secure but no control of who enters the premises Limited evidence of Colt (culture of learning and teaching) A School Governing Body was in existence but not visibly active Teachers and learners played a minimum role in management Parents played a minimum role in supporting the school

3	Teacher had a professional qualification appropriate for the Foundation Phase which included minimal Natural Science Teacher had adequate science content knowledge Teacher had adequate pedagogical content knowledge Teacher was able to balance most aspects of her portfolio but finds it difficult with the large class size Teacher claimed that she placed equal emphasis on Literacy, Numeracy and Life Skills however this was not evident in her teaching Teacher was confident to teach most content areas of Natural Science	Learners were capable of carrying out scientific investigations in groups Learners enjoyed most scientific investigations Learners enjoyed working in groups and made individual contributions	Teacher used limited resources and improvised for example appropriate models and charts are made Teacher used integrated life skills workbooks and teacher received support on how to use it. Teacher used a few science textbooks	Timetable mostly adhered to Principal and/or HoD was present at school most of the time and was in regular contact with his/her staff Staff meetings regular but not well-planned Good organisation of extramural activities which seldom interfered with classroom activities School was secure and limited control of who enters the premises Adequate evidence of COLT The school governing body is concerned with limited activities related to the school Teachers and learners played an active role in school management

				Parents played active role in supporting the school in general
4	Teacher had a professional qualification appropriate for the Foundation Phase, which included a strong Natural Science component. Teacher had good science content knowledge Teacher had good pedagogical content knowledge Teacher was able to balance all aspects of her portfolio, class size was not an issue Teacher placed equal emphasis on Literacy, Numeracy and Life Skills which was evident in her teaching Teacher was very confident to teach Natural Science	Learners were capable of carrying out scientific investigations independently Learners enjoyed all scientific investigations Learners could take responsibility for their own learning and were willing to try new kinds of learning	Teacher used appropriate science equipment to teach Science Teacher used separate life skills workbooks received support on how to use it. Teacher used science textbooks, videos and other resources that supported innovation	Timetable strictly adhered to Principal and HoD's took strong leadership roles and were very visible during school hours. Well organised regular staff meetings Good organisation of extramural activities which never interfered with classroom activities School security was excellent with good access control. Excellent COLT in the school The school governing body is active in all areas related to the school Collaboration of all stakeholders was encouraged and practised resulting in a shared vision for the school

Table 5.14 Composite levels for the implementation of the Natural Science Curriculum (adapted from Rogan and Grayson, 2003)

Level	Integration of Natural Science	Hands-on Science	Scientific Investigations	The Nature of Classroom Interaction
1	No evidence of Natural Science integrated in Numeracy, Literacy or Life Skills No evidence of Numeracy, Literacy or Life Skills integrated in Natural Science	No evidence of hands-on science to help develop concepts Teacher did not use specimens and resources found in the local environment to illustrate lessons Learners were not practically involved in the lesson	No evidence of scientific investigations	Structure of lessons were disorganised, not well-sequenced, and not as per lesson plan Textbooks/workbooks/resources were not used Teacher did not engage learners with questions Teacher did not engage learners in meaningful learning activities which results in learners losing concentration and being disruptive
2	Minimal evidence of Natural Science integrated in Numeracy, Literacy and/or Life Skills Minimal evidence of Numeracy, Literacy and/or Life Skills integrated in Natural Science	Minimum evidence of hands-on science to help develop concepts Minimal use of specimens and resources found in the local environment to illustrate lessons	Minimal evidence of scientific investigations, which was teacher controlled	Teacher presented content which showed some organisation and sequence however it was not based on the lesson plan Teacher used textbook/ workbooks, however support was still needed

		Minimum involvement of learners in the lesson		Teacher engaged learners with questions, however the teacher either answered the questions or did not give learners enough time to respond to questions Teacher engaged learners in minimal meaningful learning activities which results in maintaining learners concentration most of the time
3	Evidence of Natural Science integrated in Numeracy, Literacy or Life Skills Evidence of Numeracy, Literacy or Life Skills integrated in Natural Science	Clear evidence of hands-on science to help develop concepts Teacher used specimens and resources found in the local environment to illustrate lessons Learners participated in closed practical work	Scientific investigations was initiated by teacher with learners working in groups to carry out the investigations	Teacher presented content in a well organised and well sequenced manner, based on a lesson plan Teacher used textbooks/ workbooks effectively Teacher engaged learners with questions and provided adequate time for learners to respond Teacher engages learners in meaningful learning activities that did not promote doing practical scientific activities.

4	Clear evidence of integration of Natural Science across Numeracy, Literacy and Life Skills, which enhanced the teaching and learning Clear evidence of integration of Natural Science across Numeracy, Literacy and Life Skills, which enhanced the teaching and learning	Teacher designed hands-on science in such a way that encouraged learner discovery of information Maximum use of specimens and resources found in the local environment to illustrate lessons- Learners performed 'guided discovery' type practical work in small groups, engaging in hands-on activities	Scientific investigations was initiated by the learners with learners working in groups or individually to carry out the investigations	Teacher presented content in a well organised and well sequenced manner, based on a well-designed lesson plan that promoted practical scientific investigations Teacher used textbooks/ workbooks effectively along with other resources Teacher engaged learners with questions that encourage in depth thinking Teacher engaged learners in meaningful learning activities that promoted doing practical scientific activities.

5.6 CONCLUSION

In this chapter, I discussed the manner in which I analysed the data for each construct. It was necessary to include the construct on teachers' interpretation of the curriculum as the constructs in the theoretical framework pertain to implementation. I designed criteria for the construct on interpretation based on the foundation phase context. I then proceeded to discuss the construct and related sub-construct that I used to analyse teachers' interpretation and implementation of the curriculum. The story as the constructs and sub-constructs determined the types of data produced. Before constructing the narrative, I compiled summaries of the data obtained from the instruments. I then compiled composite tables indicating outcomes at different levels. I used the tables to place each teacher at a particular level, based on the findings.

I present the findings as narratives for each teacher in chapters six, seven, eight and nine. Chapter six presents Karen's interpretation and implementation of the Natural Science Curriculum. This is followed by Fiona's narrative in chapter seven, Carly's narrative in chapter eight and Simone's narrative in chapter nine. Each of the teacher's narratives draw on the data from each construct and sub-construct as well as the teachers' interpretation of the Natural Science Curriculum. Within each teacher's narrative, each construct will be presented, discussed and the teacher placed at the appropriate level for the respective sub-construct. In chapter 10, I will present the discussion on the commonalities and differences for each narrative with a view to theorising the critical research question: *Why do foundation phase teachers interpret and implement the Natural Science Curriculum the way that they do?*

CHAPTER SIX

KAREN'S INTERPRETATION AND IMPLEMENTATION OF THE CURRICULUM

6.1 INTRODUCTION

In this chapter, I present the findings related to Karen's interpretation and implementation of the RNCS. The findings provides answers to the first and second research questions: *What are foundation phase teachers' interpretation of the Natural Science curriculum and How do foundation phase teachers implement the Natural Science Curriculum?* I drew on data pertaining to the way she interpreted and implemented the curriculum from a number of data sources mentioned in chapter four and produced a narrative from this data. As I composed the narrative based on the data, the narrative is presented in the third person as a story told by me, the researcher. Karen's story commences with some biographical information to provide a background to her qualifications and experience. Thereafter her story unfolds, guided by the constructs discussed in chapter five. The constructs are:

- Interpretation of the Natural Science Curriculum,
- Support from Outside Agencies,
- Capacity to Support Innovation and
- Profile of Implementation.

Karen's narrative reveals a composite view of her as a foundation phase teacher within the context of teaching Natural Science. Information derived from this composite allowed me to place Karen at a particular level for each of the constructs discussed.

6.2 KAREN'S STORY

Karen has a three-year Lower Primary Teaching Certificate, which includes a General Science component. She has more experience of Biology as this was one of her high school subjects. She regards herself as being qualified as she taught Grade One for 26 years and has been teaching Grade R for nine years. Karen has 35 years' experience teaching in the

Foundation Phase. She believes that her experience best qualifies her as a foundation phase teacher. Since there was only one grade R class, she had to complete all the planning and preparation on her own. At 58 years of age at the time of the study, she was the oldest participant. She had 38 learners in her grade R class at the time of data collection.

Karen's interpretation of the Natural Science Curriculum (Grade R)

Karen's interpretation of the Natural Science Curriculum is presented as a narrative according to the constructs and the related sub-constructs.

Time Allocated for Natural Science

Natural Science forms part of the Life Skills Learning Programme and thus the time allocated was examined in conjunction with the time allocated for the Life Skills Learning Programme. One aspect of Karen's interpretation of how Natural Science should be taught in the Foundation Phase was reflected by the time allocated to the teaching of Natural Science. This was indicated in the lesson plans provided by the *Foundations for Learning* documents. Table 6.1 shows the comparison of the allocation of times according to Karen's responses to the questionnaire and during interviews, lesson plans provided by her and the curriculum documents for each learning programme.

Table 6.1: Comparison of the Allocation of Times for Respective Learning Programmes for Grade R

Learning Programmes	Time Allocation per day according to		
	Foundations for Learning Lesson Plans	Curriculum Documents	Karen
Literacy	1 hour	1 hour 50 minutes	1 hour 50 minutes
Numeracy	1 hour 15 minutes	1 hour 30 minutes	1 hour 30 minutes
Life Skills	Overview of all Life Skills activities with no time allocation	1 hour 10 minutes	1 hour 10 minutes
Additional Activities: arrival time work time small group time tidy up time, health check, hand washing, snack time, music and movement ring, outdoor play, hand washing, toilet time and story time	 15-30 minutes 30 minutes 10-15 minutes The rest of the activities had no time indicated		

The time Karen stated that she allocated to the three learning programmes is in keeping with the curriculum documents. However, the time allocated on the lesson plans for the learning areas were much less than the curriculum documents and what Karen stated, as reflected in the last column. The lesson plans supplied by Karen were analysed and these may have been incomplete documents. Although some of the additional activities are allocated times (75 minutes), there was no indication from which learning programme these times should be taken. The life skills lesson plans were integrated with Numeracy, Literacy and aspects from the Life Orientation Learning Area and as such, the time allocated to Natural Science could not be determined.

Teaching of Natural Science in the Foundation Phase

Although the *Foundations for Learning* lesson plan did not provide direct information on how Karen interpreted the curriculum, the analysis of the lesson plans provided information on what Karen had planned for each day. Karen said, "We are using the *Foundations for Learning* but we have to write it out." She explained that this was what the head of department expected of them. She stated that she did try to use the lesson plans as is but there were some things that she would have skipped, especially when it came to phonics as the lesson plan started with the letter ‘v’. Karen thought, “Children do not have names starting with ‘v’ and there are not many words starting with ‘v’. She preferred to start with ‘a’ or ‘o’ as this was more common. It seemed that Karen took the initiative to restructure the literacy lesson plans.

The lesson plans for Literacy, Numeracy and Life Skills were analysed on content knowledge, instructional methods, physical resources, types of activities and integration of Natural Science. It was important to note that the lesson plans are only the plans and not necessarily, what was actually taught during the observation lessons. Karen’s lesson plans for Literacy, Numeracy and Life Skills for the period of observation were analysed. This analysis gave an indication of Karen’s interpretation with regard to where Natural Science fits in the particular section covered during observation.

The content for the period of observation was on friends. The literacy lesson plan included a class discussion on friends and the songs to be sung did relate to the theme. Learners were to form pairs and make up a clapping sequence to accompany the rhyme. The next day, the teacher was to revise the learners’ names and colours by singing a song. A number of non-science related activities were planned for the second and third day. Much time was spent on the literacy lessons, which did show integration with other learning areas such as Art and Craft but there was no planned integration with Natural Science.

The lesson plan for the week for the Numeracy Learning Programme showed that it began with counting to 10. This was followed by revising the names of shapes already learnt. The shape of a diamond was to be discussed. Board games were to be created using shapes. There was no numeracy lesson planned for the following day. On the third day, a graph was to be drawn on the qualities listed on what made a good friend. Results were to be discussed with the learners as a whole class. More time was allocated to be spent on Literacy than Numeracy and there was no evidence of planned integration of Natural Science.

Although Karen initially stated that the curriculum did promote Natural Science, she later said, “I think so…not altogether.” However she thought “it does especially when it comes to play as the learner can play and investigate”. Karen said she brought in Natural Science any time into her lesson “because they [the Department of Education] say we must integrate it." She explained, "I could be doing it in Literacy or Numeracy or even in Life Skills Learning Programme." She viewed the curriculum as not having sufficient opportunities to teach Natural Science and believed "we could do with more of it" as in "Grade R only certain things are touched on". Karen said the teachers "don't sit down and say this is Science we are doing" rather "a lot of it is integrated into everything else." Karen admitted that sometimes the "Science is lost during the integration" with the other learning areas.

Concerning the teaching of Natural Science, Karen stated, "I would teach it through experimenting, investigating, things like that there, just making it something the children will accept and like because Science is all around them and an everyday part of their lives." However, there was no evidence of Karen planning to teach Natural Science and more specifically teaching it in this manner.

Karen was not clear on how often she taught Natural Science in a week. She responded, "You know with ... so much being integrated – we do some every day or once a week." From Karen's response she was clearly mindful that Natural Science was supposed to be taught by integrating it into the learning programmes. However, by integrating Natural Science she was unsure of how often she taught Natural Science in her class. Planning of natural science lessons and ensuring the resources were available also becomes a challenge.

Karen did consider the Numeracy and Life Skills Curriculum to be adequate as it encompassed key content areas but believed that there are other subjects that she "didn't get to". She mentioned, "Like with Natural Science there is no book to follow and the Science is lost." She was of the opinion that "eventually the teacher is concentrating more on…can the child read or can the child count?" and "the health aspects and things like that are lost."

The lesson plan for the Life Skills Learning Programme began with learners being asked to bring a photograph of themselves to school the following day. A number of activities related to *friends* were planned and there was evidence of different learning areas being incorporated in the activities such as Music, Dance, Art and Craft, Drama, but Natural Science was not one of them. There was no integration of Natural Science across the literacy, numeracy and life skills lesson plans. There were no scientific investigations indicated in the numeracy, literacy and life skills lesson plans nor was there any evidence of hands-on science in the lesson plans.

Karen's opinion on the learner workbooks (resource) contributed to her interpretation of the curriculum. Karen was hesitant as she described whether the workbooks she received from the Department of Education referred to the curriculum. Her response was

> They more or less are... they are. It's just ... you know not everyone is ... you know when they give you...an activity when you have to cut something out, they don't leave a blank page they put another activity on the other side, you know instead of leaving it blank. So the planning of the workbooks is not that good.

It was difficult to ascertain if Karen was making an excuse not to do the activities. There are ways to work around the cutting out activities and to ensure all the activities are done in class.

In a further attempt to ascertain her understanding, she was asked to give her ideas on what needed to be included in a qualification for foundation phase teachers. Karen's response was that if she had the opportunity to design, a qualification for foundation phase teachers she would ensure it had "Literacy, Numeracy, Life Skills, Natural Science, Physical Education and Health." She acknowledged that in the current curriculum, Natural Science, Physical Education and Health is under the Life Skills as well." These learning areas are already part of the foundation phase curriculum. It appears that she would like the teachers' qualification to focus on the existing learning areas in the Foundation Phase.

Natural Science Content Areas

Karen had to select content areas where she was very confident, confident, relatively confident and not confident to teach (Appendix D). From Karen's responses, it was also evident which content areas were not taught and her interpretation of which content was/was not part of the Natural Science Curriculum for Foundation Phase was also elicited. Karen said she was very confident to teach the content areas of nutrition, air, weather and water. She did not reveal her confidence levels to teach any other content area that was asked in the questionnaire. However, during the interview she mentioned that she was confident to teach about plants and animals as well. The reasons she gave were that "it is part of the school curriculum" and "these topics are taught across the grades yearly." She admitted to never teaching the rest of the content areas given in the questionnaire. The reasons she gave was that it was “inappropriate to my grade R curriculum” and that it was “not part of our curriculum.”

Instructional Methods

The instructional methods that Karen indicated she used in her lesson to teach Natural Science provided insight into her interpretation of the curriculum (Appendix D). In her response to the questionnaire, she selected discussion, role-play, problem-based learning, cooperative learning, project-based learning, hands-on, and stories/narratives as instructional methods she used daily. She justified her choice as “these are the methods used to stimulate learners thinking and imagination.” She further explained during the interview that “it is easier for the child to understand these methods” and “I get the best results.”

During the interview, she mentioned using project-based learning. She cited an example where she gave the learners a project where they had to build a house and “they take it home and do it.” She did not select any other instructional method that she used weekly, fortnightly, monthly, once a term or never, implying that she used the above-mentioned methods often. Karen did not select “scientific investigations” as an instructional method that she used to teach Natural Science. Karen’s response indicated her understanding that a variety of methods was necessary when teaching Natural Science. However, her example did not provide evidence that she used these strategies. The purpose for giving learners the project of building a house was not clear.

Karen’s understanding of hands-on science revealed that she believed it is “things that they (learners) actually do, the experiments that they do themselves.” Furthermore, she advocated, “Science should be taught using hands-on methodology as learners must experience it.” From Karen’s responses, she viewed demonstrations as having a place in the curriculum. She thought demonstrations were important as they “stick to the mind and they can remember it”. She provided examples where she had used demonstrations:

> Just lately, we took water, put some soapy solution in and blew bubbles. We also put sugar or salt in the water and mixed it and the learners could taste this and see which one....

It was not clear which science concept this activity was intended to elucidate.

Karen's implementation of the Natural Science Curriculum - the influence of Outside Agencies

A number of factors, which affect Karen's implementation of the curriculum, are influenced by outside agencies.

Learner Support

Learner support is considered in terms of learners' socio-economic status and their experience with the language of instruction. Karen believed the learners in her class came from supportive home environments. Karen described the parents' as being "helpful" and "supportive especially with their homework". Karen believed that the parents wanted to "give them a good start in life." She explained, "Parents support the child as it is the child's first year of school and in most cases it is the youngest child and the parent wants to do the best for them." Karen admitted she "had to speak to parents about helping the children with homework" in her parent meetings. Karen's response seemed to be contradictory, although the parents supported their children; she had to remind them to do so. This may imply that Karen may have experienced problems with cooperation from some parents when she needed parents' assistance. Although Karen mentioned that the majority of learners in her class came from homes where parents were able to afford to supply learners with the necessary resources required for schooling, there were a number of learners who did not have scissors and glue with which to stick their worksheets in their books.

Karen mentioned that not all children grasped concepts at the same pace. Although some of learners could work independently, not all could. The learners exhibited difficulties with the language of instruction. Karen assisted the Zulu learners by "speaking isiZulu so they can understand the content taught." Karen explained, "I mix English and isiZulu when teaching. Some parents do not want me to talk in isiZulu. I stopped talking in isiZulu in June. It is amazing how they learn when isiZulu is stopped."

Physical Resources

Physical resources as support from outside agencies is the support the school received with respect to textbooks, workbooks, science equipment that the school is given by an outside agency, e.g. the Department of Education as well as the school's infrastructure. The buildings, although old, were in good condition. The school had a small library which the learners could not access unless a teacher accompanied them. The grade R class was at the back of the school and they had their own play area and a jungle gym with murals painted on the walls. The classroom seemed to be two classrooms which were combined into one as both ends of the classroom had chalkboards. Karen's classroom was spacious with the learners seated in groups. She used the carpet at the front of the chalkboard for group discussions. At the back of the class an open area was used for play activities. The classroom was cluttered with items that she used for the play activities, many of which were donated by more advantaged schools. Her desk was cluttered with books, paper and containers of stationery. She used the chalkboard, textbook, worksheets, whiteboard and the library daily in her teaching.

Karen said that every learner in her grade R class had been given one book by the Department of Education, which had activities for Literacy, Numeracy and Life Skills. Karen explained:

> There is only one learner book for Literacy and Numeracy together that was sent by the department. I have other books that were given to me by the Deputy Principal that I could use as reference books but have not used them yet as they are too busy for them. Maybe I will try later on in the year. They are Grade One books. There is no life skills book that was sent by the Department.

Professional Development

Professional development is the training that teachers receive by either the school, Department of Education, Unions or any other outside agencies. Karen admitted that she did not attend workshops often. She did not attend any natural science workshops but did attend a workshop on using 'play' to teach. If there were workshops on how to teach Natural Science in the Foundation Phase, Karen would have liked to attend. In terms of development, they had foundation phase staff meetings once a week on a Wednesday. Karen thought these meetings were "not beneficial." Karen declared, "I am on the outside." She maintained that she did not usually fit in with the grade meetings but was allowed to attend the meetings organised for Grade R by the Department of Education. Although the school had grade meetings, these did not assist Karen, as she was the only teacher teaching Grade R. Besides the staff meetings there was no staff development planned by school.

Karen's implementation of the Natural Science Curriculum-Factors, which shape her Capacity to Support Implementation

A number of factors influenced Karen's capacity to support implementation of the Natural Science Curriculum.

Teacher Factors

A number of factors contributed to Karen's decision to become a foundation phase teacher. Karen responded confidently to the question: why she became a foundation phase teacher, "I was always a foundation phase teacher. From the time I started, I always did that, I did the Foundation Phase." She preferred "being with the children, the little ones." During the interview, Karen was asked if she enjoyed Science when she was at school. She said, "Yes, I did Biology. I enjoyed it." The subject was then called General Science. Karen thought that this qualification helped her as a foundation phase teacher to teach Natural Science. She said, "You got the basic and you more or less were taught to deal with the subject at the Foundation Phase" and "it gave us ideas on how to teach Natural Science at the Foundation Phase and we used the ideas from there." Karen did not mind the noise and messiness when children played and experimented when doing Natural Science. She responded, "No, I am not that way a disciplinarian that they won't be able to do that." During the classroom observations, Karen did not teach Natural Science. Karen described herself as being dedicated, confident, approachable, caring, well qualified and experienced in teaching in the Foundation Phase. She attended professional development activities, made an extra effort to improve her teaching and tried innovative teaching techniques.

Karen said in the questionnaire that she planned lessons well, had conscientious attendance and was committed and competent with sound science pedagogical content knowledge. Karen admitted during the interview that she used the *Foundations for learning* lesson plans with minor adjustments. Therefore, she did not plan her lessons herself. Karen acknowledged that she did not believe she had sound science content knowledge.

Karen was of the view that she possessed the characteristics of a good science teacher because of her "experience and been at it for so long". As an outcome of this, "the way you handle a child and even teaching is done in a different way." She believed that with her experience she made changes in her teaching. She stated, "This year you could do it this way and next year you could try something else." It was also because of her experience that she said, "I feel confident, at my age - what nerves?"

Karen saw her greatest strength as a foundation phase teacher as "experience in teaching in the Foundation Phase" and that she was "passionate and care for the children". Karen explained that she did "not have enough time for recording" her assessments and as a result this was where she "slips up most of the time." Even though she knew what to do, she found that "working alone somehow I do not have the time to sit and complete it." She gave the learners all her time and attention when they were with her. She surmised that if she had a helper (Teacher Assistant) then the "other things would be in place."

Karen rated herself very positively on most categories of the rating scale, which measured the teacher's attitude to science teaching (Appendix G). However, she indicated less confidence in her ability to explain science concepts and hesitance to teach Science in the presence of other educators. Karen's responses to the statements on the rating scale were confusing. She agreed that she had a difficult time understanding Science as well as having the necessary skills to teach Science. Karen was undecided on her confidence levels to explain some science concepts but seemed to agree that she understood science concepts well enough to effectively teach Science. Karen rated herself highly with regard to classroom preparation. She believed she would be able to take the time to plan and use resources to teach Science and was of the view that teaching Science did not take too much effort.

Karen was of the view that she was capable of managing hands-on science and therefore teaching Science-by-doing. She was not keen to use animals (including insects) to teach Science. Karen believed that she is comfortable determining age appropriate Science activities for learners; she is familiar with the way children learn Science and that Science should be introduced from an early age as children are curious and they do not necessarily need to be able to read to do Science.

Learner Factors

Karen had 38 learners in her class of which 11 were boys and 27 were girls with an average age of 5 years. Karen believed her learners were very eager to learn and joined in freely with the discussion of topics. She thought they were respectful and thought the world of their teacher. Karen described the learners in her class, as being enthusiastic, showed respect for the environment, enjoyed group work, were critical thinkers and creative. Karen could "go through a day and not even reprimand" the learners. She explained:

> Especially in Grade R, the children do not have to sit quiet and do everything unless they fight and stuff like that. In most cases, they are learning. They are just children. This comes with experience. Some people come out teaching Grade R; they would not really do it. I have learnt to switch off at times.

Karen did not think her learners were confident, literate, numerate, independent problem solvers although she did mention that the learners were critical thinkers, which seems to be a contradiction. Karen believed that her learners were capable of conducting an investigation and that, "they will love that." However she stated that they do not like natural science activities that involve tasting different things, which is acceptable as the learners are young. According to Karen, learners seemed to enjoy activities that involved doing Science.

Physical Resources

Karen selected the chalkboard, textbook, worksheets, whiteboard and the library as resources that she used daily in her teaching of Natural Science. She did not select any physical resources that she used weekly, fortnightly, monthly, once a term or never. She did not select science equipment, nature, videos, computers and models as possible resources. The physical resources also applied to the teacher's capacity to use the resources.

Karen indicated that she used a textbook daily as a physical resource but this textbook had no life skills information and hence no natural science information. The textbooks that she used during the observation were two storybooks and the learners' workbook. Karen was expected to select the different activities from the workbook for her learners to complete, which she thought was applicable for the section of work. According to Karen, there were a few activities on Natural Science in the learners' workbook. Karen explained, "We have got one with plants when we talk about living things. There was one of the plant where they show the root, flower, whatever." Besides this book, Karen also used exercise books.

Karen said she had a garden the previous year and "learners were excited to see the plants grow; I would have liked to do a garden again this year." She did not believe that the school restricted her in her efforts to teach Natural Science. She explained:

> They actually encourage us to even ask the parents to help in certain ways. Just say we need sand from home or if we need sugar, ingredient, a dish, or a bucket you will use.

School Ethos and Management

Karen was of the view that the school had a well-structured timetable. A strong presence of the principal and head of department was felt because they were in regular contact with staff. There was good organisation of extramural activities. There were regular staff meetings. The school was secure with access denied to unauthorised personnel. The culture of learning and teaching was strongly present. The school governing body was in existence. Both teachers and learners played an active role in management and parents played an active role in supporting the school.

Although the "support and nurturing from seniors" provided her with the "knowledge and skills" to be an effective foundation phase teacher, Karen did not receive much support from the head of department in charge of the Grade R. She stated that she would have preferred that the head of department was more involved in Grade R but she understood when "she [head of department] says she has her own work." She only saw the head of department during Integrated Quality Management System (IQMS - a teacher evaluation process) when she sat in on Karen's lessons. Karen explained, "There was no build up to tell me how I am thus far. The head of department came in and when she was finished she went through 'my flaws' and I am marked accordingly." Karen had to plan for Grade R all on her own; however, the head of department checked the plan. In addition, there were no extramural activities for Grade R unless Karen organised it as "everything is left to me to see to." Karen believed "the principal is ok." She only saw the principal once a week if she passed the office but "whatever I want I ask for and say that I want to go for a meeting she is always willing to let me go." The head of department's responsibilities extended to supporting the grade R teacher and it seemed that this did not happen and Karen had to find the support from other senior staff members.

Karen's Profile of Implementation of the Natural Science Curriculum

I compiled this part of Karen's story mainly from the observations of her and her learners in a dynamic classroom setting, and from other previously mentioned data collection methods. A number of factors relating to curriculum implementation were considered.

Integration of Natural Science

Analysis of the grade R learners' books revealed that there was no evidence of any integration of Natural Science. No integration of Natural Science within the learning programmes was identified during the observation of Karen's lessons neither was there evidence of a science lesson where Numeracy or Literacy were integrated. Karen did not seem sure if she ever had the opportunity to teach an integrated natural science lesson within the Numeracy and Literacy Learning Programmes. Her response during the interview was very uncertain:

> mmm I don't know....I will think so ....were you just errr.....when you doing water ... how many cups of water in there.... the big or the small cup of water...things like that.

Hands-on Science

Analysis of the grade R learners' books revealed that there was no evidence of hands-on science in the teaching of Natural Science. No hands-on science was observed during the classroom observations either. Although Karen mentioned in the questionnaire that she used play as an instructional method to teach Natural Science, there was no evidence of this. The only play activity involved learners making jewellery with beads. In an attempt to provide an example of how she used play as an instructional method to teach Natural Science Karen provided the following explanation during the interview:

> like with er play er when you come to… er…. especially with water like how to you know... what do you use water for…..mmm…… different attributes of water say what's it used for I will get them to dirty their hands out there and take it and you know to go and wash their hands and what happens their hands are cleaned.

Scientific Investigations

Analysis of the grade R learners' books revealed that there was no evidence of scientific investigations in the teaching of Natural Science. Neither was scientific investigation noted during the observation. Although Karen did not teach Natural Science during the observation, she did mention during the interview that she did teach Natural Science. She said, "Learners brought in fruits to make a fruit salad. We spoke about the different colour textures… like in the *Foundations for Learning* lesson plans."

The Nature of Classroom Interaction

The nature of classroom interaction considered the relationship between Karen and the learners in the classroom setting with regard to class routine and the lesson structure, language of instruction, learners' attentiveness, questioning, use of resources, types of activities and instructional methods and managing group activities. Examples of incidental teaching and learning were identified in an attempt to discover occurrences of science teaching.

Karen spent a fair amount of time settling learners as well as other organisational activities throughout the day. The language of instruction was English, however there were learners who did not understand and Karen had to speak to them in isiZulu. For example, Karen tried to encourage the learners to sit on the carpet at the front of the class according to their height. This took some time as the learners found this challenging. Karen had to repeat the instruction in isiZulu so that the learners could understand what was expected of them. She repeated most of the instructions isiZulu.

The learners seemed to be easily distracted and as a result, it was very difficult for Karen to maintain discipline. During the morning, there was constant disruption and fidgeting as learners played with their tuck-shop money. There were minor fights as learners were interfering with each other and they constantly wanted Karen's attention even when they had work to complete. Karen attempted to get the learners to settle down by singing songs. This seemed to bring the learners attention back and they seemed to be calmer.

Some activities were interactive in nature such as the previously mentioned activity about friends. Learners were less capable of doing the numeracy activity, which required them to count the number of shapes and select from those that were given which was the right answer. The majority of the learners found this exercise difficult, as they were unable to circle one number in the row. They either circled all or chose the incorrect one. Karen read to learners three times during the observation period. She read two stories to them called 'Nana and the caterpillar' and 'Oh no Nicky'. Karen used different methods to form learner groups.

Karen asked learners questions during different activities and she seemed to find it difficult to follow the learners' daily news, as they were incoherent and inaudible. She asked a lot of probing questions to clarify what the learners' news was about. She put up a poster on friends and asked the learners what it meant to have a friend and the reasons why someone would be a friend. While Karen read the learners a story, she asked them questions, such as 'what you think will happen next', 'what you should do instead'.

The resources that Karen used in her teaching were a poster, big book, workbooks, worksheets and wooden counting blocks. Karen used a ready-made poster depicting friends during her discussion with the learners.

There were incidents when learning was spontaneous. One morning when Karen asked a learner to sing, the rest of the class started to laugh at the learner's singing, Karen spoke to the learners explaining that it was unkind to laugh at your friends. There was another incident when Karen had to stop the learners singing as they were sneezing and had runny noses. Karen handed out tissues to the learners to wipe their noses. Karen spoke to the learners about blowing their noses, colds, the flu and sore throats.

6.3 DISCUSSION AND INTERPRETATION

This section covers the discussion and interpretation of Karen's story within the framework of the constructs used in the story which are derived mainly from the theoretical framework. The discussion will be followed by an interpretation with regard to Karen's interpretation and implementation of the Natural Science Curriculum, which will allow me to place Karen at a particular level for each of the constructs.

6.3.1 Interpretation of the Natural Science Curriculum

Karen's interpretation of the Natural Science Curriculum was based on the constructs depicted in Figure 6.1.

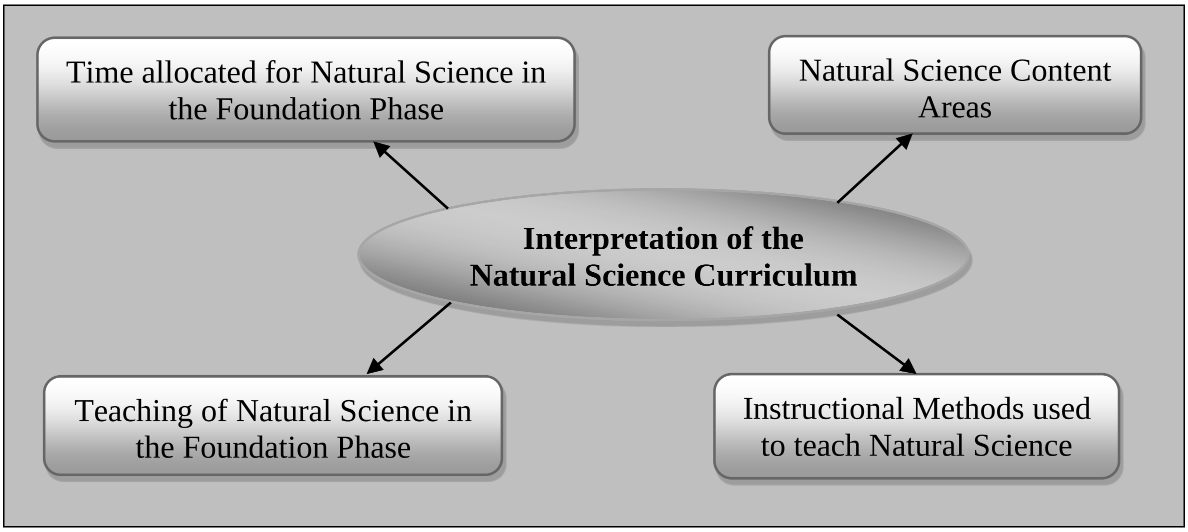

Figure 6.1: Factors affecting Karen's interpretation of the Natural Science Curriculum

6.3.1.1 Time Allocated for Natural Science

As the lesson plans were only an outline for the three observation days, rather than a specific plan for each day, the time allocated for Natural Science could not be determined. More time was allocated to Numeracy and Literacy indicating that these learning programmes were perceived to be more important. This emphasis appeared to reinforce the notion that Life Skills, and by implication, Natural Science was not very important. As the curriculum, and especially supporting documents such as the *Foundations for Learning* foreground Numeracy and Literacy, it is understandable that Karen would take this view as her responses indicate that she follows curriculum guidelines. However, a further factor that could affect Karen's interpretation of the curriculum is the fact that the times allocated in the Foundation Phase Curriculum and the *Foundations for learning* documents (which are official departmental documents) allocate different times to different programmes.

6.3.1.2 Teaching of Natural Science in the Foundation Phase

Although Karen thought the curriculum promoted Natural Science, she considered the opportunities to be insufficient. She was clearly mindful that Natural Science was supposed to be taught by integrating it into the Numeracy and Literacy Learning Programmes. However she did seem to understand that Natural Science is a learning area within the Life Skills Learning Programme and as such, it is expected that it should be taught within this learning programme. Karen, however, does not have a clear understanding of what integration means. The fact that she was confused with the Life Skills Learning Programme and the Life Orientation Learning Area contributed to her misunderstanding. Karen's reference to health aspects drew specifically from the Life Orientation Curriculum in the Life Skills Learning Programme and this was not an example of natural science integration. It is interesting to note that Karen said she required a textbook to teach Natural Science and yet only used the *Foundations for Learning* lesson plans to teach Numeracy and Literacy. She clearly needed support to teach Natural Science in Grade R. Her poor understanding of what is meant by integration, contributed to the neglect of Natural Science in her teaching programme.

Although Karen used the *Foundations for Learning* lesson plans for Numeracy and Literacy, her documentation for Life Skills showed no evidence that she planned to teach Natural Science. This showed her reliance on the *Foundations for Learning* documents in the absence of such lesson plans, she did not develop her own lesson plans. Rewriting the *Foundations for Learning* lesson plans without making changes was a futile activity and time could have been well spent on other important tasks such as preparing resources to be used when teaching, for example, Natural Science.

It was clear that Karen was unaware of the Natural Science Curriculum for the Foundation Phase and therefore she did not know what Science should be taught in Grade R. This contributed to her uncertainty whether the workbooks were in keeping with the curriculum. Her reasons for being hesitant to teach using the workbooks because they were not user friendly was an excuse as she could have copied the pictures in the book instead of cutting it out of the book. This could be easily resolved if she planned her lessons before teaching and not just rewritten the lessons from the *Foundations for Learning* lesson plans. Karen's lack of planning for the Life Skills Learning Programme contributes to her neglect of Natural Science. However, it needs to be said, the topics in the *Foundations for Learning* lesson plans covered during the period of observation were not helpful in assisting teachers to integrate Natural Science and a teacher such as Karen, who was not confident in teaching Natural Science would not be able to manage such integration.

Karen's response to designing a qualification for foundation phase teachers revealed that future foundation phase teachers should be taught the actual foundation phase learning programmes. However, she did not place particular emphasis on the inclusion of Natural Science in the training of foundation phase teachers.

6.3.1.3 Natural Science Content Areas

The content areas that Karen interpreted as part of the Natural Science Curriculum included nutrition, air, weather and water. Her confidence to teach specific natural science content areas was in relation to the content areas taught within the Foundation Phase at her school. From the reasons supplied, Karen stayed within the confines of the *Foundation for Learning* curriculum documents, as she believed that was what was expected of her. Karen was unaware of the Natural Science Curriculum and was guided by the *Foundations for Learning* books. She only taught what she was required to teach and as such with the continued teaching of the same topic, she became confident to teach them. The content selected was appropriate and taken from the workbooks and *Foundation for Learning* curriculum documents and not from the Natural Science Curriculum documents.

6.3.1.4 Instructional Methods

While Karen mentioned that she selected problem-based learning, cooperative learning and project-based learning as instructional methods and used them daily, there was no evidence in her lesson plans of such activities. Karen did not select demonstrations either as an instructional method she used in her teaching. However, during the interview she cited examples of demonstrations that she used. The learners could easily do these examples as investigations. In addition, there was no indication that the science concepts behind the demonstrations were taught to the learners.

The examples that Karen cited provided evidence that she did use demonstrations when teaching natural science content to her learners. The natural science content that was involved in the examples were both on water. However, it is not clear what was specifically taught about water. Young learners enjoy making bubbles and blowing them and are fascinated on how bubbles are made and how bubbles float. The activity on dissolving salt and sugar in water would have been captivating for young learners as they have difficulty comprehending where the sugar or salt went. Again, it was unclear what the intended outcome of the lesson was. Although these are important natural science concepts for young learners to grasp, it is uncertain if the underpinning science concepts were actually taught to the learners. Both these activities were planned as demonstrations; however, they are easy enough for grade R learners to carry out themselves, as the materials needed are easily accessible and the activities would not have been harmful to the learners. By allowing learners to carry out the activities on their own could have been regarded as an investigation, which would have been in keeping with the learning outcomes for Natural Science in this phase. Learners would have enjoyed carrying out the activities on their own. While the activities may be related to Science, there was no evidence to indicate that science concepts were taught in the process. Learners taking the project home to complete did not necessarily mean that they were doing it themselves.

6.3.1.5 Karen's level of interpretation of the Natural Science Curriculum

The levels for Karen's interpretation of the Natural Science Curriculum were determined. Table 5.11 shows the composite levels for each sub-construct, namely time allocation, teaching Natural Science in the Foundation Phase, natural science content areas and the instructional methods used to teach Natural Science. The descriptors for each level were developed and used to determine the level at which Karen was located with regard to the way she interpreted the curriculum as described in chapter five. These levels were derived from the findings discussed in this chapter. Table 6.2 reflects Karen's interpretations of the different sub-constructs, which were obtained from the questionnaire, interviews and document analysis. The table shows the levels at which Karen was placed.

Karen was placed at level one for time allocated to teaching Natural Science, as there was no evidence of this. Even though she knew Science has to be integrated, there was no evidence of this in her lesson plans. Furthermore, she had no knowledge of science learning outcomes and although her lesson plans corresponded partially to the curriculum requirements, I decided to place her at level one. Karen was at level two for science content knowledge as she did mention appropriate science topics for the Foundation Phase. She was placed at level three for instructional methods used to teach Natural Science. Although there was no evidence of this in Karen's lesson plans, the fact that she indicated in the questionnaire that they used a variety of instructional methods, appropriate to science teaching was taken into account. This composite picture of Karen's ability to interpret the Natural Science Curriculum in Grade R showed that she had certain limitations with regard interpreting the Natural Science Curriculum.

Table 6.2: Karen’s interpretation of the Natural Science Curriculum

Level	Time Allocation	Teaching Natural Science	Content Areas	Instructional Methods
1	Time allocation for all three learning programmes (Literacy, Numeracy and Life Skills) were not indicated	Karen was cognisant of the fact that Natural Science needed to be taught through integration or as a freestanding subject but there was no evidence of this in her lesson plan Karen has no knowledge of natural science learning outcomes		
2		*Foundation for Learning* Workbook and lesson plans did correspond to the curriculum to a certain extent but did need adapting	Certain topics mentioned by Karen were appropriate for the Foundation Phase	
3				Karen mentioned a number of instructional methods appropriate for teaching Science and provided suitable examples but there was no evidence of this in her lesson plan
4				

6.3.2 Implementation of the Natural Science Curriculum

Karen's implementation of the Natural Science Curriculum is discussed and interpreted using the constructs from the theoretical framework.

6.3.2.1 Outside Agencies

The constructs pertaining to outside agencies are presented in Figure 6.2.

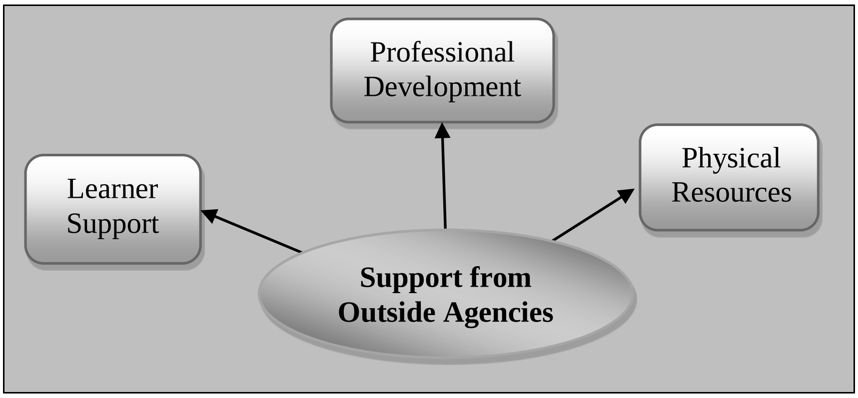

Figure 6.2: The support Karen received from Outside Agencies and the sub-constructs (adapted from Rogan 2007, p. 99)

6.3.2.1.1 Learner Support

Karen contributed to her learners understanding by speaking to them in isiZulu. She received support from most of the parents with regard to physical resources such as stationery, but the support for work done by learners at home was limited, unless she specifically requested parents to assist. Since the support was inconsistent, it would appear that Karen did not have all the parents' support all of the time. While Karen is of the view that parents would assist their children with tasks at home, including natural science tasks, their difficulty with understanding English may be a hindrance to teaching Natural Science.

6.3.2.1.2 Physical Resources

Karen said that the school did not have science equipment to assist her in implementing the Natural Science Curriculum but she was allowed to obtain the resources she needed from the learners themselves. As her class was very spacious, there was adequate space to conduct science investigations, but again no mention was made of this. The lack of resources did not contribute substantially to Karen's capacity to be innovative with regard to implementing the curriculum.

Although the Department of Education sent workbooks for the learners, there was no separate workbook for Life Skills. However, the life skills activities in the workbook were integrated across the Numeracy and Literacy Learning Programmes. According to Karen, the activities in the workbook included science concepts, such as parts of the plant but the focus was on Literacy and Numeracy not on Natural Science. Karen did not receive any support or training in the use of the workbooks. It was not clear how the workbooks facilitated the development of Learning Outcome One if only pictures of plants were included.

6.3.2.1.3 Professional Development

Karen's professional development was limited to school meetings and workshops held by the Department of Education on grade R teaching. From Karen's admission, she was of the opinion that these staff meetings are of no value to her. Karen lacked the confidence and knowledge to teach Natural Science. The limited opportunity she received to build her capacity was insufficient to give her the confidence and knowledge she needed to teach Natural Science. There is a need for workshops and training sessions to be held for the teaching of Natural Science.

6.3.2.1.4 Karen's level of implementation of the Natural Science Curriculum with regard to Outside Agencies

Table 5.12 shows the composite levels for the constructs included in the support from outside agencies. The discussion above informed my interpretation of how outside agencies support Karen's ability to implement the curriculum. This means that Karen receives limited support from outside agencies and this does not contribute substantially at all to the enhancement of her ability to implement the Natural Science Curriculum. Table 6.3 reflects how the different sub-constructs related to outside agencies influenced Karen's implementation of the Natural Science Curriculum. My findings are based on classroom observations and what was indicated in the questionnaire, interviews and document analysis. The table shows the levels at which Karen was placed.

Karen was at level two for learner support as she had some support from the parents and she spoke isiZulu to assist her learners. While the availability of an integrated workbook could place Karen at level two, all the other factors related to physical resources were at level one, placing her overall at level one. Although Karen attended limited non-science workshops, all the factors related to professional development were at level one, placing Karen overall at level one. The levels Karen was placed at for the support from outside agencies, show that she has limited capacity to support the implementation of the Natural Science Curriculum.

Table 6.3: Karen's ability to implement the Curriculum with respect to Support from Outside Agencies

Level	Learner Support	Physical Resources	Professional Development
1		No provision of science equipment to teach Natural Science No facility to teach Science, for example classroom space, water, school yard	No staff development planned by school No workshops on Science offered
2	Minimum support by parents with regard to language, finance or homework Minimum support from Karen to assist learners experiencing difficulty with the language of teaching, e.g. teacher translates in isiZulu	Integrated workbook was supplied	Limited non-science workshops attended
3			
4			

6.3.2.2 Capacity to Support Innovation

The constructs pertaining to Karen's capacity to support the curriculum as an innovation are presented in Figure 6.3.

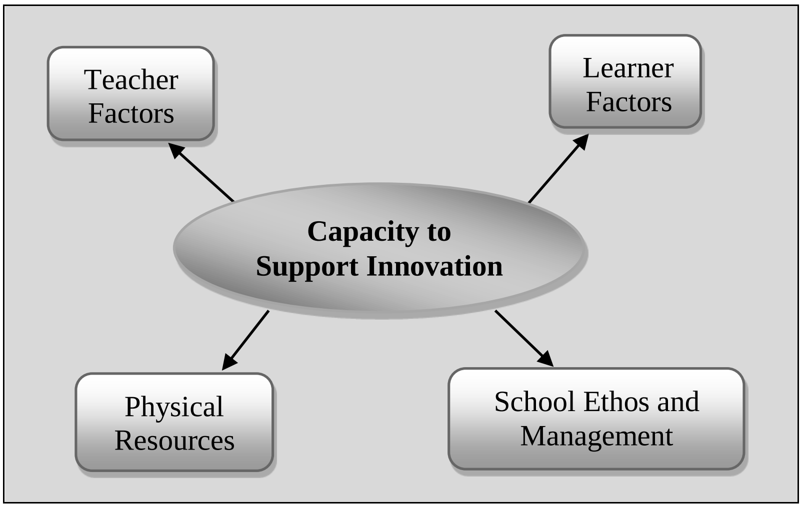

Figure 6.3: Karen's Capacity to Support Innovation and the sub-constructs (from Rogan 2007, p. 99)

6.3.2.2.1 Teacher Factors

Karen's passion for teaching in the Foundation Phase and background in Biology was a positive aspect. Although Karen's description of herself showed her commitment and confidence in her ability to teach Natural Science, there was no evidence to support this.

It was difficult to ascertain if Karen had sound science pedagogical content knowledge, as there was no evidence that she taught Science during the observation period, which in itself could imply that she did not possess science pedagogical content knowledge. Her undecidedness to be able to explain some science concepts correlated with her not having sound science content knowledge, which was an important aspect in determining her capacity to implement the Natural Science Curriculum. Furthermore, Karen's reluctance to work with insects and other animals indicates that she has a poor understanding of how to use the environment to teach Science although she professed that Science was 'everywhere'. Animals are found in the school environment and form part of the science content area in the Natural Science Curriculum. Her reluctance to use animals as teaching and learning resources could impede Karen's ability to arrange practical hands-on activities e.g. allowing children to observe the different animals in the school environment. Her intention to have a garden again was laudable but there was no evidence of this activity. Karen's confusing responses indicated that her capacity to support the implementation of the Natural Science Curriculum could be negatively affected. Karen seemed to think she had the capacity to manage hands-on science ensuring it was developmentally appropriate for her learners. However, there was no evidence to prove this was true.

With all of Karen's experience, she was still unable to balance all her responsibilities as a foundation phase teacher. Hence, her capacity to support the implementation of the Natural Science Curriculum was uncertain, as more preparation and planning time would be required to teach Natural Science. Karen's view that all kinds of additional support will help her to teach Science more effectively, will not work if she does not have the necessary knowledge of science concepts and instructional methods to teach Science. The fact that Karen never taught Science is the most telling aspect of all as she indicated that her interpretation of the Life skills Learning Programme advised that Natural Science be integrated, yet she did not implement this. Furthermore, her explanations of the science lessons that she said she taught indicated a number of misconceptions. Karen acknowledged that challenges with regard to assessment also affect her capacity, as she may not be able to record learners' performance in Science. In conclusion, Karen's confidence stems from her experience and not her ability to teach Science.

6.3.2.2.2 Learner Factors

Karen's learners experienced challenges in the classroom, one of which was language. Her learners worked at different paces, and this may prove to be challenging in designing and implementing the Natural Science Curriculum. Although Karen believed her learners were capable of doing scientific investigations, she thought that they could not work independently. Karen mentioned that learners seemed to enjoy activities that involved doing Science however, there was no evidence to support this from the classroom observations. Karen's learners did not enhance her capacity to be innovative with regard to implementing the curriculum as she had many other challenges to consider.

The fact that learners rely on public transport means they have no control when there is a strike and are thus unable to attend school, which will negatively impact on their learning. The feeding schemes that the school and the teachers organise ensure learners do not attend classes when they are hungry and they can concentrate on their learning.

Karen's description of the learners in her class is contradictory to what was observed. Her learners constantly disrupted the lesson. It was not possible to verify if the learners were creative, critical thinkers as no opportunity was provided for them to display these characteristics.

6.3.2.2.3 Physical Resources

Karen gave the learners an activity from the workbook to complete even though she did not understand its context and used the activity directly as is from the *Foundations of Learning* workbooks. Even though Karen said she planned her lessons well, this was not evident.

Using textbooks and exercise books for grade R learners seemed overly ambitious, as the learners could not read. Although there were natural science activities in the workbooks, Karen could choose what she wanted to teach. I was unable to determine how many natural science activities were in the workbooks as all workbooks were not available. There was no evidence that Karen selected any natural science activities from the available workbooks either.

Karen did not select science equipment, the natural environment, videos, computers and models as resources that she used to teach Science. This was confirmed from the observation as no science equipment or the natural environment was used in her teaching because she did not teach Natural Science.

6.3.2.2.4 School Ethos and Management

The school ethos supports teaching and learning and is well organised, but there was little support for Karen to develop as a grade R teacher and she received no support for science teaching. Karen had no support from her head of department and had to organise and plan everything on her own for Grade R, as she was the only grade R teacher. This did not contribute to her ability to implement the curriculum at all.

6.3.2.2.5 Karen's level of implementation of the Natural Science Curriculum with regard to her Capacity to Innovate

Table 5.13 shows the composite levels for the constructs used to determine Karen's capacity to support innovation with regard to natural science teaching. The discussion above informed my interpretation of how Karen's capacity supports her ability to implement the curriculum. Table 6.4 reflects how the different sub-constructs influenced Karen's capacity to implement the Natural Science Curriculum. My findings are based on information obtained from classroom observations and not necessarily, what was indicated in the questionnaire, interviews and document analysis. The table shows the levels at which that Karen was placed.

Karen's professional qualification could locate her at level three, however, all her other characteristics relating to teacher factors are located at level one, therefore placing Karen overall at level one. Karen indicated her learners were capable of guided investigations; therefore, she was placed at level two for learner factors. Karen used integrated life skills workbooks, however there was no evidence that she selected any science activities from these books. In addition she received no support to use the workbook, thus she could be placed at level two for physical resources. However the fact that Karen used no science equipment and textbooks, nor did she make use of available space to conduct investigations, placed her at level one for physical resources. While certain factors, such as the role played by the governing body could place Karen at level two, all other factors relating to school ethos and management were at level three, placing Karen overall at level three. From the levels at which Karen was placed with regard to her capacity to support the implementation of the Natural Science Curriculum, she had limited capacity to support the implementation of the Natural Science Curriculum. Although the school ethos supports teaching and learning and is well organised, little support is given for Karen to develop as a grade R teacher and she received no support for science teaching.

Table 6.4: Karen's Capacity to Support Innovation

Level	Teacher Factors	Learner Factors	Physical Resources	School Ethos and Management
1	Karen had minimal science content knowledge Karen had minimal science pedagogical content knowledge Karen was not able to balance all aspects of her responsibilities Karen acknowledged that she placed much more emphasis on Literacy and/or Numeracy and very little on Life Skills Karen was not confident to teach Natural Science		Karen used no science equipment Karen did not use additional science textbooks	
2		Learners were capable of carrying out scientific investigations with guidance Learners enjoyed some scientific investigations Learners enjoyed working in groups	Karen used integrated workbook but received no support on how to use it.	A School Governing Body was in existence but not visibly active Teachers and learners played a minimum role in management Parents played a minimum role in supporting the school

3	Teacher had a professional qualification appropriate for the Foundation Phase which included minimal Natural Science			Timetable mostly adhered to Principal and/or HoD was present at school most of the time and was in regular contact with his/her staff Staff meetings regular but not well-planned Good organisation of extramural activities which seldom interfered with classroom activities School was secure and limited control of who enters the premises Adequate evidence of COLT
4				

6.3.2.3 Profile of Implementation

The constructs pertaining to Karen's profile of implementation are presented in Figure 6.4.

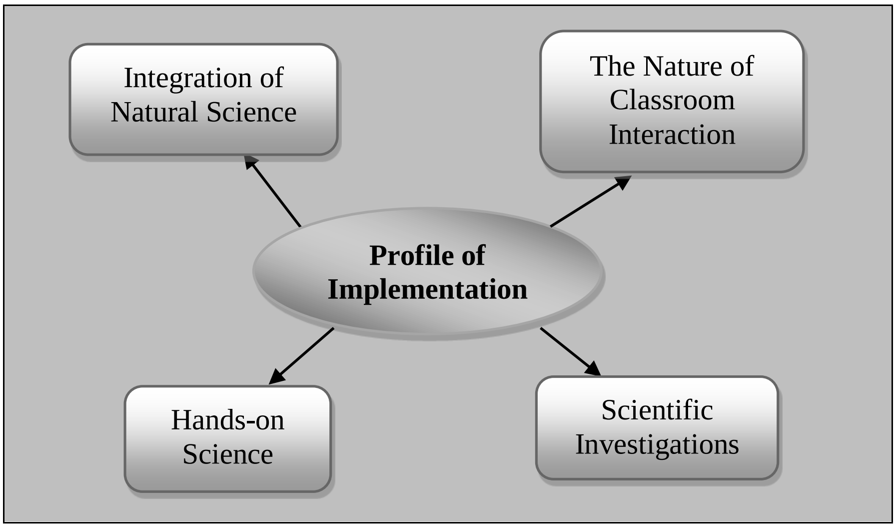

Figure 6.4: Karen's Profile of Implementation and the sub-constructs (adapted from Rogan 2007, p. 99)

6.3.2.3.1 Integration of Natural Science

The example that Karen hesitantly cited in the interview as an integrated natural science lesson was on measurement and water. The water was used to demonstrate the concept capacity. The argument may be made that this concepts falls within the Numeracy Learning Programme and that specific science concepts regarding water should have been included. Karen appears to have difficulty integrating natural science concepts in her teaching which could be due to her poor understanding of what science concepts could be taught.

6.3.2.3.2 Hands-on Science

The example that Karen provided for using play to teach Natural Science indicated that learners washed their dirty hands. Again, this was a life orientation lesson on keeping clean and not Natural Science. It seemed that the 'play' involved learners playing in the water. There was no evidence that the science aspects of water were taught.

6.3.2.3.3 Scientific Investigations

The example that Karen mentioned when she taught scientific investigations was a lesson on healthy eating where learners made a fruit salad. Again, this activity was a life orientation lesson on healthy eating habits and not a science lesson taught through investigation. The fact that Karen sees the making of fruit salad from fruit as a natural science lesson demonstrates her superficial understanding of what is meant by scientific investigations. Karen's obvious neglect of Science is related to her lack of knowledge of science concepts as well as her poor understanding of appropriate science instructional methods.

6.3.2.3.4 The Nature of Classroom Interaction

The routine that Karen had established for her was in keeping with the lesson plans as there was time allocated to these additional activities. However, she did end her lessons 15 minutes before the expected finishing time. These 15 minutes over a period of a week would accumulate to one hour 15 minutes. If the lack of time was the reason Natural Science was not taught, this accumulated time could have easily been set aside for the teaching of Natural Science. Although there was structure to the day, it was not in keeping with the lesson plans.

Karen may be commended for accommodating learners in her class who had difficulty with the instructions by speaking to them in isiZulu. However, the instructions that Karen gave learners seem to be confusing for all her learners. The fact that learners were not paying attention may have also contributed to learners not understanding what was expected of them. There could be many reasons for the learners being disruptive and inattentive. There could be a correlation between learners discipline and them not understanding the instructions. There needed to be a common understanding between Karen and her learners as to what they were expected to do when they entered the class.

On a typical day a minimum of 10 songs were sung. The majority of the songs were sung in an attempt to maintain discipline. Another aspect to consider could be that the learners did not find the lesson interesting and thus started to misbehave. There was also time between each activity that caused learners to become rowdy. The issue of discipline could have been minimised if the activities and instructions were at the level of the learners' understanding; well-thought out and planned properly. The class was spacious and yet the area that the learners sat on the carpet was very small which could have been the reason learners were constantly fidgeting and interfering with each other. The classroom could easily be re-arranged to allow for a bigger area for learners to sit on the carpet, as this is where most of the teaching occurred

Learners constantly sought Karen's attention and their interruptions interfered with Karen's working with individual groups. Learners seemed to lack confidence and could not work independently as they frequently needed Karen's approval. In addition, there seemed to be a sense of competition between the learners to see who finished their work first. This resulted in learners handing in work to Karen that was firstly not complete and secondly did not adhere to the instructions of what was expected. During the classroom observations, Karen did not attempt to address concepts that learners did not understand. For example, the activity on shapes, which was poorly understood, was not revisited. Instead of stopping and re-teaching the concept, the learners' books were collected and the activity ended.

Karen's use of stories was in keeping with the instructional method she used to teach. The fact that learners fell asleep could be because they had heard the story before. Even though Karen was expected to give her grade R learners' homework every day, she did not do so. Karen's decision to give learners homework seemed to be unplanned as she spent half an hour cutting out the worksheets. This could have been cut and prepared before the lesson if she intended giving the learners homework.

Some of the methods Karen used to form groups proved to be a challenge for grade R learners. Karen's attempt to work with the group of eight learners on the carpet was unsuccessful for a number of reasons. It was clear that proper planning was not done. The learners who were at their desks were not gainfully occupied which resulted in their being disruptive. Karen had to divide her attention between the learners at the desks and the learners on the carpet, which made it very difficult for her to manage the group activity, and she thus had to stop.

The type of questions Karen asked could have elicited meaningful responses from the learners if they answered the question. She probed learners to find out more and she asked questions that could have benefitted the discussion on friends. She tried asking questions that made learners think before responding such as: "what would happen next?" Although Karen engaged learners with questions, she often had to answer the questions herself.

The poster served as a prompt to initiate the discussion on friends. The purpose of using the big book was difficult to comprehend as the pictures were not enlarged and learners had difficulty seeing it. Karen should have realised this and made alternative arrangements such as enlarging the picture.

Although Karen mentioned during the interview that the parents supported the learners in her class, many of them did not have stationery and she had to encourage them to share. Karen seemed undecided as to whether she wanted learners to colour or draw a picture. This may have been because she did not plan what she wanted to do. Her inconsistent instructions could also be confusing for her learners.

The incidental learning opportunities are important as the learning is targeted to the learners' needs. Important life skills could be taught as the opportunity presented itself. However, these two learning incidents were examples of content that were relevant to the Life Orientation Learning Area.

Karen's classroom interaction was characterised by disorganised activities, much repetition and a poor understanding of how to manage group work. It was difficult to determine the purpose of a number of the activities. Karen also demonstrated poor use of resources in the classroom as well as wasting time on things that should have been done outside school hours. It was difficult to see how Karen would have managed a natural science lesson, which included investigating phenomena as prescribed by Learning Outcome One.

6.3.2.3.5 Karen's Profile of Implementation of the Natural Science Curriculum

Table 5.14 shows the composite levels for the constructs used to determine Karen's profile of implementation with regard to natural science teaching. The discussion above informed my interpretation of how Karen's profile of implementation supports her ability to implement the curriculum. The descriptors for each level were used to determine the level at which Karen was located with regard to the way she implemented the curriculum. Table 6.5 reflects how the different sub-constructs contribute to Karen's profile of implementation of the Natural Science Curriculum. My findings are based on information obtained from classroom observations as well as data obtained from the questionnaires, interviews and document analysis. The table shows the level at which Karen was placed.

Karen was located at level one for integration of Natural Science, hands-on science and scientific investigations as there was no evidence of this. While the use of textbooks/workbooks and questioning could place Karen at level two, all other factors relating to the nature of classroom interaction were at level one. I therefore made the decision to place Karen midway between levels one and two with regard to classroom interaction. Ironically, Karen's view of her competence to teach Natural Science in the Foundation Phase was in contradiction to what I observed in the classroom. From the levels Karen was at with respect to her profile of implementation, she had very limited capacity to support the implementation of the Natural Science Curriculum.

Table 6.5 Karen's Profile of Implementation

Level	Integration of Natural Science	Hands-on Science	Scientific Investigations	The Nature of Classroom Interaction
1	No evidence of Natural Science integrated in Numeracy, Literacy or Life Skills No evidence of Numeracy, Literacy or Life Skills integrated in Natural Science	No evidence of hands-on science to help develop concepts Karen did not use specimens and resources found in the local environment to illustrate lessons Learners were not practically involved in the lesson	No evidence of scientific investigations	Structure of lessons were disorganised, not well-sequenced, and not as per lesson plan Karen did not engage learners in meaningful learning activities which results in learners losing concentration and being disruptive
2				Karen used textbook/ workbooks, however support was still needed Karen engaged learners with questions, however she either answered the questions or did not give learners enough time to respond to questions
3				
4				

6.4 CONCLUSION

In chapter six, I presented the findings with regard to Karen's ability to interpret and implement the Natural Science Curriculum within the Life skills Programme of the Foundation Phase. Karen is a grade R teacher who is skilled in a number of areas pertaining to foundation phase teaching. With regard to the Natural Science Curriculum, Karen is unfamiliar with the time she needs to spend teaching Natural Science. She is partially competent in her interpretation of the Natural Science Curriculum, with regard to content, and demonstrated more competence in her ability to select appropriate instructional methods for teaching Natural Science. Unfortunately, her knowledge of teaching Natural Science is lacking. The support Karen receives from outside agencies to teach Natural Science is helpful and contributes to her potential to implement the Natural Science Curriculum as her learners receive support from home and adequate resources are provided. Unfortunately, this does not apply to support for Karen with regard to her professional development. Karen's capacity to implement the Natural Science Curriculum is limited.

While the school management and school environment is supportive, she does not use any of the available resources to teach Science and her teaching ability is limited with regard to science teaching. One positive aspect is the fact that Karen claimed that her learners were capable of guided investigations. In spite of a number of positive aspects Karen's profile of implementation is poor. These was no evidence that she was able to integrate Natural Science as the curriculum prescribes or that she allowed her learners to conduct investigations or engage in any other hands-on activities. A positive aspect is the fact that Karen is able to interact reasonably well with her learners. All of the above contribute to a profile of implementation that is mostly located on level one; less on level two and only two aspects reaching level three.

In chapter seven, I present Fiona's narrative with regard to her interpretation and implementation of the curriculum along with a discussion and interpretation of the findings presented in the narrative.

CHAPTER SEVEN

FIONA'S INTERPRETATION AND IMPLEMENTATION OF THE CURRICULUM

7.1 INTRODUCTION

In this chapter, I present the findings related to Fiona's interpretation and implementation of the RNCS. The findings provides answers to the first and second research questions: *What are foundation phase teachers' interpretation of the Natural Science curriculum and How do foundation phase teachers implement the Natural Science Curriculum?* I drew on data pertaining to the way she interpreted and implemented the curriculum from a number of data sources mentioned in chapter four and produced a narrative from this data. As I composed the narrative based on the data, the narrative is presented in the third person as a story told by me, the researcher. Fiona's story commences with some biographical information to provide a background to her qualifications and experience. Thereafter her story unfolds, guided by the constructs discussed in chapter five. The constructs are:

- Interpretation of the Natural Science Curriculum,
- Support from Outside Agencies,
- Capacity to Support Innovation and
- Profile of Implementation.

Fiona's narrative reveals a composite view of her as a foundation phase teacher within the context of teaching Natural Science. Information derived from this composite allowed me to place Fiona at a particular level for each of the constructs discussed.

7.2 FIONA'S STORY

Fiona obtained a three-year teaching qualification from a College of Education. She saw the benefit of her teaching qualification because she majored in the Foundation Phase in her last year of study. She has experience making teaching aids as well as making science equipment. She was very confident in her knowledge of the curriculum documents. She has experience teaching Grades One, Two and Three. Fiona was 44 years old at the time of data collection with 17 years teaching experience of which 13 years were in the Foundation Phase. At the time of data collection, she had 47 learners in her grade one class

Fiona's interpretation of the Natural Science Curriculum (Grade One)

Fiona's interpretation of the Natural Science Curriculum is presented as a narrative according to the constructs and the related sub-constructs.

Time Allocated for Natural Science

Natural Science forms part of the Life Skills Learning Programme and thus the time allocated was examined in conjunction with the time allocated for the Life Skills Learning Programme. One aspect of Fiona's interpretation of how Natural Science should be taught in the Foundation Phase was reflected by the time allocated to the teaching of Natural Science. This was indicated in the lesson plans provided by the *Foundations for Learning* documents. Table 7.1 shows the comparison of the allocation of times according to Fiona's responses to the questionnaire and during interviews, lesson plans provided by her and the curriculum documents for each learning programme.

Table 7.1: Comparison of the Allocation of Times for Respective Learning Programmes for Grade One

Learning Programmes	Time Allocation per day according to		
	Foundations for Learning Lesson Plans	Curriculum Documents	Fiona
Literacy	40 minutes	1 hour 50 minutes	1 hour 40 minutes
Numeracy	No time allocation	1 hour 30 minutes	1 hour 30 minutes
Life Skills	No lesson plan given	1 hour 10 minutes	1 hour 10 minutes

The time Fiona stated that she allocated to the three learning programmes is in keeping with the curriculum documents except for Literacy which is 10 minutes less than what is stated in the curriculum documents. However, the time allocated on the lesson plans for the learning areas were much less than the curriculum documents and what Fiona stated, as reflected in the last column. The lesson plans supplied by Fiona were analysed and these may have been incomplete documents.

The *Foundations for Learning* lesson plans for Grade One did not indicate time to be spent on any other activities as shown for Grade R. The time allocations indicated that more time was assigned to Numeracy and Literacy than to Life Skills. The absence of some lesson plans used by Fiona made it impossible to determine the time apportioned to Natural Science. Although the *Foundations for Learning* lesson plans for Numeracy were submitted the time allocation could not be established. No lesson plans for Life Skills were submitted at all.

Teaching of Natural Science in the Foundation Phase

Although the *Foundations for Learning* lesson plan did not provide direct information on how Fiona interpreted the curriculum, the analysis of the lesson plans provided information on what Fiona had planned for each day. The lesson plans were analysed on content knowledge, instructional methods, physical resources, types of activities and integration of Natural Science. It was important to note that the lesson plans are only the plans and not necessarily, what was actually taught during the observation lessons. Fiona's lesson plans for the period of observation were analysed. This analysis gave an indication of Fiona's interpretation with regard to where Natural Science fits in the particular section covered during observation.

There was no content indicated in the given lesson plans. The literacy lesson plan indicated that the lesson began daily with a class discussion using a chart, for example, month chart, birthday or special occasions and learners were expected to relate their daily news. A phonics activity was planned followed by reading from the Big Book. Different activities were planned for each day following the reading - group reading, poetry and paired reading.

The lesson plan for the Numeracy Learning Programme began with rote counting activities for the whole class on days one and two. On the third day, the plan was for learners to identify three-dimensional shapes. In this plan there was no integration of Natural Science across the literacy and numeracy lesson plans. Fiona did not present a lesson plan for the Life Skills Learning Programme.

Fiona stated, "So basically Maths and Numeracy is more important than anything else." Since the numeracy and literacy workbooks were activity based, Fiona stated that teachers still had to adapt them and she gave learners work to copy from the chalkboard, which was seen as extra and not part of the workbook. Fiona used the numeracy and literacy workbooks provided but she had to plan and organise the life skills activities. Fiona confirmed this by stating, "I have my own Life Skills stuff."

Fiona believed, “You have to know what you are about and the reason how you know what you are about is when you plan your lessons.” Being thorough ensured that life was made easier for everybody - the teacher and the learner. She went on to say, “Time efficiency comes into play. Time management is good because of your lesson plans. You know what you are about because of your learning matter.” Fiona had strong views on how she believed Natural Science should be taught. During her interview, she elaborated:

> Besides just being a lesson on its own, it should be integrated in everything because Science is around us, look around us and there is Science in everything. It shouldn’t be only integrated. Then you know.... If it’s not... if you had a choice and how many children… I know when they have a choice between Home Economics and Science they say Home Economics. It’s because it is new to them and it started off so late in life to them. If you know from Grade One…. if you know only that… so it will be… you will know only that. Give a child prawns from the age of one, he will eat prawns. If you give a person prawns from 20 something years old then they don’t eat seafood.

Fiona makes a case for learners learning Natural Science from an early age as it us all around them.

Fiona viewed the curriculum as being “teacher friendly and learner friendly”. She admitted that if she was conscious of it, she did Natural Science once a week in her class, if not it would have been part of the lesson incidentally. From Fiona’s admission, it was very difficult to ascertain how often she taught Natural Science, as she did not know this herself. From her perspective, she considered the curriculum as not having sufficient opportunities to teach Natural Science. Her views on whether the curriculum promoted Natural Science was forceful as she responded “Oh no! Absolutely not, never, never”. She explained further:

> One learning outcome for the Foundation Phase... I don’t think. Again, if you start, I mean this is where you have to start at grassroots level with everybody with Science. You can’t say you are only ready for Science in Grade Four. You know this is when you go on to the next learning outcome. You need a few more learning outcomes. It wouldn’t work. Start at the beginning and then build up your foundation – must be laid from Grade One.

Fiona’s response to the learning outcomes for Natural Science indicated that she seemed to know that only one learning outcome was insufficient for developing content knowledge in learners.

During the interview, she confessed to recognising only recently that the *Foundations for Learning* workbook "is the only book to work with". This realisation was only after she attended a workshop conducted by the Department of Education on the use of the *Foundations for Learning* lesson plans. Acquiring this consciousness meant that Fiona would use the *Foundations for Learning* lesson plans as is without amending the activities to her learners' level and including her own creativity. Fiona acknowledged that they did not get Life Skills workbooks, but only received books for Literacy and Numeracy from the Department of Education. The reason for this was most probably because schools were expected to do the Annual National Assessment (ANA), which was based on Numeracy and Literacy.

Fiona indicated that she taught Natural Science "both ways" that is, by integrating Natural Science in the Numeracy and Literacy and by integrating Numeracy and Literacy in Natural Science. She provided an example: "For instance water and finding out how many cups of water you get from a two litre. That is Science and the water. The Science of it, right? The capacity, cups, counting, data handling that's all." The activity was a numeracy lesson in which Fiona's lesson plan integrated measurement and data handling which are concepts learnt in both Numeracy and Natural Science.

According to the question about the qualification that Fiona would design for foundation phase teachers, she indicated that she would include Physical Education. She believed that it was extremely neglected and was seen as mundane and "yet to have a sound mind you have to have a fit body". She would also include Natural Science because Science is everywhere. She would have included Technology as well, which lends itself to Natural Science. She explained:

> Where is all the money now? In Technology. This is the era now the Technology era. That's why Science has to start, we must have Science in and Physical Education... those two are highly neglected.

She saw the value of having Literacy, Numeracy and even Geography from Grade One as learners "should know where Durban is".

Natural Science Content Areas

Fiona was very confident to teach nutrition, human body systems and water (Appendix D). She was also confident to teach light, energy and colour, heat energy, magnetic interactions, plants, animals, air and weather. She was not confident to teach sound energy and electrical energy. She was not confident at all to teach simple machines. She did not reveal her confidence levels to teach the other content areas that were asked in the questionnaire. Fiona stated during the interview that she was very confident to teach nutrition, air, weather and water "because we teach this". Fiona recognised that she was not confident to teach the other topics "because maybe we don't teach them". She also mentioned that she knew the universe and the solar system but she did not teach it. Fiona was of the view that the universe and solar system could be taught at the start of Grade Three. She further explained that she was "confident because I know my content and have some knowledge." She substantiated," I didn't put very confident in knowledge for animals maybe because I do not know all the animals." During the interview, the topics she mentioned she was not confident teaching included matter and motion, atoms and ecology.

Instructional Methods

Fiona selected discussion, problem solving, and stories/narratives as instructional methods she used in her daily teaching. She did select role-play, hands-on and simulations as methods she used weekly. She said she used discussions daily because, "I am a grade one teacher and have learners who are isiZulu [speaking] therefore daily discussions are important to improve vocab and also to teach them to speak in logical sequence and good train of thought." Her reason for using simulations and role-play was to "improve the learners understanding of the English language." She elaborated further:

> If you discuss you are going to bring out the knowledge. You just put something forward to them and you will be amazed at how everybody wants to have their input whether it's right or wrong. And even if it is wrong it helps with the child so you can say this is what it is supposed to be.

She used a hands-on approach, as "learners have to be consistently encouraged, motivated and immediately corrected." She considered hands-on science as "Me working with the children and them finding out for themselves, like investigations." She provided further clarification and detailed justification for her choice during the interview. During the interview, Fiona elaborated with an example to demonstrate why she selected problem solving as an instructional method she used regularly:

> The reason being is that just the other day we had done capacity with water. I put a two litre in some learners' tables. At random I put seven, eight, nine, 10 cups ...some were so excited they got 10 cups. All the time I just wanted to see how they how they were going to use these cups. They going to have to fill

> these cups up and let me see how many cups of water you get out of the two litre, one litre. They must write it down and colour it in. Every time they fill in a cup, they must colour it in.

When asked how often she used problem solving, Fiona replied, “A lot.... It comes into play in the second term.” She was of the opinion that “we underestimate learners in Grade One”. According to Fiona, “If you start off with anything and you throw it at them. Even if half of them grasped the concept, you have won half the battle. Start at the beginning they will grasp the roots level”. She was not clear on who underestimated the learners. Fiona thought her learners were capable. She cited the following as an example of problem solving that she used in class:

> Because we do colours... I give them blocks and they shade in their data handling. I give them a bunch of blocks. And I’ll say right, where would the yellow, blue, green whatever you label it each column and they must fill in how many yellow, how many blue, how many green, and how many red. That is also problem solving...

She then had a rethink:

> No, that is not problem solving it is data handling and in a sense that. And also when it comes to things like that I will say to them...how many colours in the rainbow? Children will tell you what colours in the rainbow. In that sense, we speak of the rainbow. What colours aren’t in the rainbow? So we do bring that in. Isn’t that thinking and reasoning?

Fiona was firm in her belief regarding the use of storytelling daily. She was adamant that:

> Story telling is done daily. Absolutely must be daily. That sets the tone. Sometimes in the morning or sometimes in the afternoon.... Especially when I was not too nice to them, so I must round up with a lovely story. And then they go home feeling so warm and fuzzy... you can actually see it...ah miss I love you miss.

She did not select any other instructional method that she used fortnightly, monthly, once a term or never. Fiona considered it “absolutely” important for teachers to use demonstrations. She believed everybody should be shown how to do things. She elaborated:

> It starts from even us, people as housewives and in the kitchen needs sometimes, not everybody can use their brains, they need to see a demo. For some children

> they work with visual stuff and some don't have the capacity to work with just the theory part of it or oral. They have to see it.

Fiona confirmed that she performed demonstrations in front of the class. She cited an example to verify this:

> I do that...on the board with the rainbow. I have to draw out the rainbow using different pieces of chalk and I actually show them the different colours because lot of children don't know the colour indigo and violet. And we use blue and purple to make violet.

Fiona's implementation of the Natural Science Curriculum - the influence of outside agencies

A number of factors, which affect Fiona's implementation of the curriculum, are influenced by outside agencies.

Learner Support

Learner support is considered in terms of learners' socio-economic status and their experience with English as the language of instruction. Fiona did not believe her learners had difficulties with the language of instruction, as she did not select this in the questionnaire. As a result, she offered no support to the learners by speaking to them in isiZulu. Fiona did not believe that her learners came from supportive home environments, as she did not select this as a characteristic that described her learners. When discussing the homework that she gives her learners, she mentioned:

> I don't know if it is poor cooperation at home with their parents. I gave them homework to do with seasons... four blocks and go home and look at what season it is now – is it summer, autumn, winter, spring? And go home and draw what you see outside. And nobody even bothered to do that. You know they could have drawn leaves and brown little stuff, the trees. I even coaxed them but still not even half brought that back. No interest at all.

Fiona attempted to supply reasons why learners do not do their homework:

> Maybe they don't have the tools, roll-ups and all that to colour in - bearing in mind what type of child we have what socio-economic background they come from. Yet I did give them the paper, the worksheet.

Fiona's learners did not receive support from their parents. She explained:

> You know just on Saturday we went to a community meeting. It was so poorly attended. There must have been maybe about eight parents. And the Deputy Principal catered for 150. The meeting was about - what can you do for your community - hand in hand with the school what can we do? Like the guy said we do not need any monetary help we just need your help. And just your time. The timing was also not good - it was the day after school had closed. Some parents are not from the community.

Physical Resources

Physical resources as support from outside agencies is the support the school received with respect to textbooks, workbooks, science equipment that the school is given by an outside agency, e.g. the Department of Education as well as the school's infrastructure. Since Fiona taught in the same school as Karen, the physical infrastructure is the same. Fiona's classroom was situated in the foundation phase block. Her classroom was half the size of Karen's. Her learners were seated in groups of six with very little space to walk around to the groups of learners. There was a carpet in the front of the chalkboard. Fiona's classroom was not well organised as there were books and stationery lying around. Fiona's desk was cluttered with books and stationery. The chalkboard had writing and charts stuck on it.

Fiona revealed that she did receive literacy and numeracy workbooks from the Department of Education, which were activity, based but they "still have to adapt to that". Fiona maintained, "We don't get life skills workbooks." In addition, she mentioned, "They do not have a laboratory even for the Grade Seven."

Professional Development

Although Fiona mentioned during the interview that she considered her qualification inadequate, she also believed that her professional qualification and related field experience had prepared her to be an effective foundation phase teacher. She had completed a phonics short course and she believed she was knowledgeable with regard to the different assessment techniques. She had studied the RNCS documents during the professional development workshops that she attended. She knew all the learning outcomes in each Learning Programme and she believed she was able to integrate the different learning areas. She explained:

> I think I know it through and through. I know all my learning outcomes. You cannot know all your assessment standards but I know every learning outcome for Literacy, Numeracy and Life Skills. I know what is required of me.

Fiona asserted that to be a confident teacher "you must attend professional development activities" and have the "willingness to constantly keep abreast with new educational issues and learning materials". Fiona attended workshops about three times a year. She did have a say in the workshops she would like to attend. Fiona did not recall being invited to any natural science workshops although she had attended workshops in Literacy and Numeracy. She mentioned, "There are science workshops that are offered to the Senior Phase." Besides the staff meetings there was no staff development planned by school.

Fiona's implementation of the Natural Science Curriculum - Factors, which shape her capacity to support implementation

A number of factors influenced Fiona's capacity to support implementation of the Natural Science Curriculum.

Teacher Factors

A number of factors contributed to Fiona's decision to become a foundation phase teacher. One of the reasons was because she "enjoyed working with youngsters." She was of the view that it started in the Foundation Phase, "especially when it comes to reading and writing." Fiona loved reading and stated that it is in the Foundation Phase that the "love has been lost and needs to be developed and you have to work with it." She maintained, "In the Foundation Phase we are there to develop and mould them." Fiona studied Biology at school, which she enjoyed. She believed that the science modules in her qualification had helped her in her teaching.

Fiona described herself as being dedicated, committed, confident, caring and approachable (Appendix D). She attended professional development activities and tried innovative teaching techniques. She was well qualified, experienced and planned lessons well making an extra effort to improve her teaching. She believed she was competent with both science pedagogical content knowledge and science content knowledge. However, she emphasised, "Science content knowledge is absolutely necessary." She accepted that "the degree of complexity [science content] changes from Grade One in comparison to high school but my knowledge must at least …. for although it is limited for the Grade Ones, I must know what I am talking about." She provided an example, "Even the water cycle, you can explain and they can understand. They can actually even draw it for you after you have explained it...this Grade Ones." Fiona was adamant, "Teachers have to be competent in what they doing." She explained, "If you don't know what you doing how will the child know what is expected of him or her? In the following extract, Fiona explained what she meant:

> You know and you think and what benefit is this to these children when I am teaching the water cycle but it is amazing that they understand that the puddle that was there yesterday is now gone. And that it is not a miraculous thing. Just by getting them to understand how it works whereby the sun absorbs the water. It's amazing for them and they understand that. They can actually draw it when you show them. Simple, it's drawn so simply for them whereby the rain, the clouds, the heavy clouds, the rainfall forms the puddle, the sun evaporates the water. They even learn words like that – evaporation. One lovely word... even if it is just one lovely word. You start from there. So when they come to Grade three or four evaporation is not such a big word for them...you have already started off for the Grade three teacher. You have laid the foundation. It must start there.

Fiona regarded teaching phonics and reading as her greatest strengths as a foundation phase teacher as "phonics and reading have an indispensable link." Her passion for phonics and reading was portrayed in the following extract:

> If you know your sounds, you can analyse a word and decode a word. If you know your words, you will know how to read and link a sentence together. Reading is the key in Foundation Phase. In order to execute any given written task you have to understand as to what is required of you to complete the work. It will not lend itself to Natural Science but I can teach a stone to read.

Fiona viewed "physical development whereby learners can improve their gross motor skills" as her greatest weakness as a foundation phase teacher. This was due to her paying too much "emphasis on the academic" which she realised was unfair to her learners. Fiona was honest in her response when she said, "Oh...I tend to neglect Life Skills". She explained:

> And yet I do incorporate it but I just concentrate on Maths and reading and Literacy. And on a Friday I will do my practicals. And I do, do it. I know you supposedly have to do it every day. And sometimes, I don't even realise the

> integration. Depends what my content is we are busy with animals then in Maths, I'll say four cows, how many legs? How many horns does the bull have?

Fiona attributed planning to time management. Having 47 learners in her class, her time was limited, as "everybody needs a piece of you." She was adamant, "You are going to short change yourself and more so the underachiever if you are not well planned." Fiona maintained that lesson planning was important to be more efficient in the classroom. She expanded on this:

> If you haven't planned… believe me you will be running back and forth to your table even if you have this *Foundations for Learning* book you have to know what you are going to do the day before.

There were contradictions with regard to some of Fiona's responses to the rating scale related to her confidence levels (Appendix D). Fiona stated she had sound science pedagogical content knowledge and sound science content knowledge. However, she agreed with statements on the rating scale that she feared science activities would not turn out as expected, she found it difficult to explain to learners some science concepts and she had a difficult time understanding Science.

The statements on the rating scale that related to classroom preparation considered the use of resources, time, planning and equipment in the preparation of science lessons. Fiona's responses to the statements showed that she would be able to take the time to plan and use resources to teach Science even though teaching Science takes much effort. Although Fiona agreed with the statements about teaching Science taking too much time, she was undecided with the statement that preparation for science teaching generally took more time than other subject areas. (Appendix G)

The statements related to managing hands-on science considered the teaching of science-by-doing. Fiona agreed with one statement on the rating scale on learners' developmental appropriateness, as she believed she is comfortable with determining the science curriculum that is developmentally appropriate for young children.

Learner Factors

Fiona had a total of 47 learners in her class of which 26 were boys and 21 were girls with an average age of six years. Fiona described the learners in her class as being confident, enthusiastic, creative and problem solvers. Fiona did not believe her learners were literate, numerate and were critical thinkers. Her learners did not come from supportive home environments and were from low socio-economic backgrounds. They did enjoy group work and could not work independently. Although Fiona indicated in the questionnaire that her learners did not require additional support with respect to the medium of instruction, she mentioned during the interview that they experienced difficulties. She believed her learners were not well behaved and showed no respect for the environment. These statements are contradictory to her initial statement in which she described her learners. During the interview Fiona mentioned, “They are like a sponge they absorb anything.” She also thought her learners were “impressionable” and she could “mould them”.

According to Fiona, “It’s we who underestimate our learners and think they are not ready.” Her understanding revealed, “If you tell learners anything they can repeat it, absorb it or take cognisance of it.” Fiona’s response to whether she thought her learners were able to conduct an investigation, was “Absolutely, Absolutely, Absolutely!” She maintained, “I do give students opportunity to do investigations.”

She considered demonstrations as activities that she had done in Natural Science that her learners enjoyed as “they can even go back and draw it”. Her learners did not enjoy activities, which were “given as homework concerning Science”.

Fiona believed you have to be hands-on when teaching Natural Science but this proved to be difficult as “there is no space for learners to walk in the class”. Fiona feels the lack of space resulted in her class being congested. She realised:

> You know what I need... just 30 learners and I promise you I can make the space and I can do things. There are about 12 children that get short changed. The high flyers suffer because I pay more attention to the underachievers and the high flyers suffer and stagnate. They must wait and it’s unfair to them as well.

Physical Resources

Fiona selected the chalkboard, worksheets and the library as resources that she used daily in her teaching of Natural Science. She said she used models weekly. She selected no resources that were only used fortnightly, monthly, once a term or never (Appendix D). In other words, Fiona claimed to use most of her resources on a daily basis. Natural Science was “integrated into my lessons such as the daily weather and uses of water and the importance of water.” She said she had to be resourceful and she found plastic bottles, paper cups and plastic cups that could be used.

Fiona mentioned that she did not have a textbook to teach Natural Science but she did have a life skills textbook. She asked, "Could that be part and parcel of Science?" In spite of her having a textbook for Life Skills, she did not select any resources to teach Science from the questionnaire. The only resource that Fiona remembered using was the meter stick.

Fiona declared, "I am going to make a concerted effort to establish a nature table next term." Although she did not have space for a nature corner, she realised that even if she started with a bean and placed it on the windowsill, this would be a start. She believed "a nature corner is needed and then it actually motivates you to want to do nature studies."

As a foundation phase teacher, she saw the benefits of her studies, in that in her final year, she majored in Foundation Phase and prepared teaching aids, which assisted her to teach in this phase. She also learnt to be resourceful which prepared her for "the scientific stuff like when I need science equipment I know how to make a plan there".

School Ethos and Management

Although the school did not restrict her, they did not support her either in her natural science teaching endeavours. Fiona believed, "It's not of fundamental importance as the basic thing in our school is Numeracy and Literacy." She admitted, "it's an unspoken word because no one speaks of Science." She further explained, "Science can be rowdy that's why we should start it in Grade One."

A list of statements that could describe the ethos and school management of their school were given in the questionnaire for the teachers to select on the continuum from strongly agree to strongly disagree. Fiona strongly agreed that the school was secure with access being denied to unauthorised personnel. She agreed with the remaining statements accept for being undecided about the last two statement. She agreed that there was a well-structured timetable. A strong presence of the principal was felt who was in regular contact with staff. Fiona explained the principal's presence:

> The principal could even rule from her table. She had that about her you know absolutely like for instance she would get the whole staff to attend a workshop. She will just prey on your emotions, your conscience. She could do that. The principal used to say, "Teachers it's compulsory and I would like everybody to attend and it will be beneficial to all of you and can I have a show of hands to who will not be going."

Fiona strongly agreed that there was a strong presence of the head of department who was in regular contact with staff. She explained:

> Reason being is that every Wednesday we have a phase meeting. We discuss what works and what doesn't work for us. Every Thursday we have a lesson plan meeting where we plan our lessons and the head of department is part and parcel of that planning as well.

Although Fiona agreed that there was good organisation of extramural activities on the questionnaire, during the interview she responded, "Absolutely not". She attempted to explain:

> We do have sport. I do work with baseball. Now we have a coach. This is the first time this year we have a coach. He is hands-on there. He teaches and we just do the supervision. But I too love the game and I do enjoy the game baseball. The coach literally brought himself there. Every game our school has played thus far we have won.

There were regular staff meetings. The culture of learning and teaching was strongly present. The school governing body was in existence. She was undecided on whether both teachers and learners played an active role in management and parents played an active role in supporting the school.

Fiona's Profile of Implementation of the Natural Science Curriculum

I compiled this part of Fiona's story mainly from the observations of her and her learners in a dynamic classroom setting, and from other previously mentioned data collection methods. A number of factors relating to curriculum implementation were considered.

Integration of Natural Science

During one of the lessons, Fiona had three words on a flash card stuck on the chalkboard. She asked the learners to identify which word started with the letter 'g'. The word was 'garden'. The other words were 'park' and 'playground'. There was picture stuck on the chalkboard, which showed a park and the road. Learners were asked to come to the picture and match the flashcards with the picture. Fiona then discussed playing in puddles of water after the rain. She had a bucket of muddy water and showed the water to the learners. She told them that besides the leaves that were in the water there was also bacteria and germs. She explained that when water was standing for long it had a bad smell. When Fiona asked the class what they could get from playing in the dirty water, one learner replied HIV. Fiona then explained that was not how you contract HIV. Another learner said you could get ringworms from playing in dirty water. Fiona said they could also get a rash on their skin, which could become pimples. Fiona urged learners not to play in dirty puddles of water when it was hot.

Fiona showed the class a bucket of clean water and another bucket with dirty water. She asked the class which water they would rather play in. She made the learners smell the two types of water. Fiona asked the class which water they would use to wash their hands. Learners were still seated on the carpet and this made observing the two types of water in the buckets difficult. Fiona took the bucket around to the learners. Fiona asked the learners what colour the water was in the pond near the school. The learners said that the water was green. Fiona then asked why the water was green and slimy. She told the learners that the water was very unhealthy and if they played in the water, they would get bilharzia. She explained that when the boys play in the water the 'gogos' would go into their penis and enter their bodies, kill what they need to make babies and they will not be able to have any babies.

Fiona then sent the learners back to their desks to draw two pictures, one showing dirty water and the other showing clean water. However, she continued asking the learners questions. She asked, "Which water should we drink?" The learners pointed to the bucket with the clean water. She then asked, "Which water would the fish live in?" One learner came out and pointed to the dirty water. Fiona got another learner to come out and show which water fish would live in. Fiona walked around the class checking if learners were doing their work. Fiona then started to pass out the life skills book. She asked the learners to draw what made the water dirty. Fiona asked the learners to identify what people threw in dirty water. The learners mentioned sweets, chips and ice cream wrappings. Fiona then asked if they should throw all those things in the water and what effect this would have on the fish in the rivers. She explained that the fish will not be able to breathe and it will kill the fish because they will not be able to come up from the water for oxygen. Fiona said, "Fish swim and swim and then they come up for oxygen."

Fiona wrote the heading: Safety First and one sentence on the chalkboard: *Do not play in dirty water*. She then took around the buckets of water to the learners while they were seated on their desks writing the sentence. Fiona called two learners to come and wash their hands in the bucket of clean water. The learners completed their work and gave in their books.

On the following day, Fiona stuck a chart on the chalkboard depicting hygiene and water. Fiona asked the learners to identify actions that were wrong in the picture. There were people washing clothes alongside the river and using the river as a toilet. Learners compared the two pictures and identified actions that were good and actions that were bad. Fiona gave the learners a scenario:

> If you were near a river and you were, very thirsty what would you do to make the water safe for drinking? Will the water be clean? Must you take it home and drink it? What must your mum do to the water to make it safe for you to drink?

Fiona answered the questions herself. The water could be boiled, let it cool and then it will be safe to drink the water.

Analysis of the learners' books books revealed that there was one entry in the life skills book during the observation week. The heading was 'safety first' and the learners wrote, 'do not play in dirty water'. The learners drew clean and dirty water. They also stuck in and drew pictures on the use of water.

During the interview, Fiona said she did many activities similar to the activity with the dirty and clean water, as "we bring things from the environment." Fiona cited another example where she brought in things from the environment:

> When it is autumn, everybody will bring in something related to autumn. They will bring something brown, maybe leaves. Some will bring in a kite. Some will bring a branch that is turning brown. The differences you make them understand... if it is a stalk and there is absolutely no leaves... this is winter time now. Or if they are turning orange and brown this is when the leaves are ready to fall off. We have an autumn table. We build something up for the day but as I said, it is not a permanent table and it is removed.

During the discussion on spring, Fiona told the learners that the flowers start to bloom, the trees start bearing fruit and the butterflies come out. She said, "Everything 'springs up" in spring." There are insects that come out, for example the caterpillar, ladybirds, bees. Bees make honey. Fiona asked, "How do bees make honey?" She then explained, "They take the yellow stuff from the plant. They go from plant to plant and suck out the nectar and go to their hives and make the honey." Fiona told the learners that when they get to Grade Seven they will learn about this. She then asked, "What colour is honey?" She answered herself, "Honey is golden brown and yellow."

Hands-on Science

There was no evidence of hands-on science indicated in the learners' books or during the classroom observation. An activity with the clean and dirty water was observed. Fiona explained with the following example how she used hands-on instructional methodology to teach Natural Science:

> The different seasons where we dress up the children in summer wear, winter wear and autumn. For autumn, we bring in the kite. Because autumn is not so clear and distinct. For spring, we bring some flowers any greenery. We also dress them up like summer but not so close to summer. We have four rows and we say you spring, you summer, you winter and you autumn. And they change over and I say after summer you go to autumn and after autumn ... we change and rotate. We teach them that every season has three months... it starts in December. We teach them to speak in logical sequence and good train of thought. They will give me a little story on what they up to. If the day is cold, we are going to stay inside. They know in winter the days are shorter and the nights are longer. They can tell you that.

During the interview, Fiona was asked if she used demonstrations when she taught Natural Science. She responded, "that is role playing... right?" After a bit of thought, Fiona said, "The demos are the water when they find out as to how much, they investigate to how many cups of water that you can get." Realising that the example was not a demonstration as the learners were investigating, Fiona said, "That is hands-on."

Scientific Investigations

Analysis of the grade one learners' books revealed that there was no evidence of scientific investigations in the teaching of Natural Science. No scientific investigation was noted during the observation. However, during the interview Fiona said that she does give her learners opportunity to do investigations. The example she cited was:

> They can tell me what is pollution. There I go back to that one again. It is so boring. Water... let me get off water. Now what can I get on to. Animals ... I have brought in ice cubes and put on the table. I had the kettle and put a saucer. I put that on my table. I had water as well. I showed them the water vapour too.

The Nature of Classroom Interaction

The nature of classroom interaction considers the interaction between Fiona and the learners. The nature of classroom interaction was analysed with regard to class routine and the lesson structure, language of instruction, learners' attentiveness, questioning, use of resources, types of activities and instructional methods and managing group activities. Examples of incidental teaching and learning were identified in an attempt to discover occurrences of science teaching.

There seemed to be a similar routine for each day. Each day began with the learners standing up to greet each other in different languages before they sat down. This was followed by a number of activities throughout the day that were not directly related to the academic programme but were necessary to get learners settled and for organisational purposes.

The learners counted up till 100. The class proceeded to recite the days of the week, months of the year and the names of the seasons and learners were expected to observe the weather outside. The lesson continued with a discussion on autumn. Fiona asked the learners what weather we have in autumn. One learner said we have windy weather. Fiona asked the class what they could do when it was windy. The learners did not answer. With prompting, the learners said that they could play with kites. The discussion continued on the shapes of kites and what makes the kite fly higher. The discussion then proceeded to spring as Fiona asked learners in which season the leaves were green. The major part of the day was spent on Literacy. Fiona showed the learners flash cards with different letters and learners were expected to sounds the letter and say which words started with each letter, as well as draw the letter. Learners were given instruction in English and IsiZulu and Fiona interacted with the learners by walking around the class marking learners' books.

In the following activity, Fiona handed out blank A4 paper and told learners to draw three circles, which needed to represent the colours of a robot. Then Fiona called the middle row to the carpet whilst the other rows were asked to complete the drawing of the robots. These learners engaged in additional literacy activities. The colouring in activity was an introduction to a life skills lesson. After break, learners were seated at the carpet. Fiona asked them to stand up while she proceeded to demonstrate to them how they should cross a road. Fiona drew three circles on the chalkboard and asked the learners what colour the first circle was. She proceeded to teach the colours in a traffic light by asking learners to colour in drawings on the chalkboard. Fiona then wrote the words 'stop', 'be careful' and 'go' on flash cards. She asked learners to match the names to the colours on the robot.

The second day began with a revision of the previous day's discussion of seasons. The greater part of the morning was spent on Numeracy. The next activity was related to Literacy as learners were requested to assist Fiona in writing 'Thursday' and 'Friday' on the chalkboard. The third day began by adhering to the routine as mentioned. Fiona asked the learners how they knew that it was a cloudy day. They said that the cloud was blocking the sun. When Fiona asked how they knew the cloud as blocking the sun, they said that could not see the sun. Fiona explained that they knew it was a cloudy day because it was not bright. The numeracy lesson began with a repetition of the previous day's activities. She then drew different groups of shapes on the chalkboard, asked learners to copy them and then to, count them, and then write the number and the number name for each one.

Throughout the observation, Fiona repeated and explained instructions in isiZulu. She had learners count in isiZulu to help the learners having difficulty. Fiona talked in isiZulu when learners were getting disorderly to get their attention. She also had the learners sing songs when they were disruptive to help them settle down. On the third day, it was fifty minutes into the day before Fiona wrote an exercise on the chalkboard. Learners continuously walk around the class while Fiona wrote the exercise on the chalkboard. Learners seemed to go to Fiona when they did not know what to do. They seemed to have difficulty understanding what they were expected to do and this resulted in disruptive behaviour. Learners seemed hesitant to respond to questions. Fiona asked many questions which she either answered herself or got learners to answer after much prompting.

Some of the resources Fiona used were flash cards, flipchart, worksheets, a poster, books as counters and counters. For the practical activity, she used buckets of water. During the discussion on bees and honey, Fiona asked a learner to find the colour in the class, which was the same as honey. Fiona's chalkboard had charts, bits of paper and writing cluttered on it with very little space to write. It was only after Fiona pointed to where the learner needed to focus his attention, did he manage to find a picture with yellow stuck on the chalkboard.

Most of the activities that the learners participated in were discussion activities on the carpet. These discussion activities were either with the whole class or with groups. When Fiona called groups to the carpet, she called one row at a time. However, during the group activities, learners were continuously disrupting Fiona. Her attention continuously went back to the rest of the class to quieten them and bring their attention back to their work.

There were a few instances when incidental learning took place. A learner's nose started to bleed. Fiona started talking to the learners about touching other peoples' blood to prevent them getting HIV. During the phonics lesson, after reciting the phonetic pronunciation of gum, Fiona then began to discuss aspects related to gums like bleeding gums, cleaning gums and milk teeth.

7.3 DISCUSSION AND INTERPRETATION

This section covers the discussion and interpretation of Fiona's story within the framework of the constructs used in the story and which are derived mainly from the theoretical framework. The discussion will be followed by an interpretation with regard to Fiona's interpretation and implementation of the Natural Science Curriculum, which will allow me to place Fiona at a particular level for each of the constructs.

7.3.1 Interpretation of the Natural Science Curriculum

Fiona's interpretation of the Natural Science Curriculum was also based on the constructs depicted in Figure 7.1.

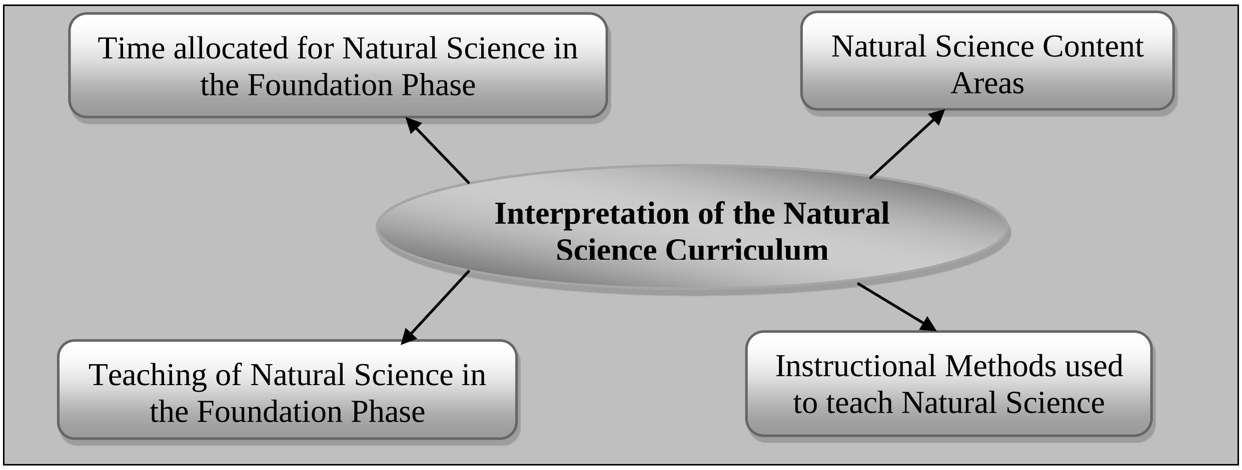

Figure 7.1: Factors affecting Fiona's interpretation of the Natural Science Curriculum

7.3.1.1 Time Allocated for Natural Science

Since no lesson plan for Life Skills was given, the time allocated for Natural Science could not be determined. The time allocated for Literacy and Numeracy seemed to confirm the priority given to these two learning programmes. Since the curriculum documents including the *Foundations for Learning* focus on Numeracy and Literacy, it is therefore logical that Fiona will also place priority with these two learning programmes as she works closely with the curriculum documents. However, this emphasis appeared to reinforce the notion that Life Skills, and by implication, Natural Science were not very important.

7.3.1.2 Teaching of Natural Science in the Foundation Phase

Although Fiona was of the opinion that the curriculum did not promote or provide sufficient opportunities for the teaching of Natural Science, she did believe that starting to teach Natural Science from an early age would ensure that learners are capable of making informed decisions when making subject choices. It would then be expected that as a passionate teacher she would create opportunities for her learners to engage with Natural Science and not use the lack of opportunities in the curriculum documents as an excuse.

Fiona's perception that the one learning outcome for Natural Science is inadequate was significant as she was aware of the fact that content knowledge also needed to be taught. However, there was no evidence to indicate that Fiona taught Science as there was no natural science lessons indicated in the lesson plans.

She was aware that Natural Science had to be taught through integration but also acknowledged that Natural Science could be taught on its own due to everything around us being Science. The example that she cited showing integration was on measurement and data handling concepts learnt in both Numeracy and Natural Science. Fiona's inability to provide appropriate examples showing how she integrated Natural Science showed she did not have a clear understanding of what integration means. The example of the water puddle could be construed as integrating Literacy into Natural Science but there was no evidence of learners engaging in an investigation. Her poor understanding of what is meant by integration, contributed to the neglect of Natural Science in her teaching programme.

Although she used the *Foundations for Learning* lesson plans, Fiona still saw the benefit in compiling lesson plans. There was no integration of Natural Science across the literacy and numeracy lesson plans. They received the literacy and numeracy workbooks but not the workbooks for Life Skills. Although Fiona recognised the importance of the *Foundations for Learning* workbooks, she did not appear to be concerned that she did not have Life Skills workbooks and that she had to adapt and supplement the activities. Having the literacy and numeracy workbooks and not the Life Skills may also indicate the importance placed on Literacy and Numeracy. Moreover, the fact that ANA tested only Numeracy and Literacy indicated more emphasis was placed on Literacy and Numeracy than on Life Skills.

As this assessment was driven by the Department of Education, it is understandable that Fiona will place an importance on Literacy and Numeracy and "tend to neglect Life Skills"

Fiona's response to designing a qualification for foundation phase teachers revealed that future foundation phase teachers should be taught the actual foundation phase learning programmes. She did mention that Natural Science needed to be included in the training of foundation phase teachers.

7.3.1.3 Natural Science Content Areas

Fiona was very confident of her knowledge levels in the content area she taught. The content areas that Fiona interpreted as part of the Natural Science Curriculum included nutrition, human body systems, water, light, energy and colour, heat energy, magnetic interactions, plants, animals, air and weather. Her confidence to teach specific natural science content areas was in relation to the content areas taught within the Foundation Phase at her school. From the reasons supplied, Fiona stayed within the confines of the curriculum, as she believed that was what was expected of her. She only taught what she was required to teach and as such with the continued teaching of the same topic, she became confident to teach it. Fiona was unaware of the Natural Science Curriculum and was guided by the *Foundations for Learning* books. The content selected was appropriate and taken from the workbooks and *Foundation for Learning* curriculum documents and not from the Natural Science Curriculum documents.

7.3.1.4 Instructional Methods

Fiona's confusion with the instructional methods indicated that she did not have a clear understanding of the different types of instructional methods used. Her apparent confusion with what constitutes problem solving and the related examples confirms this. The activity that she cited to show the use of problem solving as an instructional method was also on measurement and data handling, which are concepts learnt in both Numeracy and Natural Science. The example Fiona used to explain the use of demonstrations in teaching Natural Science was not a demonstration. There are other more effective ways of demonstrating rainbows, which involve learners' sensory perception. In addition, there was no indication that the science concepts behind the demonstrations were taught to the learners.

Fiona's use of storytelling was to build rapport and relationship with her leaners rather than being a teaching strategy. Fiona did not mention how she might have used story telling for the teaching of Natural Science. Besides demonstrations, there was no evidence of the other instructional methods used in the lesson plans or during the classroom observations.

7.3.1.5 Fiona's level of interpretation of the Natural Science Curriculum

The levels for Fiona's interpretation of the Natural Science Curriculum were determined. Table 5.11 shows the composite levels for each sub-construct, namely time allocation, teaching Natural Science in the Foundation Phase, Natural Science content areas and the instructional methods used to teach Natural Science. The descriptors for each level were developed and used to determine the level at which Fiona was located with regard to the way she interpreted the curriculum. These levels were derived based on the findings discussed in this chapter. Table 7.2 reflects Fiona's interpretations of the different sub-constructs, which were obtained from the questionnaire, interviews and document analysis. The table shows the levels at which Fiona was placed.

Fiona was placed at level one for time allocated to teaching Natural Science as there was no evidence of this. Fiona stated that Learning Outcome One was not sufficient to teach Natural Science. This indicates that she was aware of the natural science learning outcomes. However, there was no evidence that she used learning outcomes in her lesson plans. She also knew Science had to be integrated but there was no evidence of this in her lesson plans either. It is for this reason that I placed Fiona between levels one and two for teaching Natural Science.

She was at level two for science content knowledge as certain science topics she mentioned were appropriate for the Foundation Phase. While she mentioned the use of a number of appropriate science instructional methods, her responses during the interview indicated her uncertainty of what some of the instructional methods meant. I therefore placed her at level two for instructional methods. This composite picture of Fiona's ability to interpret the Natural Science Curriculum in Grade One showed that she had limitations with regard to interpreting the curriculum, although she appeared to have some knowledge of the Natural Science Curriculum and science outcomes.

Table 7.2: Fiona's interpretation of the Natural Science Curriculum

Level	Time Allocation	Teaching Natural Science	Content Areas	Instructional Methods
1	Time allocation for all three learning programmes (Literacy, Numeracy and Life Skills) were not indicated	Fiona was cognisant of the fact that Natural Science needed to be taught through integration or as a freestanding subject but there was no evidence of this in her lesson plan		
2		*Foundation for Learning* workbook and lesson plans did correspond to the curriculum to a certain extent but did need adapting Fiona was unsure of the Natural Science learning outcomes	Certain topics mentioned by Fiona were appropriate for the Foundation Phase	Fiona mentioned a number of instructional methods appropriate for teaching Science, but there was no evidence of this in her lesson plan
3				
4				

7.3.2 Implementation of the Natural Science Curriculum

Fiona's implementation of the Natural Science Curriculum is discussed and interpreted using the constructs from the theoretical framework.

7.3.2.1 Outside Agencies

The constructs pertaining to outside agencies are presented in Figure 7.2.

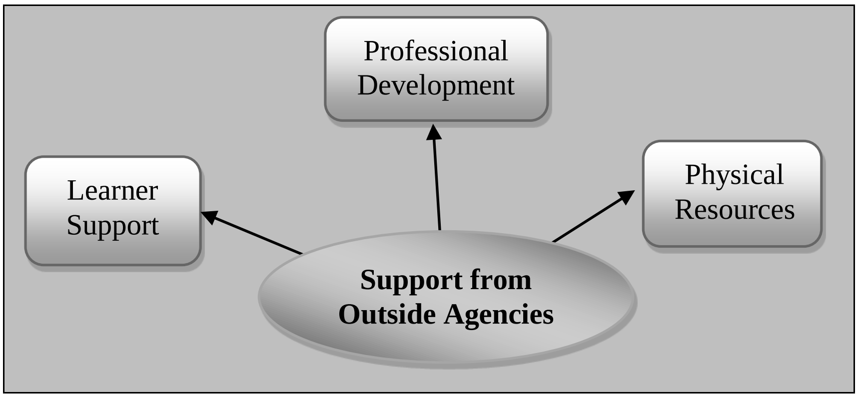

Figure 7.2: The support Fiona received from Outside Agencies and the sub-constructs (adapted from Rogan 2007, p. 99)

7.3.2.1.1 Learner Support

Fiona thought her learners did not need support with the language of instruction and yet she spoke to learners in isiZulu. Fiona's learners did not receive much support from their parents, both financially and academically as they did not have sufficient stationery, neither was there evidence that parents assisted with homework.

7.3.2.1.2 Physical Resources

Fiona did not have a workbook for Life Skills. Her uncertainty regarding how Natural Science fitted within Life Skills and whether she had a book to use to teach, demonstrated her uncertainty with regard to teaching Science. The fact that Fiona adapts the activity from the numeracy and literacy workbooks to match her learners' abilities shows that the workbooks received from the Department of Education were not a very helpful resource. Fiona's classroom was very small and cluttered and this would make it very difficult to engage in hands-on science activities. The fact that she mentioned that the school does not have a laboratory suggests that she is of the view that a laboratory and by implication science equipment is needed to teach Science.

7.3.2.1.3 Professional Development

Fiona's dedication in trying to attend workshops to improve her competency in her teaching was noteworthy. Fiona's eagerness to attend professional developmental meetings and workshops revealed that she is willing to obtain support from outside agencies to improve herself. She was willing to attend professional developmental workshops to increase her capacity to implement the Natural Science Curriculum. Unfortunately, such workshops did not exist or Fiona was never informed of them.

7.3.2.1.4 Fiona's implementation of the Natural Science Curriculum with regard to Outside Agencies

Table 5.12 shows the composite levels for the constructs included in the support from outside agencies. The discussion above informed my interpretation of how outside agencies support Fiona's ability to implement the curriculum. This means that Fiona receives limited support from outside agencies and this does not contribute substantially to the enhancement of her ability to implement the Natural Science Curriculum. Table 7.3 reflects how the different sub-constructs related to outside agencies contribute to Fiona's capacity to implement the Natural Science Curriculum. My findings are based on classroom observations and what was indicated in the questionnaire, interviews and document analysis. The table shows the levels at which Fiona was placed.

Fiona was at level one for learner support, as she did not receive support from the parents. She was at level one for physical resources as there was no evidence of the availability of science equipment and a life skills workbook. Although Fiona attended limited non-science workshops, all the factors related to professional development were at level one, placing Fiona overall at level one. Not only was the support for her learners extremely limited, the lack of appropriate books at grade one level severely hampered her. From the levels Fiona was placed at for the support from outside agencies, she seemed to have limited capacity to support the implementation of the Natural Science Curriculum.

Table 7.3: Fiona's ability to implement the Curriculum with respect to Support from Outside Agencies

Level	Learner support	Physical Resources	Professional Development
1	No support by parents with regard to language of instruction, finance, or homework No support from Fiona to assist learners experiencing difficulty with the language of instruction	No provision of science equipment to teach Natural Science No facility to teach science, for example classroom space, water, school yard No life skills workbook supplied	No staff development planned by school No workshops on Science offered
2			Limited non-science workshops attended
3			
4			

7.3.2.2 Capacity to Support Innovation

The constructs pertaining to Fiona's capacity to support the curriculum as an innovation are presented in Figure 7.3.

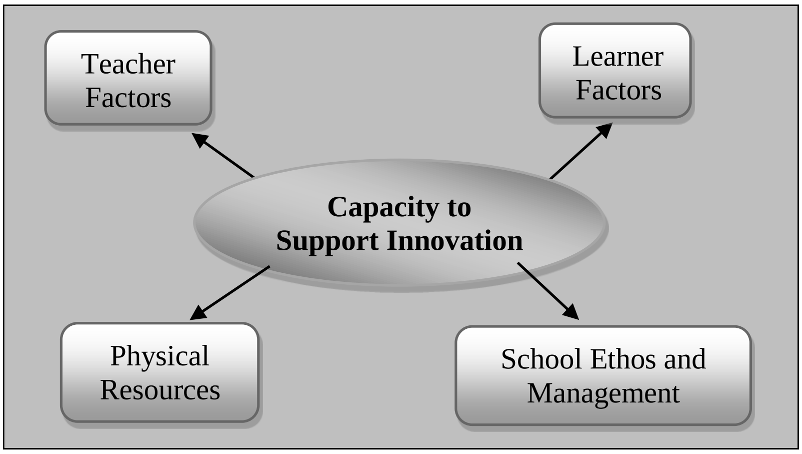

Figure 7.3: Fiona's Capacity to Support Innovation and the sub-constructs (from Rogan 2007, p. 99)

7.3.2.2.1 Teacher Factors

Fiona loved teaching and working with children. Her background in Science and Biology may have contributed to her capacity to implement the Natural Science Curriculum. Fiona's description of herself and her ability to recognise the inherent importance of having science content knowledge and sound science pedagogical content knowledge are positive attributes of a science teacher, however there was no evidence of this.

Fiona disclosed that her strengths were with Literacy and she was inclined to pay less attention to Life Skills. Using capacity and animals as examples in numeracy lessons was not an integrated Natural Science practical lesson. In addition, using cups of dirty water as examples in a computation lesson did not mean it was a lesson on pollution. Fiona's difficulty in teaching Natural Science through integration would contribute negatively to her capacity to support implementation as Numeracy and Literacy could take precedence.

Fiona's insight into using her time wisely and planning her lessons even though she used the *Foundations for Learning* documents was notable as she realised that she had to be well organised as a teacher. Fiona believed in being organised, thus her ability to balance her commitment to teaching and marking showed that she had the capacity to multi task. The rating scales provided Fiona with the opportunity to rate her capacity to support innovation and the implementation of the Natural Science Curriculum. Fiona did not seem to have the confidence as her responses to the statements were inconsistent and she was undecided on some statements. She appeared to have most of the skills required to prepare her classroom although there was one contradiction in her response. From her responses to the rating scale, she seemed to have the capacity to manage hands-on science to a limited degree but there were no examples to support this. Fiona's indecision on whether she was familiar with the processes and ways that young children learn Science could mean that she needed training and support with this aspect.

7.3.2.2.2 Learner Factors

Fiona's impression of her learners seemed to indicate that they were capable of much more than was expected from them, but this was not in line with the manner in which she described her learners. She mentioned her learners did not enjoy group work which could be attributed to them not given opportunities to work in groups or that the group work was poorly managed. However, if the learners' characteristics were developed then this could contribute positively to Fiona' capacity to support and implement the Natural Science Curriculum.

The example that Fiona cited to show that her learners were capable of conducting investigations was in fact a demonstration as her learners observed what Fiona demonstrated rather than the learners doing it themselves. Fiona's confusion with what constituted an investigation and a demonstration might hinder her capacity to implement the curriculum. Her response regarding the activities her learners enjoyed did not provide sufficient information to ascertain the types of activities they enjoyed or did not enjoy. Having 47 learners in a grade one class doing Natural Science was difficult to accomplish. By Fiona's own admission, she could not give all her learners, her attention, as the class was too large. The large class size could contribute negatively to Fiona's capacity. Fiona's description of the learners in her class is contradictory to what was observed. Her learners constantly disrupted the lesson. It was not possible to verify if the learners were creative problem solvers as no opportunity was provided for them to display these characteristics.

7.3.2.2.3 Physical Resources

Fiona did not indicate that she used science equipment, nature, videos, computers and models as teaching resources. Her ideas on planning a nature table and planting a bean plant could imply that she had the potential to implement the science curriculum but there was no evidence of this. In addition, Fiona's resourcefulness and willingness to make and look for resources indicated she had the capacity to support and implement the Natural Science Curriculum to some degree, but there was no evidence that she actually did this. However, in her view, the lack of resources did not contribute substantially to her capacity to be innovative with regard to implementing the curriculum.

7.3.2.2.4 School Ethos and Management

Fiona's responses to the ethos and management of the school seemed to indicate that although the school was well organised and had systems and procedures in place, the support to implement the Natural Science Curriculum was lacking. Although Fiona receives support from the head of department with regard to her teaching as a foundation phase teacher, this support did not contribute substantially to her ability to implement the Natural Science Curriculum.

7.3.2.2.5 Fiona's level of implementation of the Natural Science Curriculum with regard to her Capacity to Innovate

Table 5.13 shows the composite levels for the constructs used to determine Fiona's capacity to support innovation with regard to natural science teaching. The discussion above informed my interpretation of how Fiona's capacity supports her ability to implement the curriculum. Table 7.4 reflects how the different sub-constructs contributed to Fiona's capacity to implement the Natural Science Curriculum. My findings are based on information obtained from classroom observations and what was indicated in the questionnaire, interviews and document analysis. The table shows the levels at which Fiona was placed.

While Fiona's professional qualification could place her at level three and her ability to balance some aspects of her work placed her at level two, most of the other factors relating to teacher factors were at level one, placing Fiona overall at level one. While the fact that Fiona mentioned her learners did not like group work, could place her at level one, she believed her learners were capable of guided investigations and therefore she was placed overall at level two for learner factors. Although Fiona said she could make science equipment, there was no evidence of this, hence she was placed at level one for physical resources as she did not use science equipment to teach Science. While certain factors, such as the role played by the governing body could place Fiona at level two, all other factors relating to school ethos and management were at level three, placing Fiona overall at level three. From the levels at which Fiona was placed she had limited capacity to support the implementation of the Natural Science Curriculum. Although the school ethos supports teaching and learning and is well organised, little support is given for Fiona to develop as a grade one teacher and she received no support for science teaching.

Table 7.4: Fiona’s Capacity to Support Innovation

Level	Teacher Factors	Learner Factors	Physical Resources	School Ethos and Management
1	Fiona had minimal science content knowledge Fiona had minimal science pedagogical content knowledge Fiona acknowledged that she placed much more emphasis on Literacy and/or Numeracy and very little on Life Skills Fiona was not confident to teach Natural Science	Learners did not enjoy working in group	Fiona used no science equipment Fiona did not use workbooks for Life Skills Programme Fiona did not use did not use science textbooks	
2	Fiona was able to balance some aspects of her portfolio but finds it difficult with the large class size	Learners were capable of carrying out scientific investigations with guidance Learners enjoyed some scientific investigations		A School Governing Body was in existence but not visibly active Teachers and learners played a minimum role in management Parents played a minimum role in supporting the school
3	Fiona had a professional qualification appropriate for the Foundation Phase which			Timetable mostly adhered to

	included minimal Natural Science			Principal and/or HoD was present at school most of the time and was in regular contact with his/her staff Staff meetings regular but not well-planned Good organisation of extramural activities which seldom interfered with classroom activities School was secure and limited control of who enters the premises Adequate evidence of COLT
4				

*7.3.2.3. **Profile of Implementation***

The constructs pertaining to Fiona's profile of implementation are presented in Figure 7.4.

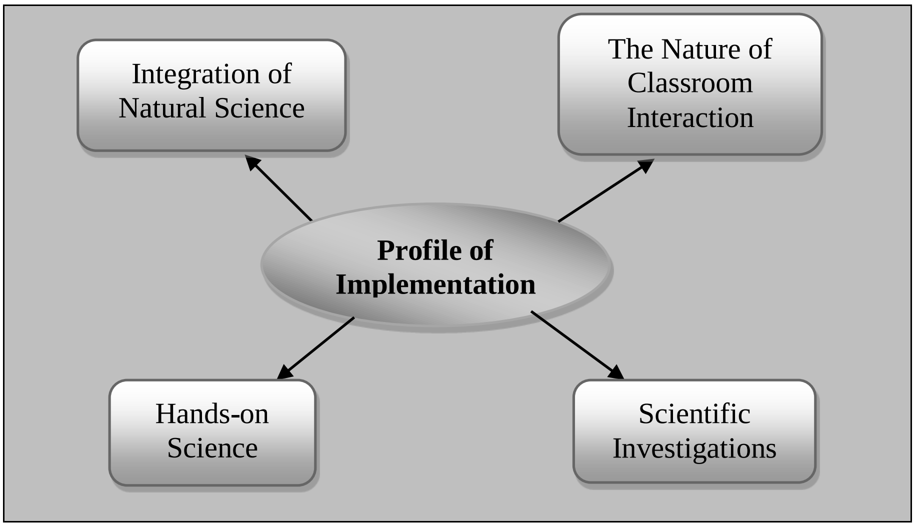

Figure 7.4: Fiona's Profile of Implementation and the sub-constructs (adapted from Rogan 2007, p. 99)

7.3.2.3.1 Integration of Natural Science

Although the example with the clean and dirty water could relate somewhat to a science lesson, as the topic of pollution was touched on, for the most part this was a life orientation lesson as the main focus was on health issues. Where Fiona attempted to include Science, her knowledge was either scanty or incorrect. For instance, she presented learners with incorrect information that fish come out of the water to breathe in oxygen showing that she did not have the subject content knowledge to teach Science. Furthermore, her knowledge of bilharzia is problematic.

The lesson in no way attempted to develop Learning Outcome One as learners were passively observing. Integration with Life Orientation was possible, but Fiona's lack of science content knowledge made this difficult and led her to focus on health issues. However, allowing learners to wash their hands in the same bucket of water also demonstrated some ignorance with regard to health. While much time was spent on teaching seasons in the literacy lessons, minimal science knowledge was developed and there certainly was no indication of developing Learning Outcome One during these periods.

7.3.2.3.2 Hands-on Science

The hands-on activity that Fiona described was on seasons. Having learners dress up according to the seasons does not constitute hands-on science. Fiona clearly needs support in understanding what is meant by hands-on science before she will be able to facilitate such activities in her class.

7.3.2.3.3 Scientific Investigations

The example that Fiona cited to show that she gives her learners opportunities for investigations was actually a demonstration to show condensation and evaporation. Fiona needs support planning appropriate scientific investigations as she appears to hold misconceptions as to what constitutes an investigation. This is in contrast to her professed knowledge of the learning outcomes of the Natural Science Learning Area. If she had studied the meaning of each outcome, she would have a clear understanding of what an investigation in Science entails.

7.3.2.3.4 The Nature of Classroom Interaction

Fiona's actions in her classroom demonstrated the importance she placed on Literacy. Learners constantly recited words and their homework focused on writing. Her attempt to incorporate a life skills lesson on safety on the roads was masked as she placed precedence on the literacy lesson. Learners could only draw the robot when they finished with the phonics lesson thus prioritising Literacy. The lesson on robots and crossing the road safely was a life orientation lesson on safety.

Fiona may be commended for accommodating learners in her class who struggled with the instructions by speaking to them in isiZulu. However, the instructions that Fiona gave learners seem to be confusing for all her learners. The fact that learners were not paying attention may have also contributed to learners not understanding what was expected of them. There needed to be a common understanding between Fiona and her learners as to what they were expected to do when they came into the class.

The majority of the songs were sung in an attempt to maintain discipline. Although Fiona did have a system to move learners to the carpet, which minimised disruptions, however as soon as learners sat on the carpet, they became noisy. The area for them to sit was too small and they began fidgeting and interfering with each other. Learners' disruptive behaviour could have a number of causes, such as, lack of interest, irrelevant topics, boredom because of constant repetition or inappropriate levels which made it difficult for them to understand.

Learners asking questions while she attempted to teach a group of learners on the carpet continuously disrupted Fiona. It was evident from the types of questions learners asked that they did not understand what was expected of them and the task was beyond their capabilities. Although Fiona asked many questions, learners were hesitant to respond. Fiona attempted to elicit answers by prompting learners. Failing to get answers, Fiona often answered the questions herself showing that she was not particularly skilled in eliciting answers from learners.

Fiona clearly needed support to use the few available resources effectively. Although Fiona said she was resourceful and could make equipment to use in her teaching, there was no evidence of her resourcefulness as she used learners' books as counters.

There were a few examples of incidental learning related to Life Orientation and a few health and safety issues such as HIV, healthy gums and the danger of swimming alone were discussed. There was one incident relating to Numeracy involving two and three-dimensional objects. Fiona was unable to use the incidental learning opportunities to teach Science. Fiona did teach learners about insects during one of the daily discussion session on seasons. The discussion was extremely short consequently not much content knowledge on bees and honey was mentioned to the learners to constitute a science lesson.

Fiona's classroom interaction was characterised by disorganised activities, much repetition and a poor understanding of how to manage group work. It was difficult to determine the purpose of a number of the activities. Fiona also demonstrated poor use of resources in the classroom as well as wasting time on things that should have been done outside school hours. It was difficult to see how Fiona would have managed a natural science lesson, which included investigating phenomena as prescribed by Learning Outcome One.

7.3.2.3.5 Fiona's Profile of Implementation of the Natural Science Curriculum

Table 5.14 shows the composite levels for the constructs used to determine Fiona's profile of implementation with regard to natural science teaching. The discussion above informed my interpretation of how Fiona's profile of implementation supports her ability to implement the curriculum. The descriptors for each level were developed and used to determine the level at which Fiona was located with regard to the way she implemented the curriculum. Table 7.5 reflects how the different sub-constructs contribute to Fiona's profile of implementation of the Natural Science Curriculum. My findings are based on information obtained from classroom observations as well as data obtained from the questionnaires, interviews and document analysis. The table shows the level at which Fiona was placed.

While the minimal integration of Natural Science in Life Skills could place Fiona at level two, the other factors relating to integration of Natural Science were at level one, placing

Fiona midway between levels one and two. Furthermore, Fiona's attempt at integrating Natural Science was conceptually flawed. Fiona was at level one for hands-on science and scientific investigations as there was no evidence of this. Fiona was on level two for the nature of classroom interaction as she presented content, which showed some organisation, and sequence; however, it was not based on the lesson plan presented. The levels indicate that Fiona had limited capacity to support the implementation of the Natural Science Curriculum.

Table 7.5 Fiona's Profile of Implementation

Level	Integration of Natural Science	Hands-on Science	Scientific Investigations	The Nature of Classroom Interaction
1	No evidence of Numeracy, Literacy or Life Skills integrated in Natural Science	No evidence of hands-on science to help develop concepts Fiona did not use specimens and resources found in the local environment to illustrate lessons Learners were not practically involved in the lesson	No evidence of scientific investigations	
2	Minimal evidence of Natural Science integrated in Numeracy, Literacy and/or Life Skills			Fiona presented content which showed some organisation and sequence however it was not based on the lesson plan Fiona used textbook/ workbooks, however support was still needed Fiona engaged learners with questions, however she either answered the questions or did not give learners enough time to respond to questions Fiona engaged learners in minimal meaningful learning activities which results in maintaining learners concentration most of the time
3				
4				

7.4 CONCLUSION

In chapter seven, I presented the findings with regard to Fiona’s ability to interpret and implement the Natural Science Curriculum within the Life skills Programme of the Foundation Phase. Fiona is a grade one teacher who is skilled in a number of areas pertaining to foundation phase teaching. With regard to the Natural Science Curriculum, she is unfamiliar with the time she needs to spend teaching Natural Science. She is partially competent in her interpretation of the Natural Science Curriculum, with regard to content and instructional methods, and has some idea of what the curriculum expects with regard to teaching Natural Science.

The support Fiona receives from outside agencies to teach Natural Science is very limited and this hampers her ability to implement the Natural Science Curriculum. Fiona’s capacity to implement the Natural Science Curriculum is limited. While the school management and school environment is supportive, Fiona does not use any resources to teach science and her teaching ability is limited with regard to science teaching. A positive aspect is the fact that she claims to be willing to allow her learners to engage in investigations

The most important aspect that contributes to Fiona’s poor profile of implementation of the Natural Science Curriculum is her very limited ability to integrate Science across the other learning programmes. Furthermore, she is unable to incorporate hands-on activities and scientific investigations in her teaching. A positive aspect is the fact that she is able to interact reasonably well with her learners. All of the above contribute to a profile of implementation that is mostly located on level one; less on level two and only one aspect reaching level three.

In chapter eight, I present Carly’s narrative with regard to her interpretation and implementation of the curriculum along with a discussion and interpretation of the findings presented in the narrative.

CHAPTER EIGHT

CARLY'S INTERPRETATION AND IMPLEMENTATION OF THE CURRICULUM

8.1 INTRODUCTION

In this chapter, I present the findings related to Carly's interpretation and implementation of the RNCS. The findings provides answers to the first and second research questions: *What are foundation phase teachers' interpretation of the Natural Science curriculum and How do foundation phase teachers implement the Natural Science Curriculum*? I drew on data pertaining to the way she interpreted and implemented the curriculum from a number of data sources mentioned in chapter four and produced a narrative from this data. As I composed the narrative based on the data, the narrative is presented in the third person as a story told by me, the researcher. Carly's story commences with some biographical information to provide a background to her qualifications and experience. Thereafter her story unfolds, guided by the constructs discussed in chapter five. The constructs are:

- Interpretation of the Natural Science Curriculum,
- Support from Outside Agencies,
- Capacity to Support Innovation and
- Profile of Implementation.

Carly's narrative reveals a composite view of her as a foundation phase teacher within the context of teaching Natural Science. Information derived from this composite allowed me to place Carly at a particular level for each of the constructs discussed.

8.2 CARLY'S STORY

Carly has a four-year qualification and she was studying for an Advanced Certificate in Education (ACE). Her teaching qualifications do not include any science component. At 34, she was the youngest of the participants. She attended workshops on phonics and reading and she believed that the workshops improved her teaching. She has experience teaching Grades

Three, Four and Six. At the time of data collection Carly had 10 years teaching experience of which eight years were in the Foundation Phase. She had 44 learners in her grade two class at the time of data collection.

Carly's interpretation of the Natural Science Curriculum (Grade Two)

Carly's interpretation of the Natural Science Curriculum is presented as a narrative according to the constructs and the related sub-constructs.

Time Allocated for Natural Science

Natural Science forms part of the Life Skills Learning Programme and thus, the time allocated was examined in conjunction with the time allocated for the Life Skills Learning Programme. One aspect of Carly's interpretation of how Natural Science should be taught in the Foundation Phase was reflected by time allocated to the teaching of Natural Science. This was indicated in her lesson plans provided by the *Foundations for Learning* documents. Table 8.1 shows the comparison with the allocation of times according to Carly's responses to the questionnaire and during interviews, lesson plans provided by her and the curriculum documents for each learning programme.

Table 8.1: Comparison of the Allocation of Times for Respective Learning Programmes for Grade Two

Learning Programmes	Time Allocation per day according to		
	Foundations for Learning Lesson Plans	Curriculum Documents	Carly
Literacy	No time allocation	1 hour 50 minutes	1 hour 30 minutes
Numeracy	No time allocation	1 hour 30 minutes	1 hour 30 minutes
Life Skills	No lesson plan given	1 hour 10 minutes	1 hour 10 minutes

The time Carly stated that she allocated to the three learning programmes is in keeping with the curriculum documents except for Literacy, which is 20 minutes less than what is stated in the curriculum documents. Since the time could not be determined from the literacy and numeracy lesson plans, it cannot be compared to what Carly stated, as reflected in the last column. In addition, with the absence of the life skills lesson plans, no comparison could be made with what Carly stated. The lesson plans supplied by Carly were analysed and these may have been incomplete documents.

The *Foundations for Learning* lesson plans for Grade Two as with Grade One, did not indicate time to be spent on any other activities as shown for Grade R. The time allocations indicated that more time was allocated to Numeracy and Literacy than to Life Skills. The absence of some lesson plans used by Carly made it impossible to determine the amount of time apportioned to Natural Science.

Teaching of Natural Science in the Foundation Phase

Although Carly used the *Foundations for Learning* lesson plans, which were supplied by the Department of Education to teach her lessons as the lessons were already planned, she still met with other grade two teachers to plan lessons a week in advance. She felt it was better this way to plan in advance so they knew exactly where they were "as they sometimes could not really stick to the curriculum." According to Carly, "sometimes, the children, depending on their levels, we have… and depending how far your learners are for that week then maybe we didn't manage to finish so we kinda carry it over." She clarified, "We build on where the learners are at." And even though they sit together "sometimes another teacher's class will be ahead of us in some areas". Carly emphasised, "We don't just stick to the curriculum but go according to the pace of the learners."

The lesson plans were analysed on content, instructional methods, physical resources, types of activities and integration of Natural Science. It was important to note that the lesson plans are only the plans and not necessarily, what was actually taught during the observation lessons. Carly's lesson plans for the period of observation were analysed. This analysis gave an indication of Carly's interpretation with regard to where Natural Science fits in the particular section covered during observation.

There was no content indicated on the given lesson plans. There were no daily lesson plans supplied by the teacher but she supplied an overview of the lesson plans for Literacy and Numeracy. The overview of the literacy lesson plan showed the morning oral work beginning with class discussion using the day chart, month chart, weather chart, birthday chart, special occasions, class programme, etc. There would be weekly focused listening activities on similarities and differences. Stories or poems could be told, read, or reread. The shared reading could use a story, song or poem.

The overview of the numeracy lesson plan showed that it began daily with the whole class rote counting. The learners could do practical work with flash cards by adding and subtracting numbers. Learners were to fill in the weather chart. On the final day the lesson concluded with the learners estimating, measuring and comparing length. There was no integration of Natural Science across the literacy and numeracy lesson plans.

Carly did not believe the curriculum offered sufficient opportunities to teach Natural Science in the Foundation Phase though it did promote Natural Science "to a certain extent". From her understanding of the curriculum, she believed that "the standard is too high" and that "it does not lend itself to certain schools". She elaborated:

> Maybe when they drew up the curriculum they looked at Model C schools where the children are more advanced and they more clued up with things. You find that even for us, some areas its working and some areas it's not so good. The children are not at that level. We find that we have to go right back to Grade One. And sometimes the standard... we cannot meet up with the standard, it's a bit too high. And also it could be a thing of the language as the majority of the school is Zulu speaking. And now you can't expect an isiZulu speaking child to come up to and be on the same level of that curriculum that they drew up. Especially in Literacy. In Numeracy we don't have so much of a problem. But in the Literacy part of it, it is very difficult.

Carly stated, "Science is incorporated in all the other learning areas and not just taught separately." Carly admitted, "I haven't tried doing Science on its own and incorporating Literacy and Numeracy."

If Carly were to design a qualification for foundation phase teachers, she would incorporate a more practical component, which would ease the transition from being at college to teaching in a school. She explained:

> When we were at college, we only went on block teaching for a certain period. When we came into the school system, it wasn't exactly the same as in college. We came there, we were just thrown in the deep end and we had to find our way. And those things they don't tell you at college.

Natural Science Content Areas

From the questionnaire, Carly did not select any content area that she was very confident to teach. Carly was confident to teach matter and materials, reactions and changes of materials and human body systems (Appendix D). She was less confident teaching plants, animals, nutrition, air, weather, water, universe and solar system, earth and moon systems, matter and motion, atoms and ecology. She was not confident at all to teach light energy and colour, heat energy, sound energy, magnetic interactions, electrical energy and simple machines. The content areas she taught often were nutrition, air, weather, water and plants. The reasons she gave for this were:

> It seems to come up a lot depending on our context. Sometimes it does fall in our context, in our lesson planning. Depends on the age group also, Grade Two, I mean they still is very small. I suppose some of these others are a bit- I do not know if the level is high. But for this level, we are on these. These are the more appropriate depending on the age group of the children, when you are talking about seven years.

Instructional Methods

The instructional methods that Carly indicated she used provided insight into her interpretation of the curriculum. In her response to the questionnaire, she selected inquiry, lecture, discussion and hands-on as instructional methods she used daily. She did select role-play, cooperative learning, discovery and stories/narratives that she used weekly. She used problem-based learning fortnightly. Project-based learning, scaffolding, simulations and case studies were used monthly (Appendix D). The reasons she provided for using these methods in her questionnaire were, “Learners are very shy due to various reasons, e.g. language barrier, etc. and the following methods seem to work for me at the moment.” During the interview, she elaborated:

> I suppose with the children that we have - they are still very young - so you have to kind of, you know, at first before you start the lesson you have to find out from the children what they know then we expand on what they know from their .... I found these methods effective.

During the interview, Carly provided an example from her teaching that showed how she accomplished this:

> You know like when you are doing the plants, you make the children bring the plant, the bean plant we actually experiment and they watch the bean plant growing. You know with the cotton wool. We have done that activity in our grade two level. And that was the inquiry that I can think of. Besides the measuring and things.

Carly thought it was important to use demonstrations in teaching Natural Science especially “on this level”. She explained:

> to get the learners to understand…you know… more clearly because sometimes depending on as I said with the type of children we have you have to sometimes be more practical because most of these children come from backgrounds that they don't have access to books, they don't go out. So we have to be kind of practical in the classroom as far as possible.

Carly's implementation of the Natural Science Curriculum - the influence of Outside Agencies

A number of factors, which affect Carly's implementation of the curriculum, are influenced by outside agencies.

Learner Support

Learner support is considered in terms of learners' socio-economic status and their experience with the language of instruction. Carly believed that having learners from a low socio-economic background did affect her teaching from time to time. She found that a quarter of the class would bring items needed and the rest were unable to do so which made it very difficult to work with. Carly's learners did not receive much support from their parents. Carly maintained, "Although parents do support but not everyone, only some, a small percentage of the parents support." Carly tried to help learners having trouble with the language of instruction by speaking to them in isiZulu and English. She believed, "If I did not know isiZulu at all I would have had a problem."

Physical Resources

Physical resources as support from outside agencies is the support the school received with respect to textbooks, workbooks, science equipment that the school is given by an outside agency, e.g. the Department of Education as well as the school's infrastructure. Since Carly taught in the same school as Karen, the physical infrastructure is the same. Carly's classroom was similar in size to Fiona's. It was neat with books arranged on shelves. The carpet area was spacious. The seating for the learners was arranged in groups of six and there was space to walk around and between the desks. Carly's table was neat and not cluttered with books and stationery. It was evident that the chalkboard was cleaned often, as there was evidence of only the day's work written. Carly did receive workbooks from the Department of Education.

However, there were only numeracy and literacy workbooks and no life skills workbooks. Carly indicated that the school could not provide science equipment.

Professional Development

Carly did not attend any workshop for Natural Science although she attended a life skills workshop "many years back that actually helped a lot because I learnt different ways of doing stuff, you know, in the classroom with the children… more creative ways." She attended workshops for phonics, which improved her teaching. She did not have a problem with Numeracy, as she was confident in this area. Carly did mention that they were "not forced" to go or not to go to workshops. It depended on where the venue was as transport was a problem. So if it was in a venue where there was no public transport then there was "no way" Carly could go unless "someone in the area is going then I'm willing to go with that person". Besides the staff meetings, there was no staff development planned by school.

Carly's implementation of the Natural Science Curriculum - Factors, which shape her Capacity to Support Implementation

A number of factors influenced Carly's capacity to support implementation of the Natural Science Curriculum

Teacher Factors

Carly became a foundation phase teacher because "she loved children, the job itself and working with children at that level." She did concede, "The extramural becomes a problem sometimes as the day is so swamped with what we have to do in classroom." She has a four-year qualification, which specialised in junior primary (Foundation Phase) studies. At the time of data collection, she was completing an ACE course, which was on Life Skills. She clarified the content of the life skills module, "it's not Science, it is Life Orientation, career guidance, child development and children with learning difficulties." Carly mentioned, "None of my qualifications helped with teaching Science."

Carly described herself as being dedicated, caring, confident, committed and an approachable teacher. She believed she was well qualified, experienced and competent. She mentioned she attended professional development activities and tried innovative teaching techniques. She said that she planned her lessons well and made an extra effort to her improve teaching. She attended school conscientiously. In spite of this Carly did not believe she had sound science content knowledge and sound science pedagogical content knowledge. She explained, "Maybe I still need more practice in the science field. Not that I can't - I think I just need to get more knowledge".

She enjoyed Numeracy and Literacy as she majored in these two subjects and regarded them as her greatest strength as a foundation phase teacher. Carly was adamant,

> We cannot say that we are not touching on Science as such because in our junior primary it is incorporated with the three learning areas. So I don't know how they work it out. I'm not too sure but they incorporated it in these three learning areas.

Carly was unclear about what she considered as her greatest weakness as a foundation phase teacher. She responded, "I don't really know because I enjoy every aspect of the Foundation Phase and I am always willing to learn new stuff so I am really enjoying the Foundation Phase."

From Carly's response to the rating scale on her confidence levels, she agreed with all the statements, thereby indicating she had the skills and knowledge to teach Natural Science. However, she did fear that the science activities would not turn out as expected and she found it difficult to explain to learners some science concepts as she has a difficult time understanding Science. She welcomed learners' questions and could answer them. If Carly had a choice, she would not invite the principal/head of department to evaluate her science teaching (Appendix G).

The statements on the rating scale that related to classroom preparation considered the use of resources, time, planning and equipment in the preparation of science lessons. Carly enjoyed reading resource books to obtain ideas about science activities for young children. Although she agreed that teaching Science took too much time, she was willing to spend time setting up materials for scientific exploration. Carly believed she was ready to learn and used scientific knowledge and skills for planning and helping children construct science equipment for hands-on science as she used many hands-on activities to help her learners learn Science. She agreed that she takes her learners outside the classroom to learn Science. Carly liked to discuss ideas and issues of science teaching with her colleagues. She was familiar with raising open-ended questions to encouraging children's scientific exploration. Carly disagreed that teaching and preparing for Science takes too much effort and more time than other subject areas. Although she disagreed that she integrates other subject areas into Science, she agreed that she integrates Science into other subject areas.

The statements on the rating scale that related to managing hands-on science considered the teaching of science-by-doing. Carly agreed that the teaching of science processes is important. She enjoyed collecting materials and objects to use in her science teaching including handling certain animals and insects to teach Science. She was comfortable using any classroom materials for science activities and was not afraid of demonstrating experimental procedures in the classroom. Carly agreed that she did not mind the messiness created when doing hands-on science in her classroom.

Carly agreed that she was comfortable with determining the science curriculum that is developmentally appropriate for young children as she was familiar with the processes and ways that young children learn Science. Carly believed that it is appropriate to introduce Science to children at an early age, as young children are curious about scientific concepts and phenomena. She disagreed that young children cannot learn Science until they are able to read.

Learner Factors

Carly had a total of 44 learners in her class of which 20 were boys and 24 were girls with an average age of seven years. The learners came from low socio-economic backgrounds and in some cases, single parent upbringing with no employment. The learners exhibited difficulties with using English as the language of instruction. Some learners were very creative and enjoyed working in groups. Carly believed her learners were not confident, literate, numerate, enthusiastic, critical thinkers or problem solvers and that they were not independent. She maintained they did not respect the environment and did not come from supportive home environments. Carly did not seem to think her learners were well behaved as she maintained, "good behaviour do not come naturally to them and you have to keep reprimanding them and reminding them."

Carly did not think all the learners in her class were able to conduct an investigation. She explained:

> Depending on their levels, they are at because they are all at different levels. The bright children, maybe a third of them will be able to but the middle group will be able to but they won't be so sufficient like the first group. The last group really struggles.

According to Carly, learners enjoyed science activities that involved them "going out and investigating and listening to the birds, looking for insects." Carly could not identify any science activities that they did not enjoy.

Physical Resources

From the list of physical resources provided in the questionnaire, Carly indicated that she used most of them on a daily basis to teach Natural Science. These included the chalkboard, textbooks and worksheets. Carly taught insects using a commercially purchased poster. She used the whiteboard and the library weekly. Carly also selected science equipment, nature, videos, computers and models. She obtained her information to teach Science from different sources, as "it is not from one specific book" because the teachers "change every year depending on the context, as they do not like to just be boring teaching one thing the whole five years and bring in other things."

Carly mentioned, "There is no science equipment or models that I know of." She would like to "have models because with small children you need concrete stuff" to teach Natural Science. She provided an example:

> When you are doing the body parts, you do the outer part of the body but you must still have like for example the skeleton to show children what the heart looks like - the shape, size.

Carly believed that to teach Natural Science:

> First, you must have good equipment, you know and... it would be nice to teach it on its own if we had all the necessary equipment and stuff that you will need for a science lesson. But sometimes it's unfortunate in some schools they can't afford certain stuff.

Carly used basic equipment to teach "because of the problem we had at school". She explained:

> We can't afford much so we normally, you know like for example we take the children out and they will investigate whatever, whatever...the grounds and things like that. So it is not like things we actually bought. It is just natural.

Carly maintained, "It is not that the school does not want to supply what is needed but the issue is with the finances." Carly was appreciative of the school management and did not hold them responsible for the lack of resources as other more urgent matters took priority. She did not select science resources mentioned above because the school did not have any equipment.

School Ethos and Management

Carly was of the view that the school had a well-structured timetable. A strong presence of the principal and head of department was felt as they were in regular contact with staff. There was good organisation of extramural activities. There were regular staff meetings. The school was secure with access denied to unauthorised personnel. The culture of learning and teaching was strongly present. The school governing body was in existence. Both teachers and learners played an active role in management and parents played an active role in supporting the school. Carly did get support from management in terms of teaching Natural Science as she could take learners outside.

Carly believed that the support she received from her seniors helped her to be a better teacher. Her head of department had workshops with them, either individually or as a group on some area that they did not understand. The head of department identified areas that needed attention when she went through their books and files at the end of term. Carly's relationship with her head of department was very good. Her head of department was very professional and gave her much help. Carly had been going to her head of department for help as she has taught in Grade Three and she had "now come down to Grade Two" and this was "really a major change". She felt that she had "to keep going to her to find out, as my standard was a bit too high". She had to be conscious of her language usage as "now most of the children are isiZulu speaking so you got to kind of change, try and make the children understand what you are trying to say". Carly had learnt a lot and it did help that she also knew the language.

Carly's Profile of Implementation of the Natural Science Curriculum

I compiled this part of Carly's story mainly from the observations of her and her learners in a dynamic classroom setting, and from other previously mentioned data collection methods. A number of factors relating to curriculum implementation were considered.

Integration of Natural Science

Although there was no evidence of scientific investigations and hands-on science, there was some degree of evidence of integration of Natural Science. There were entries in the life skills book on insects. The learners wrote the sentence - Insects have three body parts: head, thorax and abdomen and insects have two feelers and six legs. An insect was drawn with the feelers and legs labeled. A worksheet was given to label the body of this insect. The answers were given on a separate worksheet, which learners had to cut out and stick e.g. antennae, head, thorax, abdomen and wing. There was also a worksheet on a second insect, which was identified as a dragonfly. For this worksheet, the learners had to cut out the labels and paste them to the body parts of the dragonfly and to complete sentences by filling in words, for example; A dragon-fly has ____ body parts, A dragon-fly has ____ legs, A dragon-fly has ____ wings. Choices given were six, two, eight, four, no and three.

During the interview, Carly disclosed that she did integrate Natural Science into the numeracy lessons "depending on the context". She recalled the numeracy lesson on doubling and halving when she used insect legs as examples. She admitted that she did not plan the integration. Carly said she was confident teaching insects "because I taught it for a number of years. I have done the planning beforehand. It always comes up in your context." However, she did say, "It is the way I normally do it but if there are other ways I am willing to learn."

While teaching a numeracy lesson, Carly started talking about insects. She asked the learners which animals have four legs. The learners replied dogs and cats. She then continued with her numeracy lesson. In this lesson, she suddenly referred to the importance of water, explaining that people, animals and plants all need water to live. She mentioned that water is needed for many things, like cooking, washing, bathing and drinking. She added that some people boil the water before drinking to kill the germs. Carly then told the learners that we do not have to boil our water as we get it from taps and the water is already purified.

During one life skills lesson, Carly taught the learners about insects using a commercially purchased chart. The heading on the chart was 'Insects'. There were pictures of 'insects' with their names labelled. In teaching the learners, she integrated Literacy by reading out the names of the insects from the chart. She presented information on the structure of insects by discussing the number of legs the insects have and presented incorrect information on the chalkboard. Carly asked the learners for the isiZulu name for a millipede. The learners responded with "shongolo". She then said that the smaller shongolo is a centipede. Carly also referred to a spider as an insect. Carly asked the learners, "Where do these insects live?" Carly answered, "Some are found in water (e.g. scorpion), others in plants on the flowers, (e.g. honeybees on trees), branches, (e.g. ladybird) sand, (e.g. worms, snails, ant)". Then she asked, "Are all these insects harmful or dangerous?" Carly answered, "No, some of them are but not all." Carly spoke about the cockroach, which was not on the chart. She said that in Durban most of the houses have cockroaches no matter how clean you are.

She then drew a table on the chalkboard with 'harmful' and 'unharmful' [useful] insects and listed the insects in the table. Bees, scorpion, mosquito, fly and the spider were listed as harmful insects. Butterfly, ladybird and bees were listed as unharmful insects. Carly asked the learners, "Why are bees unharmful?" Carly answered, "Because they make honey and for medication." Carly then began to teach the learners about insects. Carly told the learners that the mosquito is harmful because it causes malaria. She said that insects have three parts, the head, thorax and the abdomen. According to Carly, these are the "three special body parts but they also have things on the top called the feelers and six legs". Carly wrote this on the chalkboard for the learners to copy in their life skills books.

Hands-on Science

There was no evidence of hands-on science in the life skills book or during the classroom observation. When asked during the interview what she understood by hands-on science, Carly replied "Eh... hands-on....I can't think of examples now.... isn't it things that you can practically do? You know with your hands." Carly cited the bean plant activity of hands-on science that she did with her learners. Carly believed it is important to rather use demonstrations "on this level" and cited the "type of learners" and the backgrounds they come from as reasons.

Scientific Investigations

There was no evidence of scientific investigations in the life skills book. In spite of this lack of evidence she stated that her learners enjoyed all types of activities as she said, "They actually enjoy Science because even measuring and things like that they love it." There was no evidence of scientific investigations during the classroom observation either.

The Nature of Classroom Interaction

The nature of classroom interaction considered the relationship between Carly and the learners in the classroom setting with regard to class routine and the lesson structure, language of instruction, learners' attentiveness, questioning, use of resources, types of activities and instructional methods and managing group activities. Examples of incidental teaching and learning were identified in an attempt to discover occurrences of science teaching.

Each day began with Carly reading a story and learners singing songs in English and isiZulu, followed by learners demonstrating their ability to use a calendar. The first story of the day was usually a Bible story. Carly involved the learners in working out the date to show which day it was on the calendar and to also see if the learners knew how to use the calendar.

Numeracy lessons followed the Bible story each day. The numeracy lesson began with counting backwards and learners were still having difficulty with this. The lesson progressed to doubles with Carly explaining the concept of doubling and halving. Learners struggled to understand the concept of halving in spite of Carly explaining it by using concrete examples. As the numeracy lesson ended, learners were allowed to read. Subsequently a discussion on news ensued.

The second day began with a numeracy lesson where most of the concepts covered the day before, were revised. This lesson was followed by a lesson on phonics where learners had to write five words with different sounds and write a sentence. After break, Carly taught the class a poem on opposites and then they were asked to complete an exercise on opposites. Thereafter the learners completed an exercise on the worksheet where they had to label the diagram of the spider. The numeracy lesson on the third day began with the learners counting in fives. Carly started the numeracy lesson on addition, where the learners filled in the missing numbers in the numeracy books. Thereafter the learners completed an exercise on the worksheet where they had to label the diagram of the dragonfly. Carly recapped work learnt over the previous two days about insects. She had to check her book before she proceeded. She then read all the words written on the chart and the learners were asked to repeat these after her. The word feelers, harmful and ‘unharmful’ were added to the list. Learners were then asked to add these words in their dictionaries.

Carly did not have discipline issues with her learners. She sent the learners back to their seats row by row, which ensured that there was minimum amount of noise. The learners were well behaved, attentive and sat quietly while waiting for Carly to complete the exercise. She did not stop her learners from talking but she said that they could talk softly. Carly did not use singing as a disciplinary measure, to keep the class quiet. Although learners sang songs in isiZulu, there was no evidence of Carly speaking to her learners in isiZulu. There was just once during the observation that she asked the learners what was the isiZulu name for the millipede.

There were not many instances where Carly questioned her learners. She asked them the opposites of snowy, raining and sunny. The learners could not answer and neither did Carly attempt to answer. The first sentence on the worksheet on the dragonfly that was to be completed was on the number of body parts. Learners had to choose from six, four, two, eight or three. Carly seemed hesitant when learners were calling out the answers. She did not commit to any answer but made the learners count the number of the labels on the worksheet.

Carly used blank chart paper stuck on the chalkboard to write down the names of the insects that learners remembered from the lesson the previous day. As the learners called out the names, Carly wrote them on the chart paper. The insect chart was stuck at the back of the class and the learners were turning around to get the names of the insects. Carly asked her learners to write the words in their personal dictionaries. Carly handed out two worksheets.

The one had the diagram of the spider and the other had the labels. She said they were going to label the different parts of the insect head, thorax, abdomen, wings, feelers (antenna). The learners had to cut out the words and stick them in the correct space. Carly walked around the class cutting the labels for the learners.

The activities involved class discussions, lecture style teaching and completing written exercises. The only time learners were on the carpet was for the Bible story and a reading activity. There were no examples of incidental teaching and learning.

8.3 DISCUSSION AND INTERPRETATION

This section covers the discussion and interpretation of Carly's story within the framework of the constructs used in the story and which are derived mainly from the theoretical framework. The discussion will be followed by an interpretation with regard to Carly's interpretation and implementation of the Natural Science Curriculum, which will allow me to place Carly at a particular level for each of the constructs.

8.3.1 Interpretation of the Natural Science Curriculum

Carly's interpretation of the Natural Science Curriculum was based on the constructs depicted in Figure 8.1.

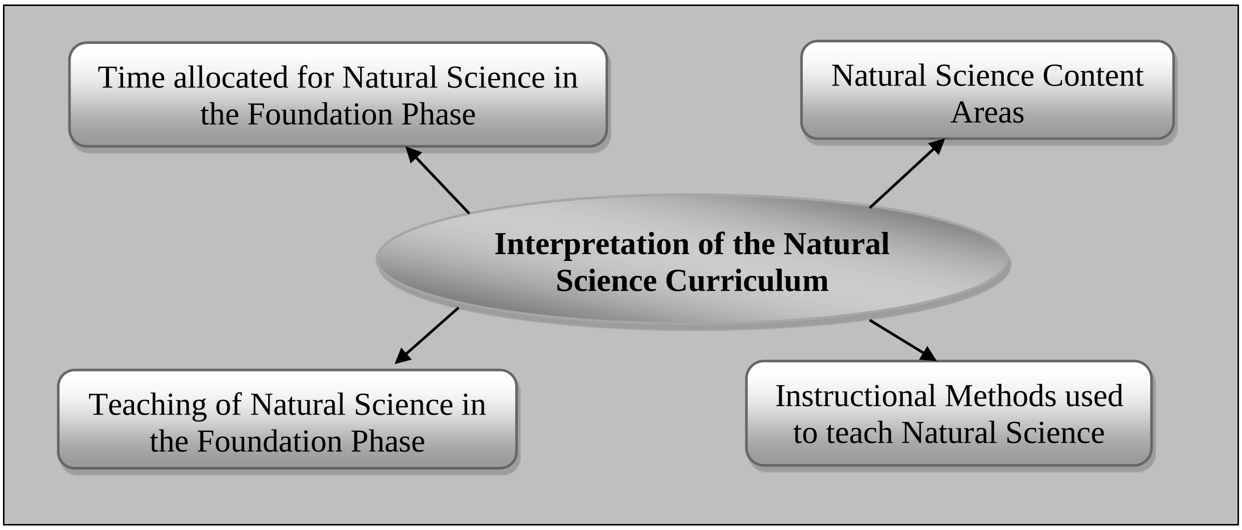

Figure 8.1: Factors affecting Carly's interpretation of the Natural Science Curriculum

8.3.1.1 Time Allocated for Natural Science

With the absence of life skills lesson plans, the time allocated for Natural Science could not be determined. Although the curriculum documents allocated more time to Literacy, Carly spent the same amount of time on Numeracy and Literacy indicating that she perceived these two learning programmes to be equally important. As the curriculum, and especially supporting documents such as the *Foundations for Learning* foreground Numeracy and Literacy, it is understandable that Carly would take this view as her responses indicate that she follows curriculum guidelines. However, this emphasis appeared to reinforce the notion that Life Skills, and by implication, Natural Science was not very important.

8.3.1.2 Teaching of Natural Science in the Foundation Phase

Although Carly saw the value of Natural Science, she believed that the curriculum did not offer adequate opportunities for teaching Natural Science. Her explanation was that it pertains to the level at which the curriculum is aimed. She was quite attuned to the level her learners are at and believed that the content of the curriculum was too difficult for them. She maintained that the level of the learners and the pace at which they work was the reason she could not follow the pre-planned lesson plans. Carly was of the view that her isiZulu speaking learners could not meet the demands of the curriculum as language was an issue. Carly's interpretation of what and how the content could be taught was dependent on the 'level', 'language', 'type' and 'age group' of the learner. Carly' constantly spoke of the level of difficulty of the curriculum and this could be the reason why she did not teach Natural Science.

Even though Carly mentioned that the grade two teachers sat together and planned as a grade, she still used the *Foundations for Learning* lesson plans. Since the lesson plans were pre-planned it was not clear what the nature of the planning was that occurred during the grade meetings. These planning meetings may have been a support mechanism for teachers.

There was no lesson plan given for Life Skills and there was no evidence of integration of Natural Science across the given literacy and numeracy lesson plans. The lack of evidence of Science seems to suggest that Carly did not teach Science and she also did not indicate that she was aware of the natural science learning outcomes.

During the interview Carly stated that she knew that other learning areas needed to be integrated into the three learning programmes, namely, Literacy, Numeracy and Life Skills; however, there was no evidence of this in her lesson plan. She stated that she was fully aware that Natural Science had to be taught through integration with the other learning programmes, but was not confident doing it as she needed to be shown how to do it. She said that she tried to integrate Natural Science but could not account for the time she spent on Natural Science. The importance that she placed on Literacy and Numeracy was evident in her responses.

Carly's response to designing a qualification for foundation phase teachers revealed that future foundation phase teachers should be taught the actual foundation phase learning programmes. The qualification for foundation phase teachers that she would design would have more emphasis on teaching practice providing guidance to teachers to bridge the gap from college to teaching at school. However, she did not place particular emphasis on the inclusion of Natural Science in the training of foundation phase teachers.

8.3.1.3 Natural Science Content Areas

It was surprising to note that Carly was not confident teaching the content areas she taught often (nutrition, air, weather, water and plants), while she was confident teaching that which she was not expected to teach. This may have been due to the fact that the selection of content was a decision made collectively by all grade two teachers and Carly had to accept this. Carly described herself as not having sound science content knowledge and sound science pedagogical content knowledge and therefore she knew that she needed training and practice.

Carly knew that Natural Science formed part of the curriculum but she did not know how it fitted in which indicated that Carly did not have a good understanding of the curriculum documents. She was unaware of the Natural Science Curriculum and was guided by the *Foundations for Learning* books. The content selected was appropriate and taken from the workbooks and *Foundation for Learning* curriculum documents and not from the Natural Science Curriculum documents.

8.3.1.4 Instructional Methods

While Carly mentioned that she selected inquiry, lecture, discussion and hands-on as instructional methods and used them daily, there was no evidence in her lesson plans of such activities. Carly said that the instructional methods that she used depended on the type of learners she had in her class.

The example that Carly cited during the interview was a practical activity showing the growth of the bean plant, which was a science content area. However, there was no evidence that the lesson was taught as a practical activity or what science concepts were specifically taught. Carly believed that learners learn more from demonstrations because of their background. There was no evidence that Carly performed demonstrations or learners' background influenced how they learnt.

8.3.1.5 Carly's level of interpretation of the Natural Science Curriculum

The levels for Carly's interpretation of the Natural Science Curriculum were determined. Table 5.11 shows the composite levels for each sub-construct, namely time allocation, teaching Natural Science in the Foundation Phase, natural science content areas and the instructional methods used to teach Natural Science. The descriptors for each level were developed and used to determine the level at which Carly was located with regard to the way she interpreted the curriculum as described in chapter five. These levels were derived from the findings discussed in this chapter. Table 8.2 reflects Carly's interpretation of the different sub-constructs, which were obtained from the questionnaire, interviews and document analysis. The table shows the levels at which Carly was placed.

Carly was placed at level one for time allocated to teaching Natural Science, as there were no life skills lesson plans. Carly knew Science has to be integrated across all learning programmes and this could potentially place her at level two. However, all other factors place her at level one. Considering there was no evidence to support Carly's interpretation of teaching Natural Science, I made the decision to place her midway between levels one and two. She was at level two for science content knowledge as the science topics she mentioned were appropriate for the Foundation Phase. Although Carly mentioned that she used a number of instructional methods appropriate for teaching Science there was no evidence in her planning that she actually used these methods. As her responses indicated that she had some knowledge of what these methods entailed, Carly was placed at level two for instructional methods. This composite picture of Carly's ability to interpret the Natural Science Curriculum in Grade Two showed that she had certain limitations with regard interpreting the Natural Science Curriculum.

Table 8.2: Carly's interpretation of the Natural Science Curriculum

Level	Time Allocation	Teaching Natural Science	Content Areas	Instructional Methods
1	Time allocation for all three learning programmes (Literacy, Numeracy and Life Skills) were not indicated	Carly was cognisant of the fact that Natural Science needed to be taught through integration or as a freestanding subject but there was no evidence of this in her lesson plan		
2		*Foundation for Learning* workbook and lesson plans did correspond to the curriculum to a certain extent but did need adapting Carly was unsure of the natural science learning outcomes	Certain topics mentioned by Carly were appropriate for the Foundation Phase	Carly mentioned a number of instructional methods appropriate for teaching Science, but there was no evidence of this in her lesson plan
3				
4				

8.3.2 Implementation of the Natural Science Curriculum

Carly's implementation of the Natural Science Curriculum is discussed and interpreted using the constructs from the theoretical framework.

8.3.2.1 Outside Agencies

The constructs pertaining to outside agencies are presented in Figure 8.2.

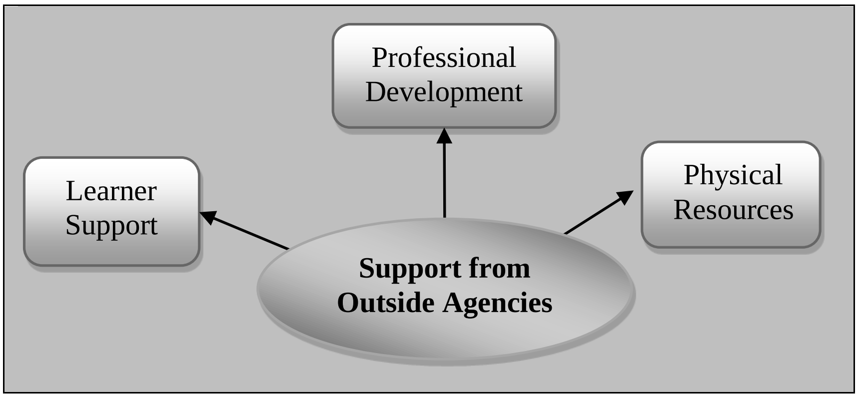

Figure 8.2: The support Carly received from outside agencies and the sub-constructs (adapted from Rogan 2007, p. 99)

8.3.2.1.1 Learner Support

The lack of support from the parents made teaching difficult for Carly. Carly's learners did not receive much support from their parents with regard to stationery or with homework. She attempted to assist students by teaching in isiZulu and English.

8.3.2.1.2 Physical Resources

Although Carly said that she did not need to use any equipment to teach Natural Science she later contradicted herself when she said she used basic equipment to teach it. She said the school would have purchased any equipment she needed but could not do so because of the lack of finances. However, it is possible that simpler and cheaper resources could be used. Even though Carly understood why the school could not buy the resources needed, the lack of physical resources made the teaching of Natural Science difficult for her. Having no workbook for Life Skills further confirmed the priority placed on Literacy and Numeracy by the Department of Education.

8.3.2.1.3 Professional Development

Carly's attendance at workshops was dependent on her having transport. Although one sympathises with her problem, this should not be an excuse not to attend workshops. Not attending numeracy workshops because she was confident in this area was not an acceptable reason as workshops are meant to extend knowledge and develop pedagogic content knowledge. The limited opportunity she received to build her capacity was insufficient to increase her confidence and knowledge to teach Natural Science.

8.3.2.1.4 Carly's level of implementation of the Natural Science Curriculum with regard to Outside Agencies

Table 5.12 shows the composite levels for the constructs included in the support from outside agencies. The discussion above informed my interpretation of how outside agencies support Carly's ability to implement the curriculum. This means that Carly receives limited support from outside agencies and this does not contribute substantially to the enhancement of her ability to implement the Natural Science Curriculum. Table 8.3 reflects how the different sub-constructs related to outside agencies influenced Carly's implementation of the Natural Science Curriculum. My findings are based on classroom observations and what was indicated in the questionnaire, interviews and document analysis. The table shows the levels at which Carly was placed.

Carly was at level two for learner support as she had limited support from parents and she assisted students by speaking in isiZulu. She was at level one for physical resources as there was no evidence of the availability of science equipment and a life skills workbook. Although Carly attended limited non-science workshops, all the factors related to professional development were at level one, placing Carly overall at level one. In the light of this, it is a pity that Carly does not seem to think that she needs resources or more professional development to teach Natural Science more effectively. The levels Carly was placed at for the support from outside agencies, show that she has limited capacity to support the implementation of the Natural Science Curriculum.

Table 8.3: Carly's ability to implement the Curriculum with respect to Support from Outside Agencies

Level	Learner support	Physical Resources	Professional Development
1		No provision of science equipment to teach Natural Science No facility to teach Science, for example classroom space, water, school yard No life skills workbook supplied	No staff development planned by school No workshops on Science offered
2	Minimum support of parents with regard to language, finance or homework Minimum support from Carly to assist learners experiencing difficulty with the language of teaching, e.g. teacher translates in isiZulu		Limited non-science workshops attended
3			
4			

8.3.2.2 Capacity to Support Innovation

The constructs pertaining to Carly's capacity to support the curriculum as an innovation are presented in Figure 8.3.

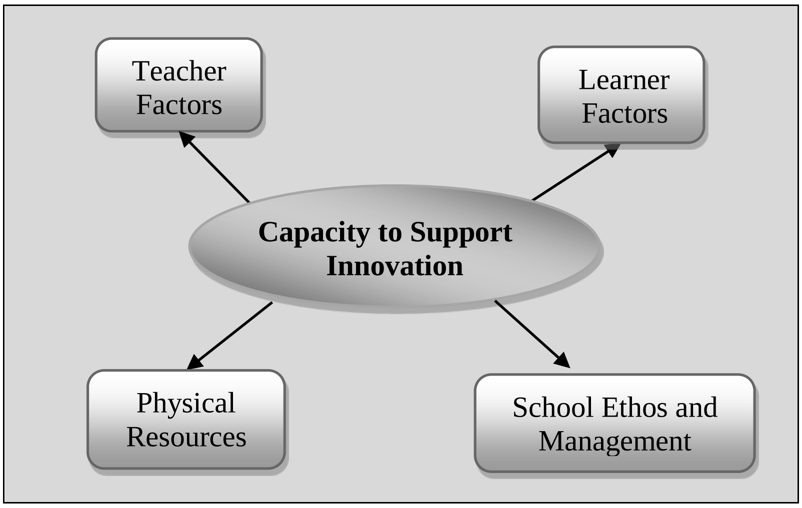

Figure 8.3: Carly's Capacity to Support Innovation and the sub-constructs (from Rogan 2007, p. 99)

8.3.2.2.1 Teacher Factors

Carly's love for teaching and working with children was a positive attribute. She admitted though that her qualification did not support her in her teaching and this could have a negative impact on her ability to teach Natural Science. She indicated that she was passionate about Numeracy and Literacy and believed that Natural Science was already integrated within the three learning programmes. However, she did not understand how this integration was accomplished.

Although Carly's description of herself showed her commitment and confidence in her ability to teach Natural Science, she also indicated that she did not have science content knowledge and science pedagogical content knowledge. This was evident from the natural science lesson on insects as the science content knowledge was flawed and she did not teach the lesson using scientific investigations. Her attempt at teaching lessons on insects indicated that she had confidence teaching some aspects of Natural Science. Carly's description of herself is contradicted by the fact that she needed ongoing support from her head of department to be able to teach effectively.

Carly's enthusiasm to work with insects and other animals indicated that she had some interest in teaching Science. Carly's inconsistent responses to the rating scale meant that she did not appear to have most of the skills required to prepare her classroom to implement Natural Science. She did not have the necessary skills to teach Science as she found it difficult to explain some science concepts to learners. Another contradiction was her response that she understood science concepts well enough to teach them, but had a difficult time understanding Science. These contradictions could imply that Carly had a poor understanding of what teaching Natural Science entailed. Carly's difficulty in teaching Natural Science through integration contributed negatively to her capacity to support implementation.

Carly's responses to the statements on the rating scale showed that she was willing to take the time to plan and use resources to teach Science. Although Carly did not agree that preparation for teaching Science generally took more time than other subject areas, she agreed that teaching Science requires much time and effort. She admitted that she did not integrate other subject areas into Science. From Carly's responses, she did not seem to have the capacity to support the implementation of the Natural Science Curriculum although she believed she had the capacity to manage hands-on science in a manner that was appropriate to the development of her learners. However, there was no evidence of this.

8.3.2.2.2 Learner Factors

There were only two positive characteristics (enjoyed group work and were creative), which Carly used to describe her learners. She felt that not all of her learners were able to do investigations as they according to her were at different levels. This means that the learners would need to be nurtured and opportunities provided for them to develop characteristics needed to perform investigations. There was no evidence that such opportunities were created for learners to develop the skills. Considering Carly's negative view of her learners, it may prove too difficult for her to achieve this.

8.3.2.2.3 Physical Resources

Although she did not select nature as a resource, she did mention in her example that she used the natural environment. However, there was no evidence to support this. The inconsistencies in Carly's responses to the use of resources made it difficult to determine her capacity to support the implementation of the Natural Science Curriculum with regard to resources. She used textbooks to assist her in her teaching Science but did not use science equipment, videos, computers and models as resources because these were not available at the school. Although the natural environment was available, she did not use this to teach the lesson on insects and used an inappropriate poster. She was aware that her learners' understanding could improve if she incorporated models in her lessons. Carly's view that good equipment was required to teach Natural Science showed the way in which she interpreted the curriculum. She believed that without the equipment, teaching Natural Science might not be possible. The school did not have many resources to assist Carly in implementing the Natural Science Curriculum as a result it did not contribute substantially to her capacity to be innovative with regard to implementing the curriculum.

8.3.2.2.4 School Ethos and Management

Carly's responses to the ethos and school management seemed to indicate that although the school was well organised and had systems and procedures in place but the support to implement the Natural Science Curriculum was lacking.

8.3.2.2.5 Carly's level of implementation of the Natural Science Curriculum with regard to her Capacity to Innovate

Table 5.13 shows the composite levels for the constructs used to determine Carly's capacity to support innovation with regard to natural science teaching. The discussion above informed my interpretation of how Carly's capacity supports her ability to implement the curriculum. Table 8.4 reflects how the different sub-constructs contributed to Carly's capacity to implement the Natural Science Curriculum. My findings are based on information obtained from classroom observations and what was indicated in the questionnaire, interviews and document analysis. The table shows the levels at which Carly was placed.

Although Carly acknowledged that she placed much more emphasis on Literacy and/or Numeracy, her professional qualification and the fact that she could balance some aspects of her work as well as her limited science knowledge, influenced my decision to place Carly overall at level two for teacher factors. Carly's learners were capable of guided investigations; therefore she was placed at level two for learner factors. Although it was inappropriate, Carly used a poster to teach Science therefore I place Carly at level two for physical resources. While certain factors, like the role played by the governing body could place Carly at level two, all other factors relating to school ethos and management were at level three, placing Carly overall at level three. From the levels at which Carly was placed with regard to her capacity to support the implementation of the Natural Science Curriculum, it was clear that she had limited capacity to support the implementation of the Natural Science Curriculum. Although the school ethos supports teaching and learning and is well organised, little support is given for Carly to develop as a grade two teacher and she received little support for science teaching.

Table 8.4: Carly's Capacity to Support Innovation

Level	Teacher Factors	Learner Factors	Physical Resources	School Ethos and Management
1	Carly acknowledged that she placed much more emphasis on Literacy and/or Numeracy and very little on Life Skills		Carly did not use workbooks for Life Skills Programme	
2	Carly had limited science content knowledge Carly had limited science pedagogical content knowledge Carly had a professional qualification appropriate for the Foundation Phase but which did not include Natural Science Carly was able to balance some aspects of her portfolio but finds it difficult with the large class size Carly was confident to teach some aspects of Natural Science	Learners were capable of carrying out scientific investigations with guidance Learners enjoyed some scientific investigations Learners enjoyed working in groups	Carly used minimal resources to teach Science which were mostly inappropriate Carly used a science textbook	A School Governing Body was in existence but not visibly active Teachers and learners played a minimum role in management Parents played a minimum role in supporting the school
3				Timetable mostly adhered to

				Principal and/or HoD was present at school most of the time and was in regular contact with his/her staff Staff meetings regular but not well-planned Good organisation of extramural activities which seldom interfered with classroom activities School was secure and limited control of who enters the premises Adequate evidence of COLT
4				

8.3.2.3 Profile of Implementation

The constructs pertaining to Carly's profile of implementation are presented in Figure 8.4.

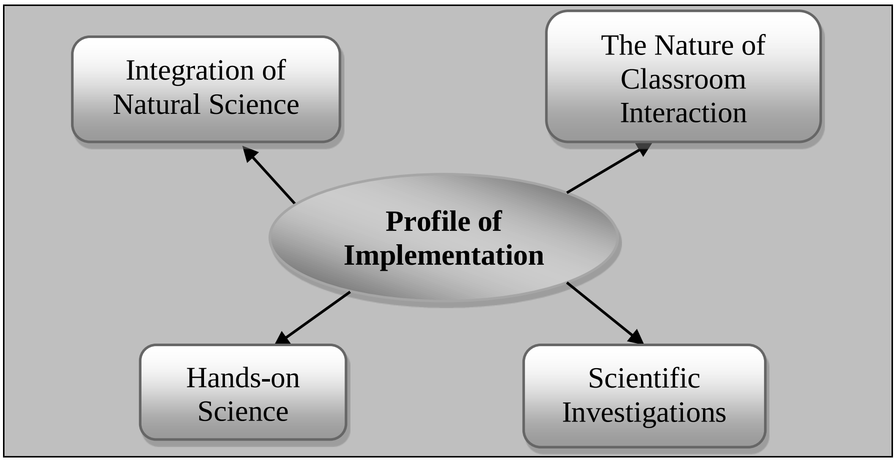

Figure 8.4: Carly's Profile of Implementation and the sub-constructs (adapted from Rogan 2007, p. 99)

8.3.2.3.1 Integration of Natural Science

Carly must be commended for attempting to teach lessons on insects. The content of the worksheet on insects that appeared in the life skills book demonstrated Carly's attempt at integrating Life Skills, Literacy and Numeracy in Natural Science. Carly also attempted minimal integration of Science in Numeracy by using animals' legs as examples in her numeracy lesson even though she stated during the interview, "She did not plan to do so". This lack of planning resulted in the lesson being flawed with respect to the execution and correctness of information. Carly's lack of scientific knowledge was demonstrated by her use of an inappropriate commercially purchased poster on insects. On this poster worms, scorpions, spiders, millipedes, and centipedes were all depicted as insects when in fact they are not insects [the millipede, centipede, spider and scorpion are other types of arthropods, while worms (earthworm) are not arthropods at all. Only insects have three body divisions, while scorpions, spiders, millipedes and centipedes have two. Scorpions are terrestrial and therefore do not live in water. Scorpions and spiders have eight legs, while insects have six. Scorpions and spiders do not possess antennae].

When discussing harmful and harmless insects, Carly used the word 'unharmful' as being the opposite of harmful. Carly did not know there is no such word as 'unharmful' as she continued teaching and even recapped this work the next day. Carly's attempts to integrate

Science in the numeracy lessons were unsuccessful. She did not have the appropriate knowledge of how to integrate natural science concepts in her teaching.

8.3.2.2 Hands-on Science

Carly's confused response to describing her understanding of hands-on science indicates she has little understanding of the concept although her example of growing beans could be hands-on science and could be developed into an investigation if Carly had the skill to do so. Nothing in her teaching of the natural science lesson indicted that she had the skills to organise hands-on activities. However, the fact that Fiona also mentioned growing beans in Grade One, begs the question of how teachers plan to ensure progression between grades and avoid repetition.

8.3.2.3.3 Scientific Investigations

Carly did not do investigations, as she believed not all her learners were capable of this. This contradicted her previous statement when she said that her learners enjoyed investigations. The lesson on insects could have been easily developed into an investigation using the natural environment as a resource. Carly did not have the skills to do this. The examples of investigations that Carly gave were those of learners engaging in activities that had no structure and no obvious aims.

8.3.2.3.4 The Nature of Classroom Interaction

Carly followed a set class routine daily. She set a religious ethos in her class that had her learners praying in the morning and before their lunch breaks. From the observations it was evident that Carly spent the most amount of time on Numeracy, which indicated that she placed more importance on Numeracy than on Literacy and Life Skills. Although Carly did not speak to her learners in isiZulu, there was no confusion with the instructions she gave them. Learners knew what was expected of them due to the set routine, which minimised disruptions to teaching and learning. Carly's classroom was neat and well organised. There was sufficient space for learners to sit on the carpet and there was no incidents of learners fidgeting. Although learners sang songs and recited poems, it was not used as a means of acquiring discipline.

Carly controlled her learners in that she had a system in place and they carried out activities in an orderly manner. Having disciplined learners is always a positive aspect in teaching and learning. However, Carly's learners were overly disciplined to the point that they never spoke to her unless she spoke to them. When questions were asked, the learners did not answer unless they were asked the question directly. Carly asked the learners if they knew what the opposites of "snowy, raining and sunny" were. Learners could not provide answers, as there are no opposites for these words. Neither did Carly attempt to provide an answer to the question. Here again, not much thought and planning went into the lesson on opposites.

Although Carly used the chalkboard and counters effectively, the same could not be said for all the resources she used. Moreover, this is evident from her use of an inappropriate chart on insects and the use of an A4 worksheet with the diagram of an insect, as a chart for learners to observe. When Carly held the worksheet up at the front of the class, it was too small for the learners to see, hence they responded incorrectly when they were asked to label the picture. Carly was uncertain about the responses that the learners gave and kept looking at her response sheet for the answers. She tried to work out the answer before giving them to the learners. Carly not only lacked confidence in teaching about insects, she also did not have the necessary content knowledge.

Learners had exercise books for each learning programme that was used to complete the written work. It was commendable that the learners had personal dictionaries and they entered the new words. However, the learners did not understand some of the words.

Since there was a limited amount of group work, she did not experience difficulty in managing this. Learners spend most of the day seated at the desk doing written exercises and completing worksheets, individually. The lessons were very controlled and teacher directed that there were no opportunities for incidental learning.

In conclusion, Carly's classroom interaction was characterised by organised activities. Since there were a few group activities, it is difficult to determine if Carly knows how to manage group activities. Furthermore, the purpose of a number of the activities was not clear. Carly also demonstrated poor use of resources and her lack of science content knowledge was evident. She thrived on control and routine. It was difficult to envision how Carly would have managed a natural science lesson, which included investigating phenomena as prescribed by Learning Outcome One.

8.3.2.3.5 Carly's Profile of Implementation of the Natural Science Curriculum

Table 5.14 shows the composite levels for the constructs used to determine Carly's profile of implementation with regard to natural science teaching. The discussion above informed my interpretation of how Carly's profile of implementation supports her ability to implement the curriculum. The descriptors for each level were used to determine the level at which Carly was located with regard to the way she implemented the curriculum. Table 8.5 reflects how the different sub-constructs contribute to Carly's profile of implementation of the Natural Science Curriculum. My findings are based on information obtained from classroom observations as well as data obtained from the questionnaires, interviews and document analysis. The table shows the levels at which Carly was placed.

While the evidence of integration of Life Skills, Literacy and Numeracy in Natural Science could place Carly at level three, the minimal integration of Natural Science in Life Skills, Literacy and Numeracy, could place Carly at level two. Hence, Carly is placed midway between levels two and three for integration of Natural Science. Carly was at level one for hands-on science and scientific investigations as there was no evidence of this. Carly was on level two for the nature of classroom interaction as she presented content, which showed some organisation and sequence. However, it was not based on the lesson plan. From the levels Carly was at she had certain limitations with regard to her implementation of the Natural Science Curriculum.

Table 8.5 Carly's Profile of Implementation

Level	Integration of Natural Science	Hands-on Science	Scientific Investigations	The Nature of Classroom Interaction
1		No evidence of hands-on science to help develop concepts Carly did not use specimens and resources found in the local environment to illustrate lessons Learners were not practically involved in the lesson	No evidence of scientific investigations	
2	Minimal evidence of Natural Science integrated in Numeracy, Literacy and/or Life Skills			Carly presented content which showed some organisation and sequence however it was not based on the lesson plan Carly used textbook/ workbooks, however support was still needed Carly engaged learners with questions, however she either answered the questions or did not give learners enough time to respond to questions Carly engaged learners in minimal meaningful learning activities which results in maintaining learners concentration most of the time
3	Evidence of Numeracy, Literacy or Life Skills integrated in Natural Science			
4				

8.4 CONCLUSION

In chapter eight, I presented the findings with regard to Carly's ability to interpret and implement the Natural Science Curriculum within the Life skills Programme of the Foundation Phase. Carly is a grade two teacher who is skilled in a number of areas pertaining to foundation phase teaching. However, with regard to the Natural Science Curriculum, she is unfamiliar with the time she needs to spend teaching Natural Science. She is partially competent in her interpretation of the Natural Science Curriculum, with regard to content and instructional methods, and has some idea of what the curriculum expects with regard to teaching Natural Science. Carly has some ability to integrate Science in Literacy and Numeracy, but her lack of scientific knowledge is a drawback as is her inability to teach Science using hands-on activities and scientific investigations. She also demonstrated some ability to interact with her learners. All of the above contribute to a profile of implementation that is mostly located on levels one and two with one aspect reaching level three.

In chapter nine, I present Simone's narrative with regard to her interpretation and implementation of the curriculum along with a discussion and interpretation of the findings presented in the narrative.

CHAPTER NINE

SIMONE'S INTERPRETATION AND IMPLEMENTATION OF THE CURRICULUM

9.1 INTRODUCTION

In this chapter, I present the findings related to Simone's interpretation and implementation of the RNCS. The findings provides answers to the first and second research questions: *What are foundation phase teachers' interpretation of the Natural Science curriculum and How do foundation phase teachers implement the Natural Science Curriculum?* I drew on data pertaining to the way she interpreted and implemented the curriculum from a number of data sources mentioned in chapter four and produced a narrative from this data. As I composed the narrative based on the data, the narrative is presented in the third person as a story told by me, the researcher. Simone's story commences with some biographical information to provide a background to her qualifications and experience. Thereafter her story unfolds, guided by the constructs discussed in chapter five. The constructs are:

- Interpretation of the Natural Science Curriculum,
- Support from Outside Agencies,
- Capacity to Support Innovation and
- Profile of Implementation.

Simone's narrative reveals a composite view of her as a foundation phase teacher within the context of teaching Natural Science. Information derived from this composite allowed me to place Carly at a particular level for each of the constructs discussed.

9.2 SIMONE'S STORY

Simone has a four-year teaching qualification. She was 43 years old at the time of data collection and had 21 years teaching experience, of which 20 years were in the Foundation Phase. She had 44 learners in her grade three class at the time of data collection. She has experience of teaching Grades One, Three and Four.

Simone's interpretation of the Natural Science Curriculum (Grade Three)

Simone's interpretation of the Natural Science Curriculum is presented as a narrative according to the constructs and the related sub-constructs.

Time Allocated for Natural Science

Natural Science forms part of the Life Skills Learning Programme and thus the time allocated was examined in conjunction with the time allocated for the Life Skills Learning Programme. One aspect of Simone's interpretation of how Natural Science should be taught in the Foundation Phase was reflected by the time allocated to the teaching of Natural Science. This was indicated in the lesson plans provided by the *Foundations for Learning* documents. Table 9.1 shows the comparison with the allocation of times according to Simone's responses to the questionnaire and during interviews, lesson plans provided by her and the curriculum documents for each learning programme.

Table 9.1: Comparison of the allocation of times for respective learning programmes for Grade Three

Learning Programmes	Time Allocation per day according to		
	Foundations for Learning Lesson Plans	Curriculum Documents	Simone
Literacy	No time allocation	1 hour 50 minutes	1 hour 50 minutes
Numeracy	No time allocation	1 hour 30 minutes	1 hour 45 minutes
Life Skills	No lesson plan given	1 hour 10 minutes	1 hour 15 minutes

The time Simone stated that she allocated to the three learning programmes is not in keeping with the curriculum documents except for Literacy which is the same as that stated in the curriculum documents. However, the time allocated on the lesson plans for the learning areas could not be compared to the curriculum documents and what Simone stated, as reflected in the last column as the information was not indicated on the lesson plans for Numeracy and Literacy and there were no life skills lesson plans. The lesson plans supplied by Simone were analysed and these may have been incomplete documents.

The *Foundations for Learning* lesson plans for Grade Three, as with Grade One and Two did not indicate time to be spent on any other activities as shown for Grade R. The time allocations indicated that more time was assigned to Numeracy and Literacy than to Life Skills.

The absence of some lesson plans used by Simone made it impossible to determine the time apportioned to Natural Science.

Teaching of Natural Science in the Foundation Phase

Although the *Foundations for Learning* lesson plan did not provide direct information on how Simone interpreted the curriculum, the analysis of the lesson plans provided information on what Simone had planned for each day. Although Simone said she used the *Foundations for Learning* lesson plans for Literacy, Numeracy and Life Skills which were supplied by the Department of Education to teach her lessons which were already planned, she admitted to still planning lessons and using *Foundation for Learning* lesson plans as well as “another one....it’s also... it’s a blue book and we got a term book....its specific term book for Numeracy divided into the weeks and we use that”. She explained that they taught to that because “we got to cover those aspects”. According to Simone the curriculum “mainly teaches to the average and above average child, but for the weaker child ...no”.

The lesson plans were analysed on content knowledge, instructional methods, physical resources, types of activities and integration of Natural Science. It was important to note that the lesson plans are only the plans and not necessarily, what was actually taught during the observation lessons. Simone’s lesson plans for the period of observation were analysed. This analysis gave an indication of Simone’s interpretation with regard to where Natural Science fits in the particular section covered during observation.

There was no content indicated on any of the given lesson plans. The literacy lesson plans showed that the lesson began each morning with oral work. This would be followed by discussion on the day chart, month chart, weather chart, birthday chart or special occasions. Learners were to bring a meaningful object to the classroom and give a one or two-minute talk on what it was and what it meant to them. This was to be followed by shared reading of the class text. Language verb tenses were to be revised based on the shared reading. The next day the morning oral was to be followed by learners re-reading the class text. Learners were then to complete a task matching vocabulary words of the previous week with short definitions of the words. The next day the morning oral was to be followed by learners re-reading the text together. Learners were to then complete the written activity that they missed during the guided reading. Group/paired reading were to follow with learners reading a short, simple text in their seating groups.

The numeracy lesson plan showed the lesson beginning daily with rote counting. On the first day, this was followed by fractions. On the second day, the rote counting was followed by the symmetry of two-dimensional shapes. On the third day, the sequence would be repeated. There was no integration of Natural Science across the literacy and numeracy lesson plans. There was no lesson plan supplied by the teacher for the Life Skills Learning Programme. Simone considered the workbooks as consulting the curriculum especially with regard to assessment. She believed the workbooks made her life a little bit easier because instead of her designing her own assessment tasks, the workbooks had assessment tasks for her to use.

Although Simone was of the view that Numeracy and Literacy should be integrated with Natural Science, she admitted, “At the moment we are doing it the other way around.” Simone attempted to provide an example of how she would integrate Numeracy and Literacy with Natural Science:

> If I had to do it... Numeracy and Literacy...in the Numeracy part the Natural Science will be to investigate... what whatever...so if it was graphs, data handling, measurement and then the Literacy part they will write about their findings-, which we don’t do. They need to write. And because we teach lots of children for who English is not their first language it is an added problem.

Even though Simone believed the curriculum promoted Natural Science “in a very subtle way,” she found it difficult to discover the natural science content within the curriculum. She clarified, “You see if I was science driven as a teacher then maybe I will pick up the aspects of Science easier, but because I am not, it is hard to find it.” Simone was of the opinion that the curriculum did not offer sufficient opportunities to teach Natural Science. She explained,

> You see now because we have so many assessments to do. We mainly focus on what we have to cover. So we are assessment driven. So we don’t have time to really explore the whole syllabus and teach that. We are actually teaching under pressure to cover the areas we need to cover. Because under one topic, there are five sub-headings that we need to go through and they stipulate that we got to cover this in Learning Outcome One and this in Learning Outcome Two. Also, because of the pace at which the children are learning.

Simone admitted, “Science is not something we really expose our learners to.” She went on to say, “We supposed to integrate it into our learning areas but we don’t really have the equipment”. She remembered the time when she was in the USA (United States of

America) where the classrooms were well-stocked with science equipment. She compared that with her experiences here in South Africa and concluded, “We don’t have those things.”

Before attempting to describe how she thought Natural Science should be taught, Simone asked how many learning outcomes there are in Natural Science. She then continued her explanation:

> only one....give them a topic...let them research it...and see what they come up with...help them get the information...help them sort it but not really teaching to it. And sort of a mini project but not done at home, done in the class without parental help, without teacher help. And let them ...say Tyrannosaurus the dinosaur and they choose that. And why did they choose that. Discuss the characteristics of the dinosaur. When was it found? Describe it. And they have little things; just on an A4 size and they will come up in front and talk about their dinosaur. And maybe in groups, maybe there are eight groups and there is eight dinosaurs to choose. In that, way they will learn about the different dinosaurs in a shorter space of time.

If Simone was to design a qualification for foundation phase teachers, she was adamant it should have Art and Craft, Physical Education, Drama and Music. She believed that before learners are able to conduct investigations and play they need to find the things they need to play with. She drew from her personal experiences and remembered, “Like we played with three stones, where we collected a group of stones. They had to find more or less the same shape, size and weight to play with so that when they throw it up”.

Natural Science Content Areas

Simone was very confident to teach plants, animals, nutrition, air, weather and water as she taught this as part of the curriculum (Appendix D). She was confident to teach the universe and solar system and the human body. She was not confident to teach light energy and colour, heat energy, sound energy, magnetic interactions, electrical energy, simple machines, matter and materials, reactions and changes of materials, earth and moon systems, matter and motion, atoms and ecology. She had never taught light and energy as it was “not relevant to the curriculum for Grade Three”.

Instructional Methods

The instructional methods that Simone indicated she used daily in her teaching of Science were lectures, demonstrations, discussion, role-play, problem-based learning, cooperative learning and hands-on activities (Appendix D). Simone said she used journal writing and stories/narratives weekly. She selected learning centres as a method she used fortnightly. She did not select any method that she used monthly, once a term or never, implying that she used the above-mentioned methods often. She explained her reasons for selecting these methods, "In the Foundation Phase, we use a variety of teaching/instructional methods to convey the learning content to the learners in the way that they will fully comprehend the learning material."

Simone's view was that demonstrations can be "very effective" in teaching Natural Science. She drew from her personal experiences as a visual learner and knew that if she saw something she learnt better. She considered showing things to the child as effective so that "it will stick in their heads" than just telling them to do something. Simone did not select problem solving as an instructional method used by her to teach Natural Science. However, during the interview she stated that there was a place for problem solving in the teaching of Natural Science. She responded, "Yes, problem solving involves everything. To investigate, you are giving them a problem and they have to investigate. How many litres in a two-litre container? How many 250 ml will you get from two litres? That's problem solving."

Her understanding of hands-on science was "where they must go and do it themselves". She explained that the teacher had to show and demonstrate and then the learners do it. The example she provided was from a lesson on measurement:

> Like now, we doing mass - kg and g. If I had a physical scale beside the one I use for weight... you tell them "mummy goes to the supermarket...she can buy a small packet of sugar or she can buy a big packet of sugar. She can buy two apples or she can buy a pack of apples. It depends on mummy's budget"… so if I had a scale where they could bring things from home and just put them on for their own sake and measure it, I mean weigh it, it will be more exciting for them and they will understand. Because many of them go to the supermarket with their parents, and what I discovered was the scale that they use in the shops now are electronic. So it doesn't have that where one side goes down and one side stays up like ...and you tell them this is how a scale works. Heavy objects will go down and the lighter one will go up. They don't understand this because

they can't see it. I mean I am showing them a picture of a scale, but they don't know it.

Simone's implementation of the Natural Science Curriculum - the influence of Outside Agencies

A number of factors which affect Simone's implementation of the curriculum, are influenced by outside agencies.

Learner Support

Learner support is considered in terms of learners' socio-economic status and their experience with the language of instruction. Simone indicated on the questionnaire that learners in her class came from supportive home environments. She did not offer any examples of the manner in which parents support their children. However, during the interview she said, "Very few learners are from a home where they help them or support them in doing tasks at home." She added, "Most of the learners in my class are from low socio-economic background." Simone specified that eight learners in her class have trouble with the language of instruction.

Physical Resources

Physical resources as support from outside agencies is the support the school received with respect to textbooks, workbooks, science equipment that the school is given by an outside agency, e.g. the Department of Education, as well as the physical infrastructure of the school. The physical infrastructure is the same as for the other teachers. Simone's classroom was similar in size to Carly and Fiona's. It was relatively neat with books arranged on shelves. The carpet area was small. The seating for the learners were arranged in groups of six. Simone's table was cluttered with books and stationery. It was evident that the chalkboard was cleaned often, as there was evidence of only the day's written work.

Simone declared, "We don't have the facilities. We don't have school kits to work with. We don't have place to work with." They did receive workbooks from the Department of Education. Simone mentioned:

> For the first time this year, we got wonderful workbooks from the department, which are also based on the assessment. We teach to the assessment. Basically, it is assessment driven. The workbooks are on Numeracy and Literacy and not Life Skills.

Simone later clarified:

> The workbooks make our lives a little bit easier because instead of us going and drawing up our own assessments things it is there for us. It makes our lives a little bit easier but it is not as flexible as you would have drawn it up yourself because you would have catered for the different type of child in your class. This mainly teaches to the average and above average child but for the weaker child ...no.

Simone used sample books for Life Skills, which she received from publishers. She said, “We have quite a few over the years and we use these as a backup.”

Professional Development

Professional development is the training that teachers receive by either the school, Department of Education, Unions or any other outside agencies. Simone did not attend any professional development workshops with regard to teaching Natural Science in the Foundation Phase. She did attend professional development workshops on Numeracy and Literacy that were organised by the Union, which she found to be informative. She said,

> I would say that I am a committed teacher who makes every effort to improve my teaching by attending workshops to keep abreast with the new RNCS documents. I also attend workshops held by the Union for the *Foundations for Learning* Programme.

Simone did have a say in deciding which workshops she wanted to attend. They were given the notices from which they could choose the areas they would like to be developed in addition to those areas that have been identified on the IQMS that they submit. Natural Science workshops were only offered to the teachers in the Intermediate Phase. Simone would attend if there were workshops in Natural Science for Foundation Phase because she believed “Science is everything.” Besides the staff meetings there was no staff development planned by the school.

Simone’s implementation of the Natural Science Curriculum - Factors, which shape her Capacity to Support Implementation

A number of factors influenced Simone’s capacity to support implementation of the Natural Science Curriculum

Teacher Factors

Simone became a foundation phase teacher because she loved children and loved working with children. She was of the opinion that the Foundation Phase "is the most rewarding phase to teach in because you get them from knowing nothing and you take them to a place where, you can't believe it's the same child". In her ACE qualification, Simone studied a module on computers and the use of computer technology. Simone was of the view that having her ACE qualification had best prepared her to be an effective foundation phase teacher as she integrated teaching and using computers and showed her learners how to do research on the computer. She thought her "learners somehow do amazing work when using technology".

Simone described herself as dedicated, caring, well qualified, experienced, confident, competent and approachable. She said she attended professional development activities and tried innovative teaching techniques. She said that she planned lessons well and made an extra effort to improve her teaching. Simone did not believe she had sound science content knowledge and sound science pedagogical content knowledge. She stated, "I would like to improve my natural science content knowledge as I am not confident in this learning area; however I do try to do my best."

Simone loved Literacy and saw this as her greatest strength as a foundation phase teacher. She was passionate about teaching reading as she felt it was imperative that her learners were literate. She thought she was "also fairly good in Numeracy and Life Skills". She viewed her greatest weakness as a foundation phase teacher as having "not enough time to deliver lesson content to 44 learners." She said her class size affected her teaching.

With regard to the rating scale, Simone agreed that she found it difficult to explain some science concepts to learners although she is typically able to answer learners' science questions as she usually welcomes learners' questions. Simone indicated she had a difficult time understanding science concepts well enough to effectively teach Science. Although Simone felt comfortable doing science activities in her classroom and was not afraid that her science activities would not turn out as expected, she was undecided on whether she had the necessary skills to teach Science. She stated that if she was given a choice, she did not know if she would invite the principal/head of department to evaluate her science teaching. She also stated that she was undecided if she enjoyed teaching Science (Appendix G).

The statements on the rating scale that related to classroom preparation considered the use of resources, time, planning and equipment in the preparation of science lessons. Simone agreed that she was willing to spend time setting up materials for scientific exploration. She was happy to help children construct science equipment for hands-on science even though preparation for science teaching generally takes more time than other subject areas. Simone agreed that teaching Science takes too much time and effort; however, she was ready to learn and use scientific knowledge and skills for planning hands-on science. Simone agreed that she integrated Science into other subject areas and she was able to take her learners outside the classroom to learn Science. She stated that she did not like to discuss ideas and issues of science teaching with her colleagues and she was not sure if she enjoyed reading resource books to obtain ideas about science activities for young children. She was undecided if she was familiar with raising open-ended questions to encouraging children's scientific exploration and whether she used many hands-on activities to help her learners learn Science by integrating other subject areas into Science.

The statements on the rating scale that related to managing hands-on science considered the teaching of science-by-doing. Simone agreed that she was comfortable using any classroom materials for science activities and that she did not mind the messiness created when doing hands-on science in her classroom as the teaching about the science processes is important. She was not interested in handling certain animals including insects to teach Science and she was undecided on whether she was afraid of demonstrating experimental procedures in the classroom and whether she enjoyed collecting materials and objects to use in teaching Science.

Simone agreed that she was familiar with the processes and ways that young children learn Science. Simone believed it is appropriate to introduce Science to children at an early age, as young children are curious about scientific concepts and phenomena. She disagreed that young children cannot learn Science until they are able to read. Simone was undecided on whether she was comfortable with determining the science curriculum that is developmentally appropriate for young children.

Learner Factors

Simone had a total of 44 learners in her class of which 15 were boys and 29 were girls with an average age of eight years. The learners came from low socio-economic backgrounds. She said that they were not independent learners, as they needed her to constantly monitor them. She did not select group work as something her learners would enjoy. Simone believed her learners would able to conduct an investigation but with "guidance". According to her, the learners were very eager and willing to learn. Simone described her learners as, "They are like sponges and they suck up anything." Simone maintained, "Science is basically hands-on" and her learners enjoyed hands-on activities. Her learners did not enjoy it when "she spoke to them about Newton's Law".

Physical Resources

From the list of physical resources provided in the questionnaire, Simone indicated that she used the chalkboard, textbooks and worksheets daily and the natural environment, weekly, to teach Natural Science. She said she used the library and computers fortnightly. She did not select any physical resources that she used monthly, once a term or never. Simone did not select science equipment, videos and models as physical resources that she used in the teaching of Natural Science. Simone said that she would find "magnets, funnels, basically a Science box" useful when teaching Natural Science. She indicated that she used worksheets from textbooks and made use of measuring equipment and natural resources to teach Natural Science. During the classroom observation, Simone read from Young Wildlife and Folklore from Africa.

School Ethos and Management

Simone was of the view that the school had a well-structured timetable. There was a strong presence of principal and head of department as they were in regular contact with staff. There was good organisation of extramural activities and regular staff meetings. The school was secure with access denied to unauthorised personnel. The culture of learning and teaching was strongly present. The school governing body was in existence. According to Simone, both teachers and learners played an active role in management and parents played an active role in supporting the school.

Simone's Profile of Implementation of the Natural Science Curriculum

I compiled this part of Simone's story mainly from the observations of her and her learners in a dynamic classroom setting, and from other previously mentioned data collection methods. A number of factors relating to curriculum implementation were considered.

Integration of Natural Science

Grade three learners' life skills books were examined for the period of the observation. There was only one entry in their life skills books. Learners were given a worksheet with the South

African Flag drawn on it on which they wrote what each colour meant. The literacy books had three entries. The first was a worksheet where the learners rearranged sentences to form a story. The second was a phonics where learners had to choose the correct word from those in brackets. This exercise was on animals, for e.g. Animals that eat meat are called _______. Learners had to choose between carnivore and herbivore. There was a worksheet on animals and their homes. Learners had to draw lines to join them. There were sentences and learners had to fill in the missing words with the choices given, for example: The bird ____ feeding her baby in the _________. Learners had to choose from a few given words. For the third entry learners had to match animal sounds, for e.g. donkey - brays, dog - bark. In the numeracy book, there was a worksheet with various animals drawn on it and learners had to count how many of each animal there was and draw a bar graph. There was a worksheet on visiting the Game Park and learners had to look at the picture and count the different kinds of animals. Simone was asked during the interview if she was confident teaching animals. She said, "I'm learning. I won't say I am 100% confident...no. I have the knowledge but not all that I should have." However, in the questionnaire, she said she was very confident teaching animals.

During the numeracy lesson on data handling, learners had to count how many different types of animals there were in the picture to draw the graph. Simone then discussed types of animals. The spelling words were words related to animals. Simon read from Young Wildlife and Folklore from Africa during reading time and showed learners a poster. She was asked during the interview if the extract that was read from the poster was part of the syllabus. Simone answered:

> Some children will get it. Most of them wouldn't but I think by exposing them is more beneficial because if we keep children at the level that we think they are, we are also stagnating them. So maybe out of that lesson one or two of them learnt a new word or never heard that story before so they learnt something from it. And it is not only done there it would have been revisited some other time.

Hands-on Science

There was no evidence of hands-on science in the life skills book or during the classroom observation. During the interview Simone was asked to explain using an example how she used the instructional methods she selected from the questionnaire to teach Natural Science. Simone said:

> Basically we don't... because of our large class sizes when we want to do Science we come outside. I mean like capacity and things like that, water, and things like that... we have to go outside, put them in the corridor or put them by the taps. We take buckets.

Simone realised that it was not a demonstration but a hands-on activity:

> No no... They do it hands-on. They must do it. The one that stands out to me is the capacity one - the learners were so enthusiastic because there were 5 ml, 10 ml, 300 ml 500 ml. They brought containers and did research prior to this at home. They go through their homes and all the things that you measure in millilitres they had to write down. Some of them brought containers. Some didn't have containers because they don't have many things at home. But we did have a few for them to work with and then we just grouped them and some areas we put a mixed bottle sizes and let them work with it. It was fun. We made them put their PE [Physical Education] outfits on and it was a nice warm day so they ended up splashing each other with water.

Scientific Investigations

Analysis of the grade three learners' books revealed that there was no evidence of scientific investigations in the teaching of Natural Science and no scientific investigation was noted during the observation. During the interview, Simone explained how she could have introduced investigations into the lesson on animals at grade three level. She began by saying the investigation could be on the animals' eating habits. Learners could also choose the animals themselves. If they were doing dinosaurs then they would choose which dinosaur to study.

The Nature of Classroom Interaction

The nature of classroom interaction considered the relationship between Simone and the learners in the classroom setting with regard to class routine and the lesson structure, language of instruction, learners' attentiveness, questioning, use of resources, types of activities and instructional methods and managing group activities. Examples of incidental teaching and learning were identified in an attempt to discover occurrences of science teaching. Simone's learners settled down quickly. The language of instruction was English. The first day began with Simone checking if learners had completed their homework. A considerable amount of time was spent practising writing.

The writing lesson was followed by a numeracy lesson, which was taught with smaller groups on the carpet. Simone asked different learners to read questions from the worksheet. Some learners had problems with the pronunciation of words. Simone wrote the words elephant, giraffe, cow and impala one below the other on the chalkboard. She then asked the learners to read question two out loud: "How many of each kind of animals are there in the picture?" She asked the learners to mention the types of animals they saw in the picture. The learners said there were elephants, giraffes, cows and springboks. Simone erased the word impala on the chalkboard and replaced it with springboks. One learner said they were buffaloes as well. Simone wrote "buffalos" on the chalkboard. One girl said that there were no cows. Simone then erased the word cow from the chalkboard. She asked the learners on the carpet to count how many animals of each kind there were in the picture. The learners said there were 21 buffaloes, 10 springboks, two giraffes and five elephants

Simone demonstrated to the learners how to draw a bar graph indicating the numbers of animals. She asked the learners to complete the graph by colouring each bar a different colour. This activity was taught to a small group of learners on the carpet and repeated for each group that moved to the carpet. On completion of the activity, Simone reminded them that they would be going to the zoo at the end of term for an excursion.

Simone never taught graphs to the entire class with the learners at their desks. She stated:

> No if they are at their desks then believe me I have lost half of them. If they come to the carpet there is a definite difference in teaching at the table and at the carpet. Even if I sit like on ... the front desk is here and I sit...it's better. If I am at the board...it's just that space between us...you lose half of them.

During the numeracy lesson on graphs, the whole class did not get an opportunity to complete the worksheet on graphs during that day. Simone was asked during the interview if the remainder of the class completed the worksheet. Simone responded:

> They will complete it. They have to complete. There is time when they... if they are slow and they don't complete. If they are slow in other areas as well so it comes back up. Normally one break a week they will get to finish their work or during PE, they won't go out.

Simone then wrote the word 'animals' in the centre of the chalkboard and circled it. She asked the class to mention a few animals that they know of from the worksheet they did that morning. One learner mentioned an elephant. Simone asked the learners, "What type of animal is an elephant?" and "what category of animal is an elephant?" She then went to the chalkboard saying that there are different categories or types of animals. When she reached the chalkboard, she drew three arrows from the word animal, saying that there are three kinds of animals. She then asked the class, "Can you keep an elephant at home in your yard?" They said no. She then asked what type of animal an elephant is. One learner mentioned it was a dog. Simone told the learners that they also studied animals in Grade One and Two. She repeated, "What type of animal is an elephant?" She then asked, "Is it a wild animal or is it a tame animal?" A learner said it was a wild animal. She then asked the learners where wild animals lived. Simone did not wait for learners to answer and said they live out in the bush or in the zoo. She explained, "Zoo is a protective place where these animals live." She then asked, "What are the types of animals that we can keep at home?" Some learners mentioned dogs and cats. Simone asked, "What type of animals are those?" When there was no response she asked, "Are they wild or are they tame?" The learners said they are tame animals. She then asked the learners to which group of animals a cat and dog belongs. The learners said, "Tame". She then asked them what other animals live in bush or in the wild. Simone then went to the side table and looked through some worksheets while waiting for the answer. One learner said snakes. Simone told the learners, "We also find snakes in our yards and in our houses."

Simone then drew a table on the chalkboard showing wild and tame animals. In the column with wild animals, she wrote elephant, tiger, cheetah, wolf, lion, snake, fox, hyena jackal and monkey. In the column with tame animals, she wrote dog, cat, snake and birds. Some learners mentioned the dinosaur was a wild animal. One learner said a chicken could be kept as a pet. Simone said that the chicken is not kept as a pet but for eating purposes. The third type of animal that Simone included in the table was the domesticated animal. She said that domesticated animals are kept as pets. Simone drew learners' attention to the list of wild animals and asked the learners to name an animal from the list that was a predator. She asked the learners, "What do predators do?" She answered that they eat other animals as their meal and proceeded to ask the learners to name one animal from the list of wild animals that eats another animal as a meal. A learner mentioned the lion. Simone wrote "cat" as an example of a domesticated animal on the chalkboard. She asked, "Do animals wear clothes?" The learners replied no in unison. Simone said, "Yes, animals do wear clothes." She explained that some people dress up their cats and dogs and an animal's clothing is their skin. She said that there were different types of skin, for example, "the giraffe has fancy skin and you can say it wears clothes." Simone asked, "What does an animal have a lot of that keeps them warm in winter?" She told the learners that some animals have lots of fur to keep them warm and that is their clothes. She then said that man has many uses for animals. Simone pointed to the word "bird" on the chalkboard and asked, "What group of animal is this?" She wanted to know if anyone had a budgie at home. She asked, "Can you keep a budgie and a cat together?" She said we get clothes, food and protection. She also said that we get tame animals, domesticated animals and predators and we get carnivores and herbivores.

Simone then told the class she was going to read them a story to check their listening skills because she was going to ask them questions on the story. However, she changed her mind and asked the learners if anyone would like to read the story. One girl volunteered. The story was about taking care of our pets. Simone expected the learners to relate the story in their own words to each other. She then wrote sentences on the chalkboard, which learners were expected to arrange in sequence. Some learners had great difficulty with this activity. Simone then told the learners that they were going to do Life Skills as she handed out a worksheet with an illustration of the South African flag. She instructed learners to number the different parts of the flag and then wrote a key on the chalkboard for each number and what colour it represented.

A numeracy lesson followed this activity. Learners worked in groups using bottle caps and blocks to make groups consisting of different numbers. Simone called six learners who had completed their work to the carpet and proceeded to only teach them while the other learners were completing worksheets. This was followed by another lesson on 'Animals'. Simone wrote the words: herbivore, fierce, carnivore, extinct, alive, shadows, ancient, sharp, strong, huge, fast and slow on a flipchart. Simone read each word and the learners repeated after her. She then explained the meaning of each word. This was followed by Simone showing the group a picture of a dodo from a book and read a short passage from the book. Simone told the learners the words are for the spelling test that they would write next Wednesday. The same six learners learnt about penguins as well. During the interview, Simone was asked if all the learners do the same spelling test. Simone said:

> Yes, the words were given to the rest of the class. We try to have the spelling test with what we are working with.

Simone read a story about the disappearing wildlife, the Jackass/African penguin to the same group of leaners. She asked the learners, "Why the penguins' bellies are white and the outer sides black?" She then instructed them to find out why this is so. She continued by telling the learners that the penguins are an endangered species and proceeded to ask the group questions based on the story.

Simone then handed out a worksheet on animal homes to the whole class. There were two sections to the worksheet. For the first section, learners had to draw lines to join the home to the animal. For the second section, they had to complete sentences. The animals were the ant, spider, bird and bees. The first section showed bees living in a honeycomb and in the second section; bees' homes were called hives. Simone then wrote a few sentences on the chalkboard where learners had to choose the right word and fill in the blanks. The exercise was on defining herbivores and carnivores.

Simone then spent a very short time on phonics with the 'u' sound, e.g. bull. Simone's attention went to the sentences on the chalkboard on animals where learners needed to choose the correct word. She read to the learners from a book:

> Bears are carnivores. Carnivores are animals that eat meat. They must kill other animals to get meat. Bears are the largest carnivores on land. There are no bears in Africa but there are other carnivores in Africa. Another type of carnivore is lions, cheetahs and leopards. Herbivores like impalas are not carnivores. They do not eat meat. They do not kill other animals. Impalas eat plants. Impalas are herbivores. Giraffes and zebras are also herbivores. There are lots of giraffes and zebras in Africa.

Simone told the class to choose the correct word from the extract she read. She read each sentence and gave the class the answers which learners had to copy in their books.

Another group was called to the carpet. They had a big poster from Young Wildlife and Folklore from Africa in the centre of the group. Simone read from the poster about the diversity of African mammals and the different reproductive styles. Simone had difficulty with the pronunciation and explanation of the terms, for example, parental care. This concept could have been explained in a much simpler way than that which was read from the poster. While reading Simone seemed to be making herself understand first before trying to explain to the learners. As Simone read, she paused to explain to learners. She explained:

> We are very closely linked to animals. We are just more highly evolved. We also when we are born we are also born, are we born dead? How are we born? We are born alive. When we are born in the first couple of weeks in our life, we are mostly dependent on who?

Simone continued to explain the characteristics of mammals as observed in humans. She then read an extract: “The males are the few mammalian species who help, raise or protect their offspring.” Simone then explained the concept of parental care using humans as an example. Simone read from the extract, “Mothers invest much more time and energy in their young and are totally responsible for raising them.” Simone continued to speak to the learners:

> So what happens is when they give birth they normally go away and have their babies where they are protected so that no other animals see the cubs - the lions have cubs - they need to go out and hunt and get food and they can come back and feed their babies.

When Simone stopped reading, she showed the learners in the group, the pictures of the mammals.

Much time was then spent with learners using a piece of material to make the flag of England. Simone moved on to read an extract on visiting a game park to the learners on the carpet. She then handed out the worksheet on visiting a game park for the learners to colour in. Simone said, “We get farm animals.” She asked the learners to name one thing we get from a pig. The discussion then continued about products humans obtain from farm animals.

Simone then moved on to discussing our planet:

> We live on planet Earth, don’t we? We do not live on Jupiter and Mars. Our planet needs each and everyone one of us to take special care of it. We need to think about it when we go to the beach, we eat, and we litter and throw our litter in the sea. What dies in the sea? The fish and whales. When the ship are sailing and let their oil run the animals and penguins that are there are affected. The whales are being affected. You know when you throw your plastic bottles and paper in the river and it is washed down stream then eventually the fish try to go and eat it and what happens is that they get caught up in the plastic and it strangles them and kills them. So we need to protect our planet.

Simone reverted the discussion to animals:

> There are wild animals. We need wild animals too. There is a food chain. We all are part of the food chain and after break; we are going to do the food chain. So let’s look at our picture visiting the game park. What animals are in the picture? Look at the picture. There is a giraffe, zebra, lions, cub and lioness. Now if you look at the picture I need you to count the different animals.

Simone then wrote an exercise on matching animal sounds on the chalkboard. Learners had to match the animals to the sounds they make, bleats, neigh, bellows, brays, mew, trumpet and barks. Another group was called to the carpet and she asked them what sounds babies make when they are born. The learners said that babies cry. However, Simone said, "The first sounds the babies make is dada," and she stated that she did not know why. Then she asked, "How many legs does the dog have?" The discussion then proceeded to sounds domestic animals make and learners were asked to imitate these animals. This activity was followed by one where Simone told the learners that when dogs bark they are telling you something. She said,

> Someone is not supposed to be in your yard, like the postman. Dogs have a very, very good sense of hearing. They can hear (I think I stand to be corrected) 42 times clearer than what we hear. You know when we bust crackers at Guy Fawkes time and Diwali time. We need to be very sensitive and think about the animals. You know what they say we need to keep our pets inside so we can protect them from the sounds because the sounds are amplified much more in their ears than in our ears.

Simone then focussed on the horse and asked the learners, "What sounds does the horse make?" The learners were making the sounds but not the correct one as some were bleating.

Simone asked learners many questions during the discussion on animals, such as "How high do the penguins grow? Then she asked, "Do they grow in cm or mm?" Learners called out different answers. However, Simone did not respond to any of their responses.

Simone used group teaching frequently. She explained:

> It's effective because sometimes you teach… you have mixed ability groups but in that mixed ability groups you have children from A to Z in that group and some of them catch what you doing or trying to do and some of them just don't get the picture.

The groups that Simone called out seemed to be random learners. During the interview, an attempt was made to clarify if the learners that she called out were those that finished their work or the high performing learners. Simone responded, "No, it is the ones that I thought needed more time to do something." Simone mentioned the all the groups must be taught the same work. She explained how she accomplished this:

> I try to do two groups doing the same work a day. The next day I will do the next two groups and then the other two groups will do something else. But let's

say there are four aspects in the week...they must have rotated and covered all four within the week.

There were not many examples of incidental teaching and learning. During a class discussion, a learner mentioned the dinosaur was a wild animal. Simone spoke about the dinosaur being extinct. She gave them a homework exercise to find out the meaning of the word extinct and to find other animals that were extinct.

9.3 DISCUSSION AND INTERPRETATION

This section covers the discussion and interpretation of Simone's story within the framework of the constructs used in the story and which are derived mainly from the theoretical framework. The discussion will be followed by an interpretation with regard to Simone's interpretation and implementation of the Natural Science Curriculum, which will allow me to place Simone at a particular level for each of the constructs.

9.3.1 Interpretation of the Natural Science Curriculum

Simone's interpretation of the Natural Science Curriculum was based on the constructs depicted in Figure 9.1.

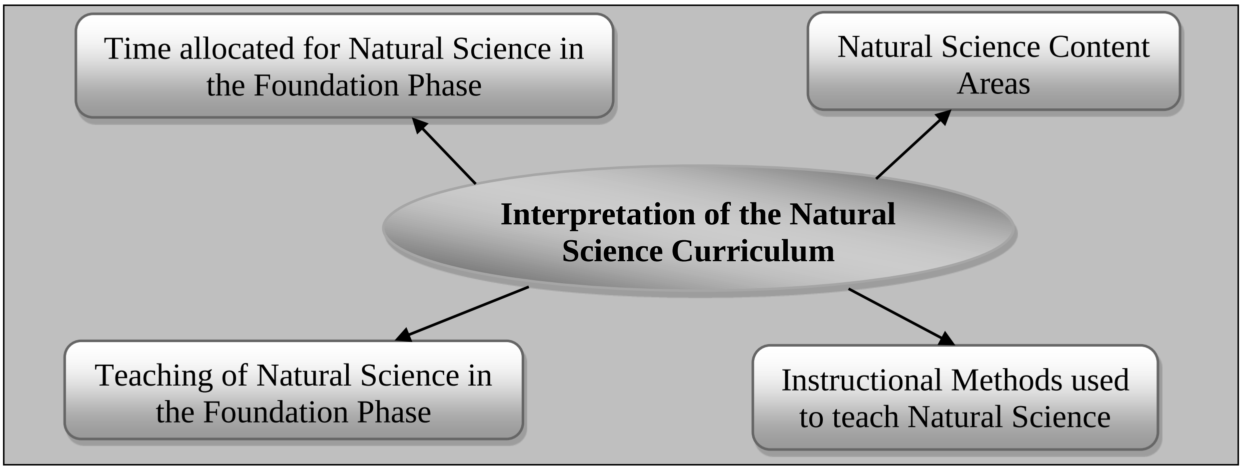

Figure 9.1: Factors affecting Simone's interpretation of the Natural Science Curriculum

9.3.1.1 Time Allocated for Natural Science

Since no life skills lesson plans were supplied the time allocated for Natural Science could not be determined. More time was allocated to Numeracy and Literacy indicating that these learning programmes were perceived to be more important. As the curriculum, and especially supporting documents such as the *Foundations for Learning* foreground Numeracy and Literacy, it is understandable that Simone would take this view as her responses indicate that she follows curriculum guidelines. However, this emphasis appeared to re-enforce the notion that Life Skills, and by implication, Natural Science were not very important.

9.3.1.2 Teaching of Natural Science in the Foundation Phase

Simone's interpretation of the curriculum revealed that she thought there were not sufficient opportunities to teach Natural Science; however, there was a strong focus on assessment, which interfered with the content in the curriculum being covered. She also revealed that the learners worked slowly and this affected the amount of content that could be taught. With assessment being the focus (as the ANA only assesses Literacy and Numeracy), it is understandable that Simone placed importance on Literacy and Numeracy and said she neglected Life Skills.

Simone was of the view that a natural science teacher would find it easier to draw the science content from the curriculum that should be taught to learners. Simone was not a science teacher and therefore experienced difficulty in isolating the science content from the curriculum. This was very important to note as it implied that the structure of the curriculum was not designed in an accessible manner for all teachers. It was evident that Simone was unaware of the Natural Science Curriculum for the Foundation Phase and therefore she did not know what Science should be taught in Grade Three.

Simone was clearly mindful that Natural Science was supposed to be taught by integrating it into all the learning programmes. In addition, she believed that learners must write down their science findings, as this would be integrating Literacy. The activity cited as an example of integration was a numeracy lesson in which Simone integrated measurement and data handling which are concepts learnt in both Numeracy and Natural Science. Simone's inability to provide appropriate examples of how she integrated Natural Science showed that she did not have a clear understanding of what integration means. The fact that Simone was unsure of the number of learning outcomes in Natural Science showed that she was not familiar with them.

From her interpretation of the curriculum, she required resources to teach Natural Science practically and since she did not have the resources, her learners were not exposed to science-by-doing. Simone believed that having science equipment, as she had when she taught in the USA, would make teaching Natural Science through integration much easier. The literacy and numeracy lesson plans revealed no integration with Natural Science.

Simone said she used the *Foundation for Learning* lesson plans and workbooks but found them to be inflexible and did not cater to all the learners' needs. She therefore opted to plan her own lessons as she accommodated the different levels of her learners. By using other books to plan her lessons she showed that her interpretation of the curriculum went beyond what was in the curriculum documents.

Simone cited various examples to show how she used integration in her teaching of Natural Science. Most of the examples she mentioned were numeracy lessons on measurement. The example she cited on teaching dinosaurs was a project she would give learners to research rather than an example on integration. She appreciated the need to have investigation and play incorporated in the curriculum although the example she cited for play did not relate to Natural Science. Simone's inability to provide appropriate examples showing how she integrated Natural Science indicated that she did not have a clear understanding of what integration means.

Simone's response to designing a qualification for foundation phase teachers revealed that future foundation phase teachers should be taught the actual foundation phase learning programmes. However, she did not place particular emphasis on the inclusion of Natural Science in the training of foundation phase teachers.

9.3.1.3 Natural Science Content Areas

Simone was very confident in the content areas she taught regularly. The content areas that Simone interpreted as part of the Natural Science Curriculum included animals, nutrition, air, weather and water. Her confidence levels for the content she taught correlated with the content she taught within the Foundation Phase at her school. From the reasons supplied, Simone stayed within the confines of the curriculum as she believed that was what was expected of her. Simone was unaware of the Natural Science Curriculum. She only taught what she was required to teach and as such with the continued teaching of the same topic, she became confident in it. The content selected was appropriate and taken from the workbooks and *Foundation for Learning* curriculum documents and not from the Natural Science Curriculum documents.

9.3.1.4 Instructional Methods

While Simone mentioned that she selected demonstrations, discussion, role-play, problem-based learning, cooperative learning and hands-on activities as instructional methods and used them daily, there was no evidence in Simone's lesson plans of such activities, except for small group teaching. The activity cited as an example of problem solving was a numeracy lesson on capacity in which Simone integrated measurement, which is a concept learnt in both Numeracy and Natural Science. Once again, the activity cited as an example of hands-on science was a numeracy lesson in which Simone integrated measurement.

The issue with teaching mass stemmed from the fact that Simone did not have a scale to teach this aspect of measurement. At grade three level learners would have been able to make a balance, which could have been used to compare masses of different objects. This would have linked with Technology and they could have used the scale in their Numeracy, Natural Science and Technology lessons thereby allowing for integration. Simone selected demonstration as an instructional method to teach Natural Science because it resonated with her own learning style. There was no evidence in her lesson plan that she used demonstrations to teach Natural Science.

9.3.1.5 Simone's levels of interpretation of the Natural Science Curriculum

The levels for Simone's interpretation of the Natural Science Curriculum were determined. Table 5.11 shows the composite levels for each sub-construct, namely time allocation, teaching Natural Science in the Foundation Phase, natural science content areas and the instructional methods used to teach Natural Science. The descriptors for each level were developed and used to determine the level at which Simone was located with regard to the way she interpreted the curriculum as described in chapter five. These levels were derived from the findings discussed in this chapter. Table 9.2 reflects Simone's interpretations of the different sub-constructs, which were obtained from the questionnaire, interviews and document analysis. The table shows the levels at which Simone was placed.

Simone was placed at level one for time allocated to teaching Natural Science as there were no life skills lesson plans. Simone knew Science has to be integrated, however there was no evidence of this in her lesson plans. Hence, she could be placed at level one. For all other factors, Simone could be placed at level two. Considering there was no evidence to support Simone's interpretation of teaching Natural Science, I placed her midway between levels one and two. Simone was at level two for science content as certain science topics she mentioned were appropriate for the Foundation Phase. Although Simone mentioned that she used a number of instructional methods appropriate for teaching Science there was no evidence in her planning that she actually used these methods. As her responses indicated that she had some knowledge of what these methods entailed, Simone was placed at level two for instructional methods. This composite picture of Simone's ability to interpret the Natural Science Curriculum in Grade Three shows that she had some limitations with regard to interpreting the curriculum.

Table 9.2: Simone's interpretation of the Natural Science Curriculum

Level	Time Allocation	Teaching Natural Science	Content Areas	Instructional Methods
1	Time allocation for all three learning programmes (Literacy, Numeracy and Life Skills) were not indicated	Simone was cognisant of the fact that Natural Science needed to be taught through integration or as a freestanding subject but there was no evidence of this in her lesson plan		
2		*Foundation for Learning* workbook and lesson plans did correspond to the curriculum to a certain extent but did need adapting Simone was unsure of the Natural Science learning outcomes	Certain topics mentioned by Simone were appropriate for the Foundation Phase	Simone mentioned a number of instructional methods appropriate for teaching Science, but there was no evidence of this in her lesson plan
3				
4				

9.3.2 Implementation of the Natural Science Curriculum

Simone's implementation of the Natural Science Curriculum is discussed and interpreted using the constructs from the theoretical framework.

9.3.2.1 Outside Agencies

The constructs pertaining to outside agencies are presented in Figure 9.2.

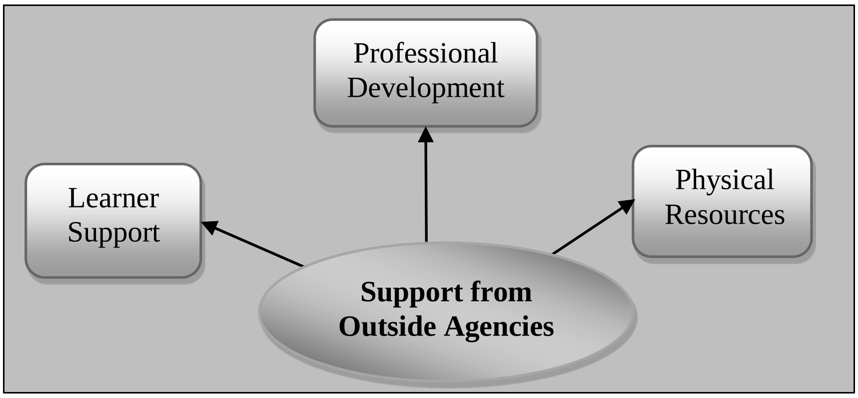

Figure 9.2: The support Simone received from Outside Agencies and the sub-constructs (adapted from Rogan 2007, p. 99)

9.3.2.1.1 Learner Support

Simone did not speak to her learners in isiZulu and yet she identified learners who experienced difficulty with the language of instruction. She did not receive support from most of the parents with regard to physical resources such as stationery and the support for work done by learners at home was limited.

9.3.2.1.2 Physical Resources

Simone's view that equipment was required to teach Natural Science indicated how she interpreted the curriculum. The lack of facilities and physical resources makes teaching Natural Science challenging for Simone. She believed that without equipment, teaching Natural Science was not possible.

9.3.2.1.3 Professional Development

Simone realised the importance of attending professional development workshops. Simone's professional development was limited to school meetings and workshops held by the Union.

The limited opportunity she received to build her capacity was insufficient to give her the confidence and knowledge she needed to teach Natural Science according to Learning Outcome One. Simone would benefit from workshops and training sessions to be held for the teaching of Natural Science.

9.3.2.1.4 Simone's level of implementation of the Natural Science Curriculum with regard to Outside Agencies

Table 5.12 shows the composite levels for the constructs included in the support from outside agencies. The discussion above informed my interpretation of how outside agencies support Simone's ability to implement the curriculum. This means that Simone receives limited support from outside agencies and this does not contribute substantially to the enhancement of her ability to implement the Natural Science Curriculum. Table 9.3 reflects how the different sub-constructs related to outside agencies influenced Simone's implementation of the Natural Science Curriculum. My findings are based on classroom observations and what was indicated in the questionnaire, interviews and document analysis. The table shows the levels at which Simone was placed.

Simone was at level one for learner support. Although she indicated that she had learners who had difficulty with the language of instruction there was no evidence of her supporting them. She was at level one for physical resources as there was no provision for equipment or facilities to teach Science. Although Simone attended limited non-science workshops, all other factors related to professional development were at level one, placing Simone overall at level one. Not only was the support for her learners extremely limited, the lack of appropriate resources that she could use to teach Science severely hampered her. From the levels Simone was placed at for the support from outside agencies, indicate that she had limited capacity to support the implementation of the Natural Science Curriculum.

Table 9.3: Simone's ability to implement the Curriculum with respect to Support From Outside Agencies

Level	Learner Support	Physical Resources	Professional Development
1	No support by parents with regard to language of instruction, finance, or homework No support from Simone to assist learners experiencing difficulty with the language of instruction	No provision of science equipment to teach Natural Science No facility to teach Science, for example classroom space, water, school yard No life skills workbook supplied	No staff development planned by school No workshops on Science offered
2			Limited non-science workshops attended
3			
4			

9.3.2.2 Capacity to Support Innovation

The constructs pertaining to Simone's capacity to support the curriculum as an innovation are presented in Figure 9.3.

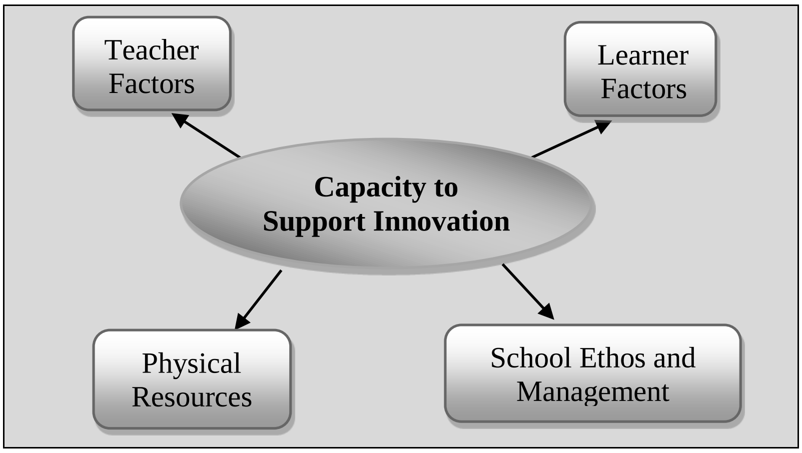

Figure 9.3: Simone's Capacity to Support Innovation and the sub-constructs (from Rogan 2007, p. 99)

9.3.2.2.1 Teacher Factors

Simone's passion for teaching in the Foundation Phase and her ACE qualification with her experience of computers had a positive effect on her ability to teach Natural Science. Simone described herself as having limited science content knowledge and science pedagogical content knowledge and yet she was observed teaching lessons on animals to her grade three class. Although she had some science content knowledge, she was aware of her lack of knowledge in certain areas. She would like to improve her knowledge, which would result in an improvement of her capacity to support the implementation of the Natural Science Curriculum. Simone's passion for Literacy could take precedence and thus hinder her capacity to support the implementation of the Natural Science Curriculum.

On close inspection of Simone's responses to a number of crucial statements on the rating scale, it would suggest she was not confident in her capacity to support innovation and the implementation of the Natural Science Curriculum. Simone's responses to the statements showed that she would be able to take the time to plan and use resources to teach Science even though teaching Science takes too much effort. Simone's indecision about whether she enjoyed reading resource books to obtain ideas about science activities for young children creates doubt with regard to her being able to research innovative ideas to assist her in her teaching of Natural

Science. Although, Simone's responses indicated that she did not seem to have much capacity to support the implementation of the Natural Science Curriculum, she did attempt to teach Science but the lessons were disorganised and conceptually flawed.

From Simone's response, she seemed to be disinterested in handling certain animals to teach Science, which is a content area in the curriculum. She was undecided on whether she was afraid of demonstrating experimental procedures in the classroom and if she enjoyed collecting materials and objects to use in her science teaching. Hence, Simone's capacity to support innovation and the implementation of the Natural Science Curriculum was compromised. Furthermore, Simone's reluctance to work with animals indicates that she has a poor understanding of how to use the environment to teach Science. Animals are found in the school environment and form part of the science content area in the Natural Science Curriculum. This reluctance could impede Simone's ability to arrange practical hands-on activities, for example allowing children to observe the different animals in the school environment. Simone could have developed her lesson to incorporate scientific investigations had she used animals from the environment. Simone was not sure that she would be able to implement the Natural Science Curriculum that was developmentally appropriate for young children. Hence, Simone's capacity to support the implementation of the Natural Science Curriculum was uncertain.

9.3.2.2.2 Learner Factors

From Simone's description of the learners in her class there was only one characteristic (enthusiastic) which could contribute to the teacher's capacity to support the implementation of the Natural Science Curriculum. She found it difficult to teach her large class of 44 learners. Simone mentioned her learners did not enjoy group work which was surprising as the majority of her lessons was small group teaching. She mentioned that her learners enjoyed hands-on science but there was no evidence to support this. However, Simone did believe her learners would be able to conduct investigations with assistance.

9.3.2.2.3 Physical Resources

Simone indicated that the lack of science equipment restricted her teaching of Natural Science. However during the interview she said she used measuring equipment and natural resources to teach Natural Science. From the observation, no science equipment or the natural environment were used when she taught Natural Science. She used a poster and read from a book when she taught the lessons on animals. The extract from the book was beyond the level of understanding of her learners. Simone was aware that the reading was difficult and yet she chose to continue. It was clear that Simone is not capable of selecting age appropriate activities for her learners. Simone wrote on the chalkboard when she taught learners how animals are grouped and she wrote spelling words on animals, on a flipchart. While these resources might have assisted her in teaching Science, it did not assist her in teaching Science the way the curriculum document prescribes, that is, through Learning Outcome One (scientific investigation).

9.3.2.2.4 School Ethos and Management

Simone's responses to the ethos and school management seemed to indicate that although the school was well organised and had systems and procedures in place, the support to implement the Natural Science Curriculum was lacking.

9.3.2.2.5 Simone's level of implementation of the Natural Science Curriculum with regard to her Capacity to Innovate

Table 5.13 shows the composite levels for the constructs used to determine Simone's capacity to support innovation with regard to natural science teaching. The discussion above informed my interpretation of how Simone's capacity supports her ability to implement the curriculum. Table 9.4 reflects how the different sub-constructs influenced Simone's capacity to implement the Natural Science Curriculum. My findings are based on information obtained from classroom observations the questionnaire, interviews and document analysis. The table shows the levels at which Simone was placed.

While Simone's professional qualification could place her at level three, her self-confessed lack of confidence place her at level two, placing Simone midway between level two and three for teacher factors. Even though Simone mentioned her learners did not like group work, which places her at level one, she believed her learners were capable of guided investigations and therefore she was placed overall at level two for learner factors. Although it was inappropriate, Simone used a poster to teach Science and I therefore place Simone at level two for physical resources. While certain factors, such as the role played by the governing body could place Simone at level two, all other factors relating to school ethos and management were at level three, placing Simone overall at level three. From the levels at which Simone was placed with regard to her capacity to support the implementation of the Natural Science Curriculum, she had some limitations with regard to capacity to support the implementation of the curriculum. Although the school ethos supports teaching and learning and is well organised, little support is given for Simone to develop as a grade three teacher and furthermore she received no support for science teaching.

Table 9.4: Simone's Capacity to Support Innovation

Level	Teacher Factors	Learner Factors	Physical Resources	School Ethos and Management
1		Learners did not enjoy working in groups	Simone did not use workbooks for Life Skills Programme	
2	Simone was able to balance some aspects of her portfolio but finds it difficult with the large class size Simone acknowledged that she placed much emphasis on Literacy and/or Numeracy and very little on Life Skills Simone was confident to teach some aspects of Natural Science	Learners were capable of carrying out scientific investigations with guidance Learners enjoyed some scientific investigations	Simone used minimal resources to teach Science which were mostly inappropriate Simone used a science textbook	A School Governing Body was in existence but not visibly active Parents played a minimum role in supporting the school
3	Simone had a professional qualification appropriate for the Foundation Phase which included minimal Natural Science Simone had adequate science content knowledge			Timetable mostly adhered to Principal and/or HoD was present at school most of the time and was in regular contact with his/her staff Staff meetings regular but not well-planned

	Simone had adequate pedagogical content knowledge			Good organisation of extramural activities which seldom interfered with classroom activities School was secure and limited control of who enters the premises Adequate evidence of COLT Teachers and learners played an active role in school management
4				

9.3.2.3 Profile of Implementation

The constructs pertaining to Simone's profile of implementation are presented in Figure 9.4.

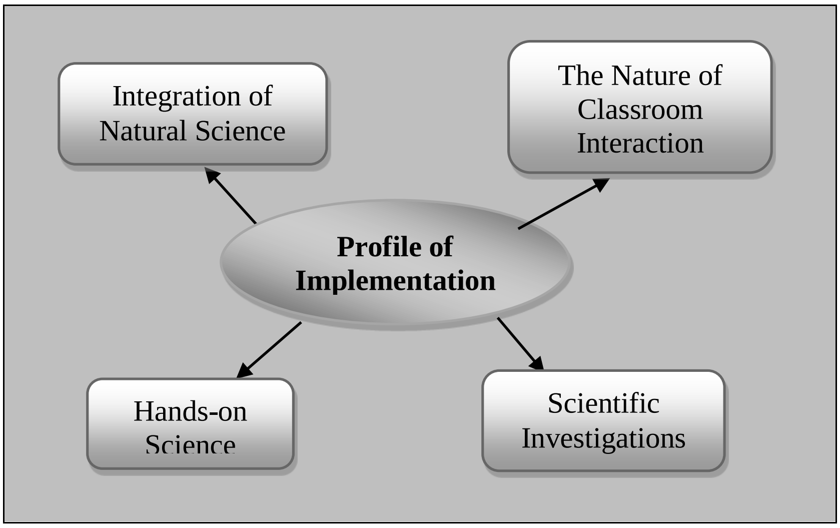

Figure 9.4: Simone's Profile of Implementation and the sub-constructs (adapted from Rogan 2007, p. 99)

9.3.2.3.1 Integration of Natural Science

Although the entries in the literacy books were on animals' homes and sounds, this could be a literacy lesson integrated with Science. Simone may be commended for integrating Natural Science in her teaching. She taught science lessons on animals by integration in Literacy and Numeracy as well as integrating Literacy and Numeracy in Natural Science. Although Simone attempted to integrate Science, her knowledge in some instances was either scanty or incorrect. The lesson on animals in no way attempted to develop Learning Outcome One as learners were passively listening. Simone's inconsistent response with regard to her confidence in teaching animals actually showed in her inability to teach using animals as a resource.

9.3.2.3.2 Hands-on Science

The example that Simone provided as evidence of hands-on science was on measurement and water. The argument may be made that this concept falls within the Numeracy Learning Programme and that specific concepts regarding water should have been included. No further evidence on hands-on science was observed.

9.3.2.3.3 Scientific Investigations

Simone's obvious neglect of scientific investigations is related to her lack of knowledge of the Natural Science Curriculum as well as her poor understanding of appropriate science instructional methods.

9.3.2.3.4 The Nature of Classroom Interaction

There was no set routine that was followed except that learners had their lunch breaks at the same time. Simone mentioned that there were eight learners who experienced difficulty with the language of instruction. However, there was no evidence that Simone supported the isiZulu-speaking learners by speaking to them in isiZulu.

A substantial amount of time was spent on Numeracy and Literacy daily, which indicated Simone's preference. Animals were used as examples in the numeracy and literacy lessons, which indicated that it was the theme. This theme was reinforced by an excursion to the zoo. The story that was read was also on animals. While using animals as examples, Simone addressed some science concepts. Although she taught appropriate content on animals, the instructional methods used were not in keeping with the Natural Science Curriculum. Simone did not seem confident in what she was teaching as she constantly looked at her notes.

Learners were not given sufficient time to complete the exercise on animals and access the information as Simone read out the answers to them. One of the reasons learners could not complete their work was due to the fact they were called out to the carpet for group work. As a result, no time was spent on reinforcing concepts that learners did not understand. Simone's indecision with regard to whether she was going to read to the class or the learners were to read showed her lack of planning which contributed to her indecisiveness.

The penguin story and learning about endangered species were only taught to the six learners on the carpet. The rest of the learners did not receive the spelling words and learn about penguins. Although it is acknowledged that small group activity is used for teaching in the Foundation Phase, Simone used small group teaching for every lesson she taught. Simone's methods of calling learners to the carpet seemed random. Much of the small group activity could be done with the entire class as they all needed to learn the same work. Teaching small groups different things is problematic as all learners write the same test. Simone's explanations regarding her use of group work is not convincing. Her random calling of learners to the carpet clearly showed that proper planning was not done for small group teaching.

The home of bees was referred to as a honeycomb and as a hive in the same worksheet. Simone did not draw learners' attention to this or explain the difference between the two. This could imply that Simone lacked knowledge needed to explain this to her learners. It was clear that the poster on animals was not age appropriate for a grade three class as Simone also experienced difficulty with pronunciation. Simone was incapable of selecting age appropriate tasks for her learners. Simone moved from each lesson without any consolidation of the previous lesson. She did not seem to mind that all the learners did not complete the work. The learners who were at their desks and not part of the group activity spent their time completing worksheets. Simone only taught the learners on the carpet.

Although Simone asked many questions during the lessons, she did not give learners time to answer; she answered the questions herself or she moved on without providing the answers. To ask the class if penguins grow in cm or mm is unacceptable and clearly Simone did not realise what she asked. This could mean that she did not have the content knowledge and needed guidance on the technique of asking questions. Simone did not make efficient use of resources. Simone should have realised that learners would not be able to see the A4 worksheet as she attempted to use it as a chart and make alternative arrangements such as enlarging the picture.

Not many opportunities for incidental learning were available, as the small group activities took up much of the teaching time. Simone's classroom interaction was characterised by disorganised activities, too many small group activities and a poor understanding of how to manage group work. It was difficult to determine the purpose of a number of the small group activities. Although Simone taught Science, no time was spent on reinforcing concepts taught and not all learners had the opportunity to be taught all the work. Simone also demonstrated poor use of resources in the classroom as well as not planning properly. It was difficult to see how Simone would have managed a natural science lesson, which included investigating phenomena as prescribed by Learning Outcome One.

9.3.2.3.5 Simone's Profile of Implementation of the Natural Science Curriculum

Table 5.14 shows the composite levels for the constructs used to determine Simone's profile of implementation with regard to natural science teaching. The discussion above informed my interpretation of how Simone's profile of implementation supports her ability to implement the curriculum. The descriptors for each level were used to determine the level at which Simone was located with regard to the way she implemented the curriculum. Table 9.5 reflects how the different sub-constructs contribute to Simone's profile of implementation of the Natural Science Curriculum. My findings are based on information obtained from classroom observations as well as data obtained from the questionnaires, interviews and document analysis. The table shows the level at which Simone was placed.

Since there was evidence of Natural Science integrated in Numeracy, Literacy and Life Skills as well as evidence of Numeracy, Literacy or Life Skills integrated in Natural Science, Simone is placed at level three for the integration of Natural Science. Simone was at level one for hands-on science and scientific investigations as there was no evidence of this. While the structure and sequencing of lessons could place Simone at level one, all other factors relating to the nature of classroom interaction were at level two, placing Simone overall at level two. From the levels Simone was at with respect to her profile of implementation, she had limited capacity in certain areas, like hands-on science and scientific investigations to support the implementation of the Natural Science Curriculum.

Table 9.5 Simone's Profile of Implementation

Level	Integration of Natural Science	Hands-on Science	Scientific Investigations	The Nature of Classroom Interaction
1		No evidence of hands-on science to help develop concepts Simone did not use specimens and resources found in the local environment to illustrate lessons Learners were not practically involved in the lesson	No evidence of scientific investigations	Structure of lessons were disorganised, not well-sequenced, and not as per lesson plan
2				Simone used textbook/ workbooks, however support was still needed Simone engaged learners with questions, however she either answered the questions or did not give learners enough time to respond to questions Simone engaged learners in minimal meaningful learning activities which results in maintaining learners concentration most of the time

3	Evidence of Natural Science integrated in Numeracy, Literacy or Life Skills Evidence of Numeracy, Literacy or Life Skills integrated in Natural Science			
4				

9.4 CONCLUSION

In chapter nine, I presented the findings with regard to Simone's ability to interpret and implement the Natural Science Curriculum within the Life skills Programme of the Foundation Phase. Simone is a grade three teacher who is skilled in a number of areas pertaining to foundation phase teaching. However, with regard to the Natural Science Curriculum, she does not understand how often she needs to teach Natural Science. She is partially competent in her interpretation of the Natural Science Curriculum, with regard to content and instructional methods, and has some idea of what the curriculum expects with regard to teaching Natural Science.

The support Simone receives from outside agencies to teach Natural Science is very limited and this hampers her ability to implement the Natural Science Curriculum. Simone has some capacity to implement the Natural Science Curriculum. The school management and school environment is supportive and this adds to her capacity; she has capacity to use resources pertaining to Science to some extent and claims to be willing to allow her learners to engage in investigations. The biggest drawback is her inability to teach Science using hands-on activities and scientific investigations, as well as presenting organised lessons that have been thoroughly planned. Her greatest strength is her ability to integrate Natural Science across the three learning areas. All of the above contribute to a profile of implementation that is mostly located on levels one and two with two aspects reaching level three.

In chapter ten, I focus on discussing findings that emerged from the study, with the intention of theorising the critical research question: *Why do foundation phase teachers interpret and implement the Natural Science Curriculum the way that they do?*

CHAPTER TEN

INTERPRETATIONS, CONCLUSIONS AND RECOMMENDATIONS

10.1 INTRODUCTION

Before embarking on answering the research questions and providing recommendations, it is appropriate to reiterate the focus and research questions that framed this study. The purpose of this study was to explore how foundation phase teachers interpret and implement the Natural Science Curriculum in the Life Skills Learning Programme. The main research question that guided this study is: *How do foundation phase teachers interpret and implement the Natural Science Curriculum within the Life Skills Learning Programme?* The sub-questions, which steered the study are:

1. What are foundation phase teachers' interpretation of the Natural Science Curriculum?
2. How do foundation phase teachers implement the Natural Science Curriculum?
3. Why do foundation phase teachers interpret the Natural Science Curriculum the way that they do?
4. Why do foundation phase teachers implement the Natural Science Curriculum the way that they do?

In this final chapter, I endeavour to address three critical areas. Firstly, I respond to the first two sub-questions based on my interpretation of my findings. Secondly, I theorise around these findings to provide possible answers to the third and fourth sub-questions. Thirdly, I present recommendations based on my findings and suggestions for future research.

10.2 TEACHERS' INTERPRETATION OF THE NATURAL SCIENCE CURRICULUM

The findings related to teachers' interpretation of the Natural Science Curriculum provides responses to the first research question: *What are foundation phase teachers' interpretation of the Natural Science Curriculum?* In Table 10.1, I present a summary of the levels at which I placed each teacher for the sub-constructs pertaining to interpretation of the Natural Science Curriculum.

Table 10.1 Summary of the teachers' levels of interpretation of the Natural Science Curriculum

	Teachers' interpretation of the Natural Science Curriculum			
	Time Allocation	Teaching Natural Science	Content Areas	Instructional Methods
Karen	1	1	2	3
Fiona	1	Between 1 and 2	2	2
Carly	1	Between 1 and 2	2	2
Simone	1	Between 1 and 2	2	2

In this phase, the Life Orientation Learning Area forms the backbone of the Life Skills Learning Programme and all other learning areas also have to be integrated in this programme. The teachers did not attempt to present lesson plans for life skills lessons consistently, neither did they indicate the time spent on Life Skills nor did they indicate the time spent on Natural Science in the respective foundation phase grades. When the teachers described life skills activities, they were in fact describing life orientation activities. This situation is not unique to the South African context as research has shown that Science is not given precedence at primary school level (Albion & Spence, 2013; Campbell & Chittleborough, 2014). This is particularly apparent in the Foundation Phase.

The teachers' interpretation of the curriculum stemmed from their understanding of a curriculum, which consists of discrete subjects. This is consistent with Curzon's (1985) findings in which he established that generally school curricula are structured around subjects. From this viewpoint, the teachers believed that the curriculum did not offer sufficient opportunities to teach Natural Science, as they were unable to find links between topics included in Literacy, Numeracy and other areas of Life Skills. Since the teachers mainly used the *Foundations for Learning* documents as a resource and these lesson plans do not include natural science lessons, this in a way influenced all the teachers views of the importance of Natural Science. While all the teachers were cognisant of the fact that Natural Science has to be integrated in the three learning programmes, the absence of existing lesson plans [available to them] made it difficult for them to understand how this integration should occur.

The teachers were truthful in their responses when they said they did not teach much Natural Science. They are not specialist science teachers so they were inclined to avoid teaching Science. This type of action is found where teachers with poor subject knowledge in Science often leads to a neglect of the subject (Buxton, 2010; Hackling, Southerland, Sowell, & Enderle, 2011; Tosun, 2000; Tytler, 2009). The teachers did not try to interrogate the curriculum to find ways of teaching Science. While it is stated in the Natural Science Curriculum that Natural Science should be taught, the *Foundations for Learning* documents do not cater for this. Teachers are happy to follow these documents, as they view them as expressing the views of the curriculum. Kelly's (1999) research found that teachers interpret the curriculum as having very little significance to them and prefer to use supplementary materials that spell out exactly what they need to do. The same seems to apply to teachers in this study. Official workbooks and lesson plans are used even though it may restrict their integration and creativity with regard to planning their own lessons.

While many of the topics listed in the Natural Science Curriculum are not suitable for the Foundation Phase, numerous other topics are suitable. In this research, teachers' choices of topics were guided by those discussed in the *Foundations for Learning* documents. Liu and Lederman (2007) maintain that teachers have different worldviews and thus interpret the same curriculum differently. However, this was not evident in this study as the content taught was decided on at grade meetings and using the *Foundations for Learning* resource documents, thus not allowing for the teacher's own interpretations and creativity.

Research has shown that foundation phase teachers may lack confidence in their abilities to teach Science because of incomplete content knowledge (Akerson & Flaningan, 2000; Borko, 1993; Smith & Neale, 1989). In this study, the teachers seemed more confident to teach biology-related topics than physical science-related topics, except for ecology. The teachers content knowledge in discussed on detail in the section on teachers' capacity to support innovation. Studies have shown that teachers experience insecurity with regards to their content knowledge when new content areas are introduced to the curriculum (Henze, Van Driel &Verloop, 2008; Lee & Luft, 2008). This could have been the reason the teachers in this study did not change the topics that they taught year after year.

The teachers indicated that they used a variety of methods to teach Natural Science, but this was not evident in their lesson plans. While hands-on science was indicated as a method often used, discussions with the teachers indicated that they had a very poor understanding of what problem solving, project-based learning and inquiry learning are. I suspect that the Hawthorne effect (where the participant's behaviour is influenced by the presence of the researcher) was in operation here as teachers chose instructional methods that made it look as if they did use them to teach Natural Science. But, when questioned about the meaning of these methods it was apparent that they had a poor understanding of what each method entailed. The best way to learn Science is to do Science (Lind, 1999) even though this type of methodology, as indicated by Atieno (2000) requires additional time for planning and preparing lessons.

As shown in Table 10.1 above, the levels for interpretation of the Natural Science curriculum for each teacher was determined and subsequently used to place them with regard to the ZFIs. Figures 10.1-10.4 represent Karen, Fiona, Carly and Simone's ZFI (adapted from Rogan, 2006) with regard to their interpretation of the Natural Science Curriculum. The ZFI continuum has been demarcated showing levels one to four which correspond to the levels in Table 10.1.

Figure 10.1: Karen's ZFI for her interpretation of the Natural Science Curriculum

Figure 10.2: Fiona's ZFI for her interpretation of the Natural Science Curriculum

Figure 10.3: Carly’s ZFI for her interpretation of the Natural Science Curriculum

Figure 10.4: Simone’s ZFI for her interpretation of the Natural Science Curriculum

The ZFI for all four teachers indicate they have an inadequate understanding of the Natural Science Curriculum, which placed them at low levels of interpretation for each of the sub-constructs, with the exception of instructional methods, the levels of which were determined only by what teachers said. Teachers’ interpretations of the Natural Science Curriculum revealed that although they may say Natural Science is important, they have little knowledge of the Natural Science Curriculum. Also, the official documents do not contribute to their understanding at all. They follow the *Foundations for Learning* lesson plans and workbooks that focuses on Numeracy and Literacy and these in a way serve to undermine the importance of a subject such as Natural Science. While the importance of Literacy and Numeracy is acknowledged, the RNCS clearly indicates the importance of teaching Science to children in the early years of schooling. This is also supported by the literature (Campbell & Chittleborough, 2014; Charlesworth & Lind, 1995; Verloop, 2001). However, the fact that the Natural Science Curriculum was not made as readily accessible to teachers as one would expect, the importance of Natural Science was not emphasised sufficiently for teachers to take cognisance of its importance.

10.3 FACTORS INFLUENCING FOUNDATION PHASE TEACHERS' IMPLEMENTATION OF THE NATURAL SCIENCE CURRICULUM

This section responds to the second research question: *How do foundation phase teachers implement the Natural Science Curriculum.* To answer this question, I first consider the support teachers received from outside agencies and then their capacity to support innovation.

10.3.1 Support from Outside Agencies

In Table 10.2, I present a summary of the levels that I placed each teacher for the sub-constructs pertaining to support received from outside agencies.

Table 10.2: Summary of the support teachers' received from Outside Agencies

	Support from Outside Agencies		
	Learner support	Physical Resources	Professional Development
Karen	2	1	1
Fiona	1	1	1
Carly	2	1	1
Simone	1	1	1

With regard to learners' support, Karen received support from the learners' parents and Carly received minimum support, which is interesting as the teachers are all at the same school and draw children from the same community. As Karen sees parental support in a more positive light, this may be due to the nature of Grade R. Grade R has recently become part of compulsory schooling but many parents still do not send their children to attend Grade R classes. It could be that the parents who send their children have the monetary means to do so and also have the means to support their children.

The learners in this study live in low socio-economic conditions and this places an added challenge on teachers, especially in this context where they are expected to implement a new curriculum. Studies have shown that there is a correlation between low socio-economic conditions and learners academic performance (Dahl & Lecher, 2005; Gershoff, Aber, & Raver, 2003; Hartas, 2011; Mayer, 2002) and this was supported by the teachers' views of their learners' capabilities which is discussed in detail in the section on teachers capacity to support innovation.

All teachers, with the exception of Simone spoke to their learners in isiZulu. Even though Simone did not speak to her learners in isiZulu, she did acknowledge that a few of them experienced difficulty with English. Fiona was the only teacher who did not believe her learners had difficulty with English as the language of instruction. It seems highly unlikely that Fiona's class did not have trouble with language of instruction. Fiona's reluctance to admit that her learners had problems with the language of instruction may be because she does not speak isiZulu fluently. Code switching is a possible solution to this problem and is advocated widely (Brock-Utne, 2003; Cleghorn, 1992; Cummins, 2003; Eastman, 1992). Research indicates that the key obstruction to learning Science for most learners is language (Henderson &Wellington, 1998; Löfgren et al., 2013).

Not much science equipment is required to teach Natural Science in the Foundation Phase. Also, the natural environment (school garden, the sun) can be used as a resource as it is available to all teachers. In this case, the lack of resources was a hindrance for these teachers and teachers in primary schools share this thinking (Appleton, 2003). While the teachers may not have received science equipment from the Department of Education or the school, they did have adequate resources for general teaching.

The teachers realised the benefits of attending professional development workshops, as supported by the literature (Fetters et al., 2002; Fullan & Miles, 1992). As a scholar, researcher and lifelong learner, an educator is expected to pursue further studies and research to increase their academic, personal and professional knowledge. Teachers are part of the IQMS evaluations where self-reflection is encouraged. Self-reflection is a key aspect in professional development (Posner, 1995; Rodman, 2010; Singh, & Singh, 2012). It was clear however that the Department of Education and the school did not present workshops for the teaching of Natural Science in the Foundation Phase. The emphasis was on Literacy and Numeracy.

As shown in Table 10.2, the levels for the construct support from outside agencies for the Natural Science Curriculum for each teacher was determined and subsequently used to determine their respective ZFIs. Figures 10.5-10.8 represent Karen, Fiona, Carly and Simone's ZFI (adapted from Rogan, 2006) with regard to the support they receive to implement the Natural Science Curriculum. The ZFI continuum has been demarcated showing levels one to four which correspond to the levels on Table 10.2.

Figure 10.5: Karen's ZFI for the support she received from Outside Agencies

Figure 10.6: Fiona's ZFI for the support she received from Outside Agencies

Figure 10.7: Carly's ZFI for the support she received from Outside Agencies

Figure 10.8: Simone's ZFI for the support she received from Outside Agencies

It is evident in Table 10.2 and Figures 10.5-10.8 that all teachers are at low levels for all sub-constructs for the construct support from outside agencies. This means that the support they receive from outside agencies is limited and does not contribute substantially to enhance the manner in which the teachers implement the Natural Science Curriculum. Even though the school is well organised, there is no provision made for the teaching of Natural Science. All of this influences the way in which the teachers implement the Natural Science Curriculum.

10.3.2 Teachers' Capacity to Support Innovation

In Table 10.3, I present a summary of the levels at which I placed each teacher with regard to her capacity to support innovative practices in the curriculum.

Table 10.3: Summary of the teachers' Capacity to Support Innovation

	Capacity to Support Innovation			
	Teacher Factors	Learner Factors	Physical Resources	School Ethos and Management
Karen	1	2	1	3
Fiona	1	2	1	3
Carly	2	2	2	3
Simone	Between 2 and 3	2	2	3

From the teachers' positive responses it was evident that they thought that they had most of the characteristics required to be a good foundation phase teacher. However, this was based mostly on their ability to teach Numeracy and Literacy. While the teachers have experience of working with young children they thought that their classes were too large to enable them to teach effectively. Karen and Fiona had difficulty controlling their learners.

The teachers were less confident with regard to their abilities to teach Science. However, they did not recognise the extent to which they were not capable of teaching Science as recommended by the RNCS. This finding is in line with research that teachers were unaware of how little they knew and how this might affect their ability to provide appropriate science experiences for young children (Garbett, 2003). I am of the view that content knowledge and sound science pedagogical content knowledge are the two most important aspects required to enhance the teachers' capacity to support innovation and the implementation of the Natural Science Curriculum. According to Garbett (2003) having content knowledge and pedagogical content knowledge affects the teacher's ability to create new ideas and understandings accessible to young learners. In spite of their low confidence levels, all four teachers believed that young children could and should learn Science even before they learnt to read. Karen, Fiona and Carly were confident that they, as teachers, could determine what Science would be appropriate for their learners' level of development. This aspect is confirmed by the literature, when teachers choose suitable content which has to match learners' intellectual abilities (Lind, 1991). Research has shown that the natural science content taught to learners must be within the realm of their cognitive competencies (Covington & Berry, 1976). The teachers in this study were also of the belief that what and how content could be taught depended on the level at which the learners were, the pace at which the learners worked, their age appropriateness and the type of learners they had in their class.

While teachers' understanding of the impact of a number of factors on their learners' progress is commendable, it does open the door for teachers to interpret the curriculum in such a way that enables them to spend more time on Literacy and Numeracy. The teachers generally did not have high expectations of their learners. While they did not ascribe higher order cognitive skills to their learners, all of them, with the exception of Carly thought that their learners would be able to conduct investigations. Although small group teaching is a characteristic of foundation phase teaching, only two of the teachers thought their learners would enjoy working in a group when doing Science. For learners to work together while doing investigations is important (Pappas & Tepe, 2002) and they should be able to work in social contexts.

Learners' home language was also an issue of concern as English was not the home language of most of the learners. For these learners their lack of understanding of the language of instruction impacts on their learning as has been shown in many other studies (Brock-Utne, 2012; Henderson & Wellington, 1998). However, reducing the time learners are actively involved in doing Science because they are deemed not capable, may be counterproductive as Brophy (1986) contends that involvement in activities contribute to learners' understanding.

It is clear that resources were not widely used. The resources selected by the teachers were not sufficient to teach Natural Science, using a scientific investigations approach. So, it is not the inadequate or non-existent resources that affected the teaching of Natural Science (Johnson, Hodges & Monk, 2000), it was the teacher's limited knowledge of resources that could be used. When resources are available, the challenge, according to Fitzgerald and Schnieder (2013) is to ensure teachers are trained to use them or they could be seen as an obstacle. While teachers use the lack of resources as an excuse not to teach Science, Muwanga-Zake (2000) established that teachers did not teach Science because they did not have the resources but due to their lack of understanding of science concepts and processes. I am of the view that this also applies to the teachers in this study.

If teachers do not have the will or the knowledge to teach Natural Science, the availability of resources will not affect this. Teachers require support with regard to the use of science equipment. Research by Fitzgerald and Schneider (2013) on the support teachers need to teach Science revealed that they needed resources but, in this case the need is not the focus. My view is that to teach Science in the Foundation Phase requires equipment that can easily be obtained or assembled by the teacher her/himself, this includes charts, pictures and very importantly the natural environment. The teachers in this study showed no action and creativity in this regard. Petre (2013) advocated for the use of nature and natural processes to build a positive relationship between the learner and the environment.

The school ethos and management provide a suitable environment for the teachers to perform their duties as foundation phase teachers in general. This is important as a school environment serves as a motivation for teaching and learning (MacDonald & Rogan, 1988). Furthermore, strong leadership in schools is important (Fitzgerald and Schneider, 2013) as is the support from management to teach Science (Nabors, 1999). Unfortunately, the school in this study provides little support to the teachers to improve their capacity to teach Natural Science.

A number of factors determine the teachers' capacity to implement the Natural Science Curriculum. The teachers' qualifications and attitudes, learner performance and behaviour, available resources and the school environment may influence this capacity. As shown in Table 10.3, the levels for the construct capacity to support the implementation of the Natural Science Curriculum for each teacher was determined and subsequently used to determine their respective ZFIs. I present the ZFI for each teacher with regard to their capacity to support the implementation of the Natural Science Curriculum in Figures 10.9-10.12. The ZFI continuum has been demarcated showing levels one to four which correspond to the levels on Table 10.3.

Figure 10.9: Karen's ZFI for her Capacity to Support the implementation of the Natural Science Curriculum

Figure 10.10: Fiona's ZFI for her Capacity to Support the implementation of the Natural Science Curriculum

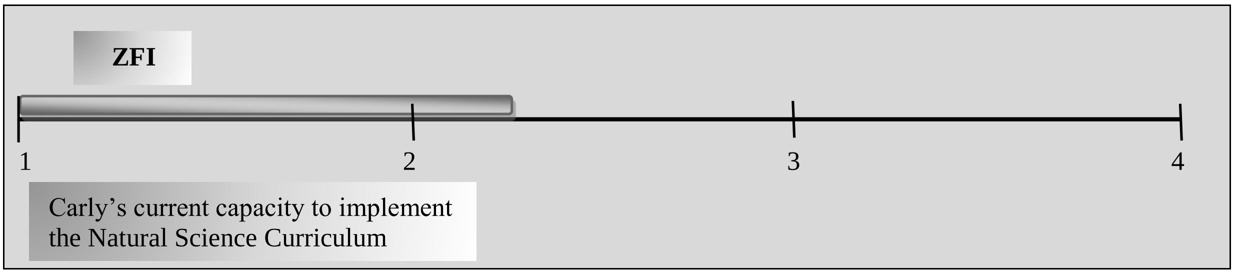

Figure 10.11: Carly's ZFI for her Capacity to Support the implementation of the Natural Science Curriculum

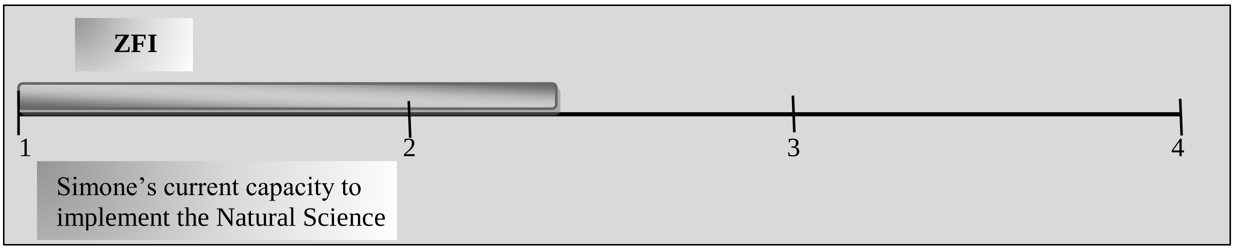

Figure 10.12: Simone's ZFI for her Capacity to Support the implementation of the Natural Science Curriculum

It is clear from Table 10.3 and Figures 10.9-10.12 that all four teachers are at different levels for most of the sub-constructs for the construct capacity to support innovation. This means that their capacity is limited in certain areas to support their ability to implement the Natural Science Curriculum. Carly and Simone's ZFI are extended as their levels for teacher factors are higher because they attempted to teach Natural Science. From Table 10.3 it is evident that while the school is well organised there is no provision made for the teaching of

Natural Science. All of this impacts on the way the teachers implement the Natural Science Curriculum.

10.4 TEACHERS' IMPLEMENTATION OF THE NATURAL SCIENCE CURRICULUM

This section also responds to the second research question: *How do foundation phase teachers implement the Natural Science Curriculum?* In Table 10.4, I present a summary of the levels at which I placed each teacher with regard to her profile of implementation for the Natural Science Curriculum.

Table 10.4: Summary of the teachers' Profile of Implementation

	Profile of Implementation			
	Integration of Science	Hands-on Science	Scientific Investigations	Classroom Interaction
Karen	1	1	1	Between 1 and 2
Fiona	Between 1 and 2	1	1	2
Carly	Between 2 and 3	1	1	2
Simone	3	1	1	2

Carly and Simone attempted to teach Science through integration even though there were flaws. Fiona's attempt at teaching Natural Science was merely a life orientation lesson. Karen did not attempt to teach Science. Carly and Simone had more success integrating Literacy and Numeracy in Science than integrating Science in Literacy and Numeracy. Their attempts at integrating Science in Numeracy resulted in using animals as examples without much success. None of the teachers' attempts at teaching Science developed Learning Outcome One, scientific investigations.

The examples that teachers cited for using hands-on science were actually not science lessons but life orientation and numeracy lessons. Carly and Fiona both used the bean plant as an example when explaining how they taught Science. None of the teachers taught Science using hands-on methodology. This possibly is due to the fact that all the teachers needed support in understanding what is meant by hands-on science and how to incorporate it into her science teaching before she would be able to facilitate such activities in her class. In this regard all teachers fell short in terms of facilitating science-by-doing as advocated by many researchers (Lind, 1999; Murphy et al., 2012; Osbourne, 2002). Since the science content that was taught informed learners of the facts, speaks to teachers' lack of science content knowledge (Grossman et al., 1989; Yilmaz-Tuzun, 2008).

None of the teachers taught Science using scientific investigations. The examples that the teachers cited of doing scientific investigations were demonstration lessons. The teachers did not have the skills to teach Science through investigations, indicating their ability to only teach in traditional ways when they attempted to teach Science, and in this way demonstrated an inability to meet the call for the use of appropriate science methodology (Llewellyn, 2002; Millar, 1998; National Science Foundation, 1999) at an early age (Roth, 1995). The teachers indicated that they thought that preparing for and teaching Science takes up too much time. However, it is surprising that all four teachers did not use their teaching time effectively

All the teachers except Carly's classroom interaction were characterised by disorganised activities, much repetition and a poor understanding of how to manage group work. A well organised and supportive classroom climate has a positive effects on learner achievement (Brophy, 1986; Hayes et al., 2006). Carly, however was very organised, so much so, that there was no opportunity for the learners to interact with her or with each other during the teaching and learning process. Although all four teachers indicated that they were open to answering learner questions they did not have questioning skills to elicit learners' responses, which could be attributed to their limited subject content knowledge (Garbett, 2003; Pearson, 2002).

Observations of learners in the classroom situation showed that the teachers were challenged by learners who had difficulty carrying out instructions and completing work within certain deadlines. Learners were often disruptive and too much time was spent by singing songs, a method used by all the teachers, with the exception of Carly to calm them down. At the other extreme, Carly's learners appeared to be too subdued to interact with her. The fact that the teachers used the singing of songs as a way to manage discipline issues shows that it was a common practice at their school. They were of the view that their learners' behaved badly, but this could be an indication that learners have difficulty understanding what was expected of them. While all teachers stated that their learners had difficulty with the level of the work prescribed by the curriculum and therefore they taught at a lower level, Simone was observed reading text that was beyond grade three learners' comprehension. There is evidence that teaching beyond or below learners' capabilities could lead to discipline problems (Andrée, 2012).

All the teachers demonstrated a poor use of resources in the classroom. Fitzgerald and Schneider's (2003) findings indicate that teachers require support with resources. Although Carly and Simone were the only two teachers who taught Science both of them did not seem confident in what they were teaching as they constantly looked at their notes and both used inappropriate charts to teach their respective topics. None of the teachers used the opportunities for incidental learning to teach Science. It was difficult to see how the teachers would have managed a natural science lesson, which included investigating phenomena as prescribed by Learning Outcome One.

As shown in Table 10.4, the levels for profile of implementation of the Natural Science Curriculum for each teacher was determined and subsequently used to determine their respective ZFIs. Figures 10.13-10.16 represent Karen, Fiona, Carly and Simone's ZFI (adapted from Rogan, 2006) with regard to their profile of implementation of the Natural Science Curriculum. The ZFI continuum has been demarcated showing levels one to four which correspond to the levels on Table 10.4.

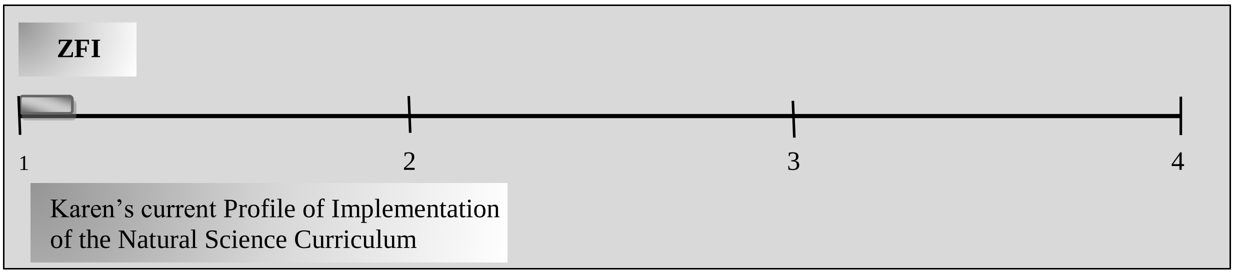

Figure 10.13: Karen's ZFI for her Profile of Implementation of the Natural Science Curriculum

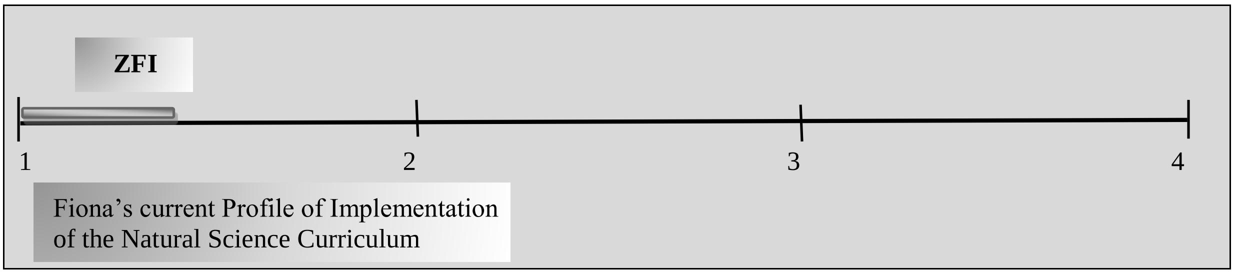

Figure 10.14: Fiona's ZFI for her Profile of Implementation of the Natural Science Curriculum

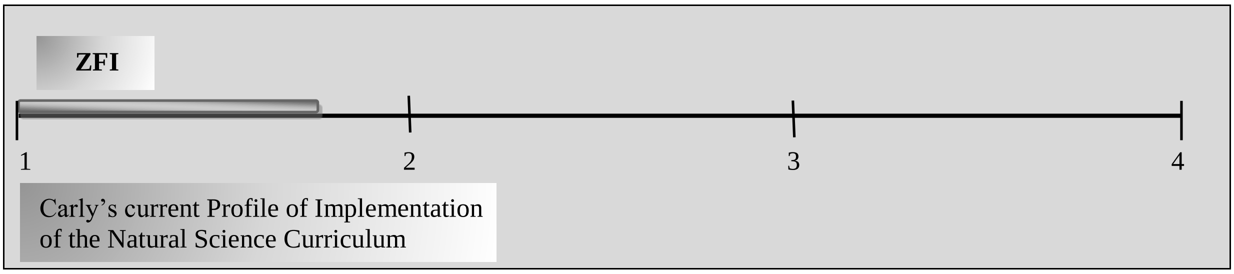

Figure 10.15: Carly's ZFI for her Profile of Implementation of the Natural Science Curriculum

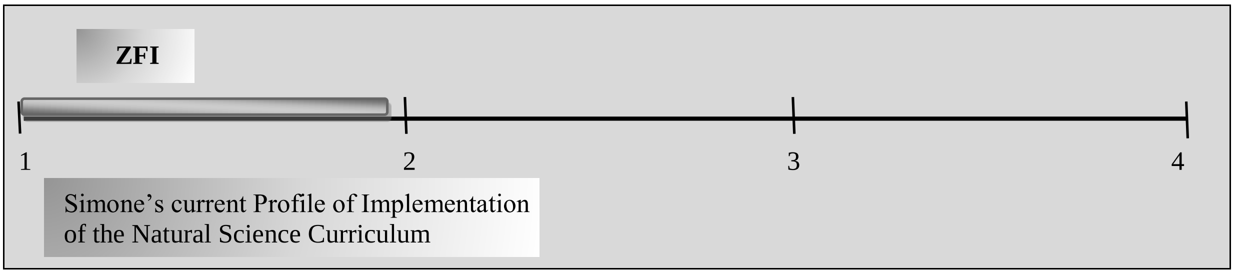

Figure 10.16: Simone's ZFI for her Profile of Implementation of the Natural Science Curriculum

While the four teachers have different ways of interacting with their learners and the levels of integrating Science is significantly different between Carly and Simone, on the one hand, and Karen and Fiona on the other, all the teachers are at the same levels for hands-on science and conducting scientific investigations. Simone is the only teacher who was able to reach level three with regard to integrating Numeracy and Literacy in her science lessons with Carly reaching a level between two and three for integration as she showed minimal evidence of Natural Science integrated in Numeracy, Literacy and/or Life Skills. This places all four teachers at overall levels below two with regard to their profiles of implementation as indicated in Table 10.4.

10.5 WHY TEACHERS INTERPRET AND IMPLEMENT THE NATURAL SCIENCE CURRICULUM THE WAY THAT THEY DO

To enable me to respond to the third and fourth question: *Why do foundation phase teachers interpret the Natural Science Curriculum the way that they do? and Why do foundation phase* *teachers implement the Natural Science Curriculum the way that they do?* I theorise the findings obtained from research questions one and two and present my findings with regard to these question as a number of propositions. Finally, I present my views on the greatest impediment/s to the expansion of the teachers' ZFI.

10.5.1 Proposition One - No set time allocation for Natural Science

Natural Science education is often absent in the Foundation Phase because of the precedence placed on Literacy and Numeracy. This perception is not solely because of the teachers' views but the manner in which Natural Science is portrayed in the curriculum documents. There is no specific time allocated to Natural Science as it forms part of the Life Skills Learning Programme, which was also evident by the lack of teachers' life skills lesson plans. Studies have shown that the time allocated to the teaching of Science Education in the Foundation Phase is not adequate to meet the learning outcome for Science (Albion & Spence, 2013; Mudulia, 2012). Another reason for teachers neglecting Natural Science is that they require more time to meet the assessment demands for Numeracy and Literacy. This coincided with Fitzgerald and Schnieder's study (2013) where they found that national assessment of Literacy and Numeracy takes precedence. Unless specific times are allocated to the teaching of Natural Science, the importance of developing the skills particular to this discipline will not be realised.

10.5.2 Proposition Two - The nature of the Foundation Phase does not promote science learning

Teachers are expected to accomplish the different roles defined in the Norms and Standards for Educators. The key aspect derived from the literature and curriculum documents is that the foundation phase teacher in the South African context has to be a generalist teacher. They are expected to teach all Learning Areas and have in-depth knowledge of children, their development stages, including working with the pastoral care aspects. Research has identified that science teaching is challenging and this creates the situation of teachers either depending on a 'specialist' teacher for science lessons, or avoiding science teaching themselves because of beliefs of inadequacy in themselves as teachers of Science (Appleton, 2003; Buxton, 2010; Hackling et al. 2007; Southerland et al., 2011; Tosun, 2000; Tytler, 2009). Teachers avoid teaching Natural Science because they do not have the content knowledge; they have limited science pedagogical content knowledge and lack confidence to teach it (Appleton, 2003; 2008).

This has also been found to be the case in this study. As the Foundation Phase Curriculum does not specifically state where and how teachers should teach Science and the *Foundation for Learning* documents have very little to say about the teaching of Science, teachers are able and have chosen to avoid teaching Science.

10.5.3 Proposition Three - Teachers' qualifications do not assist in preparing them to teach Science

The teachers had minimal or no science courses in their qualifications which affects their confidence to teach Natural Science. Their qualifications did not prepare them to be specialist teachers but rather general foundation phase teachers. Research indicates that there are very few science components in initial teacher education programmes (Bartholomew et al., 2012). To be able to teach Natural Science teachers would need to have the content knowledge, know how to use resources to complement their teaching and select appropriate instructional methods. Researchers maintain that teachers' background in Science frames the way they will teach Science (Palmer, 2001; Tosun, 2000; Young & Kellogg, 1993; Mellado et al, 2008). Research has also shown that teachers have their own preconceptions and alternative conceptions due to their worldviews that determine how they understand Science (Bayraktar, 2009; Liu & Lederman, 2007). These need to be taken into account when curriculum planners are planning one curriculum for all to follow.

10.5.4 Proposition Four - Teachers lack science content knowledge

The content areas recognised by the RNCS and CAPS for the Natural Science Curriculum are Life and Living, Energy and Change, Planet Earth and Beyond, and Matter and Materials (Department of Education, 2002a; Department of Education, 2011a). The teachers' science content knowledge was lacking. Although there is only one learning outcome in the Foundation Phase foregrounding scientific investigations, this is only be attained by incorporating content knowledge. There is a correlation with research which has shown that teachers' content knowledge affects their confidence in teaching Science (Akerson & Flaningan, 2000; Appleton, 2008; Borko, 1993; Smith & Neale, 1989; Waters-Adams, 2006). The topics taught in all the grades were topics that had a strong slant towards Life Orientation and teachers often focused on the life orientation aspects, rather than the science aspects. The teachers' interpretations of the Natural Science Curriculum revealed that the teachers were not aware of how little science knowledge they had and how this impacted on their ability to teach

Science. This accounted for the fact that the same topics were taught every year and in every grade.

10.5.5 Proposition Five - Teachers lack experience in appropriate instructional methods to teach Science

The teachers had minimal knowledge of appropriate instructional methods in science teaching and poor understanding of how to use appropriate methods such as inquiry-based or problem solving approaches. Transmission methods were common and the closest teachers came to some kind of interaction with learners were discussions of topics. Research has shown that there is a correlation between teachers' content knowledge and their choice of instructional methods (Muwanga-Zake, 2000; Rennie et al., 2001; Yilmaz-Tuzun (2008).

10.5.6 Proposition Six - Lack of professional development

Professional development workshops for the teaching of Natural Science in the Foundation Phase is non-existent, according to the findings of this study. The fact that the books provided by the Department of Education and used by all the teachers, provides no support for the teaching of Natural Science in an appropriate manner, is a major concern. The teachers had no opportunity to improve their knowledge and skills with regard to science teaching, which could be an important reason for Science either not being taught or taught poorly. The absence of professional development programmes for foundation phase teachers with regard to teaching Natural Science may send a message that Science is not important in this phase. Furthermore, teachers require development in using appropriate methodologies to teach Natural Science, especially with regard to Learning Outcome One as well as support in learning how integration may be applied in the teaching of Natural Science.

10.5.7 Proposition Seven - Poor understanding of integration

The evidence obtained from the data in this study supports my view that a lack of understanding of how integration should occur in the teaching of Science is one of the major reasons why Natural Science is taught poorly or not at all, in the Foundation Phase.

With the implementation of the RNCS in the Foundation Phase, Natural Science became one of the six learning areas embedded in the Life Skills Learning Programme. This is where the problem lies. The teachers give precedence to the Life Orientation Learning Area when teachers teach Life Skills. Teachers teach life skills lessons that mainly relate to health and safety issues and avoid teaching Science. This is due to the fact the curriculum documents maintain that Life Orientation is the backbone of the Life skills Learning Programme and all other learning areas need to be integrated. The curriculum documents advocate teaching through integration and ensuring conceptual progression but there is no guidance given to teachers regarding how this is to be achieved (Department of Education, 2002b).

The teachers in this study chose science topics such as *insects* and *animals* and proceeded to teach aspects of Science, integrating numerous aspects of Literacy and some aspects of Numeracy. It is my contention that this approach of integration makes it impossible to teach Natural Science as the RNCS recommends as the only aspects of Science that are taught are concepts. Although the topic may be related to Science such lessons are numeracy and literacy lessons. To teach Natural Science by integration, learners should engage in investigations which enable them to achieve Learning Outcome One and during this process numeracy and literacy aspects should be addressed. None of the documents available to foundation phase teachers, advocate this approach.

10.5.8 Proposition Eight - The crux of the matter: Two non-aligned curricula

The RNCS (and CAPS) in the GET Band include a curriculum for every Learning Area. This means that the Natural Science Learning Area is presented in the RNCS as a separate learning area with a specific section for the Foundation Phase from Grade R to Grade Three. Included in this curriculum is content, learning outcomes and assessment standards. Although the specific content for each grade is not specified, a range of content topics are listed in each of the knowledge areas from which teachers may choose. This document clearly states that Learning Outcome One is the outcome teachers in the Foundation Phase should focus on in the teaching of Natural Science. The Natural Science Curriculum across the GET band was designed by specialists in the field, and as expected their focus is Natural Science.

The RNCS also contains a curriculum for the Foundation Phase. In this document, criteria for teaching in the Foundation Phase are set out. The design of this curriculum is focussed on the three Learning Programmes Numeracy, Literacy and Life Skills. As mentioned earlier, although all six remaining Learning Areas (including Natural Science) are located in the Life Skills Programme this document clearly states that Life Orientation forms the backbone of Life Skills and proceeds to only discuss outcomes pertaining to Life Orientation. This curriculum was designed by Foundation Phase specialists.

To compound matters, the Department of Education issued documents termed *Foundation for Learning*, which attempts to guide teachers as to how they should approach teaching in the Foundation Phase. As mentioned numerous times, these documents foreground Numeracy and Literacy and place very little emphasis on Life Skills. Where reference is made to Natural Science in these documents, it is inappropriate with regard to developing Learning Outcome One.

The *Foundation for Learning* documents are issued to all teachers and used in professional development courses conducted by the Department of Education. It is therefore understandable that teachers would regard such documents as important guidelines for teaching. As mentioned earlier, teachers are often inclined to ignore curriculum documents and prefer to work with supplementary materials that spell out exactly what they should do. This is exactly what happened in this study.

It is against this background that I formulate my final proposition which is that two curricula exist within the Foundation Phase that are so misaligned that it makes it impossible for teachers to comply with the expectations of both curricula. As the *Foundations for Learning* documents, which are the official documents supporting the Foundation Phase Curriculum, are foregrounded, this is what teachers use. The Natural Science curriculum has, in effect become invisible.

The question therefore arises if it is fair to attempt to determine a ZFI for foundation phase teachers in the context of teaching Natural Science. Do these teachers have any chance of expanding their ZFIs to move along the continuum of competences and eventually reach level four with regard to assisting their learners to achieve Learning Outcome One through teaching Natural Science in appropriate ways? While numerous barriers discussed above prevent teachers from expanding their ZFI, the most important one is a barrier imposed by curriculum developers who have designed two curricula that do not speak to each other.

Although I presented each teachers' ZFI, I believe it is unfair to the teachers as many of the challenges they encountered were beyond their control. The teachers' ZFI are currently too narrow to envisage them implementing the Natural Science Curriculum. Furthermore, the teachers cannot expand their ZFI as the problem lies with the design of the curriculum and it is not something the teachers can work on to improve without the necessary support. The barrier preventing teachers from implementing the Natural Science Curriculum is the non-alignment of the two above-mentioned curricula.

Rogan and Grayson (2003) maintain that curriculum implementation strategies are ‘good’ when they proceed just ahead of current practice, i.e. are within the zone of feasible innovation”. Curriculum implementation has to consider the present level of the teachers’ capacity to support innovation to be successful. Considering the findings and interpretations made in this study, I propose a model that illustrates the barrier that teachers face when implementing this curriculum. There is a disjuncture between teachers’ current implementation and the type of implementation that needs to take place that is envisaged by the Natural Science Curriculum documents. The model shown in Figure 10.17 is a representation of this disjuncture which is represented as a barrier. Although some of the barriers may be overcome by the teachers themselves with support, there are others such as the non-alignment of the curricula that are beyond their control. The barriers that are indicated at the bottom of the ZFI line are those over which the teachers do not have control. The barriers indicated above the ZFI line are the those over which the teachers have control provided they have the support to do so. The arrows are indicative of the flow that needs to occur. For example, once the curricula have been aligned and there has been professional development, teachers’ content knowledge, instructional methods and confidence may improve. To ensure the eradication of the barrier there needs to be synergy between the Foundation Phase Curriculum and the Natural Science Curriculum.

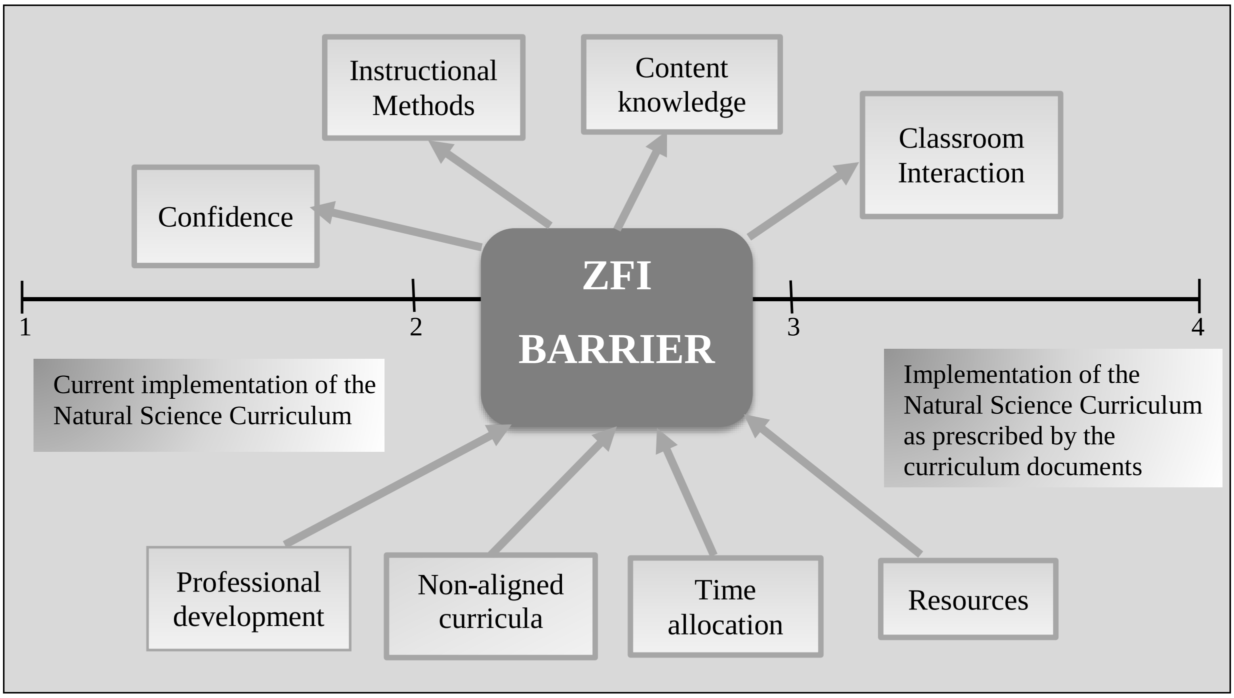

Figure 10.17: Model depicting the barrier to expansion of the ZFI

10.6 RECOMMENDATIONS

According to the RNCS, “The Natural Science Learning Area deals with the promotion of scientific literacy” (Department of Education, 2002a, p. 4). If we are to ensure our education system is producing scientifically literate people then we need to afford Natural Science the prominence needed to achieve this as envisaged by the curriculum documents. I wish to propose a number of recommendations that may assist in giving Natural Science the prominence it deserves in the Foundation Phase Curriculum

10.6.1 Recommendation One

I propose that either Natural Science be recognised as a freestanding learning area in the Foundation Phase or more time be allocated to Life Skills and specifically to Beginning Knowledge so that time can be explicitly allocated to the teaching of Natural Science in the Foundation Phase. The CAPS document [the newest version of the NCS] describes Life Skills Learning Programme in the Foundation Phase as being structured around four study areas which are Beginning Knowledge, Personal and Social Well-being, Creative Arts and Physical Education (Department of Education, 2011a). The teachers need to use the content and concepts from Social Sciences (History and Geography), Natural Science and Technology to teach Beginning Knowledge. Similar to the RNCS, the CAPS documents also advocates integration across Beginning Knowledge and Personal and Social Well-being study areas. The problem of time allocation therefore persists in the CAPS. Only by allocating specific time for Natural Science in the Foundation Phase will there be some assurance that Science will be given adequate attention.

10.6.2 Recommendation Two

Pre-service and in-service teacher education and training need to include a Natural Science component that thoroughly prepares the teacher to teach Natural Science in the Foundation Phase. In addition, the Department of Education and other stakeholders should present workshops to develop teachers sufficiently in teaching Natural Science. From the teachers’ responses, it was evident that they require guidance with the implementation of appropriate instructional methods in their teaching of Natural Science as they found it challenging to define some instructional strategies. The content of these workshops should include science content knowledge, the use of resources and the selection of appropriate instructional methods to teach

Natural Science, which will contribute to developing teachers' confidence to teach Natural Science.

10.6.3 Recommendation Three

Teaching Natural Science in the Foundation Phase does not require expensive science equipment. The natural environment provides opportunities to achieve Learning Outcome One and most schools have surrounding areas where this may be achieved. However, teachers need education on how to use the environment in their teaching. Support is also required to enable teachers to effectively use books supplied by the Department of Education. Some inexpensive resources need to be provided to the teachers through either the school budget, the Department of Education or outside support in terms of funding. Workshops where teachers learn how to make simple equipment from basic resources may also assist.

10.6.4 Recommendation Four

Appropriate curriculum documents for the Foundation Phase need to be designed by foundation phase specialists in conjunction with natural science specialists to ensure that there is synergy between the two. Research needs to be carried out regarding the inclusion of selected concepts appropriate for this phase as well as outcomes related to investigations. Furthermore, the Natural Science Curriculum should be more prominent to enable teachers to understand the imperatives of both curricula. It is essential that teachers are competent in interpreting the curricula they work with and in this case, being able to interpret the Natural Science Curriculum is important.

10.6.5 Recommendation Five

Teachers are the critical agents of curriculum implementation. However, teachers' implementation of the curriculum depends on how they interpret the curriculum. Teachers' experiences influences the way in which they interpret the curriculum (Cornbleth, 1985). Teachers would have an even better understanding of the curriculum if they were involved at the conceptual stage of curriculum development. Teachers' wealth of knowledge and experience could be advantageous in this process. However, it is only once the curriculum decisions have already been taken that teachers become involved in the curriculum implementation (Kliebard, 1979; Reid, 1978). At this stage the value that teachers could have brought to the curriculum development process is negated.

In South Africa the curriculum documents allude to the contribution of many stakeholders in the design of the curriculum. However the role played by the teachers in this process as well as their exact contributions are not clear. The greater the teachers' role in curriculum development the greater will be the teachers' ownership of the curriculum. Teachers' seven roles (Norms and Standards, 2000) have been discussed at depth and highlights what is expected from a teacher concerning probable curriculum duties in the South African context. However it is not clear when these roles come into play. It may be that the teachers' roles regarding curriculum is only be effective during the implementation of the curriculum in the classroom. If this is true then the teacher is not seen as an equal contributor to the curriculum development process.

Finding where exactly the teachers' role in curriculum development is located becomes crucial. Kirk and Macdonald (2001) proposed an additional viewpoint on teacher participation and ownership in a model that concentrated on the association regarding meaning-making processes on several stages of the curriculum development process. They found that the teachers' inputs are predominantly significant in respect of the local context, that is in the classroom or school, when they indicated that "teachers' authoritative voice is rooted in the local context of implementation" (Kirk & Macdonald (2001, p. 565). In the South African context the teachers' involvement is similarly concentrated in the school and the classroom. Researchers believe that there are methods in which to involve teachers in the curriculum development process beyond the school and the classroom (Fullan &Hargreaves, 1992; Kirk & Macdonald, 2001). As result of teachers not being involved more substantially in the curriculum development process, they seem to not take ownership of the curriculum (Kelly, 1999).

Although many researchers (Handler, 2010; Ornstein & Hunkins, 2009; Young, 1979) supports the teachers' role as being central to curriculum development and planning, others (Handler, 2010; Leithwood & Jantzi, 2000; Ryan, 1999; Weiss, 1993) do not. Researchers Conthran and Ennis (1997) found that teachers still operate within existing curriculum frameworks even though they were given the freedom to design the curriculum. These findings suggest something more is needed before teachers can start developing curriculum and then implement the curriculum in the way it was intended. From my study it was evident that teachers' implementation of the curriculum resonates from their interpretation of the curriculum. Currently in South Africa it is not clear what their role is in the curriculum development process.

In light of the above, I propose an adaptation to Rogan's (2007) theory of implementation by expanding the framework to include teachers' interpretation as the fourth construct as shown in Figure 10.18. There needs to be an interrelationship between all four constructs to ensure that innovation may take place. Teachers' current interpretations have to be considered when developing curriculum innovations to ensure that teachers are able to expand their ZFIs. It would be difficult to evaluate the teachers' implementation of the curriculum without considering their interpretation of the curriculum. To build capacity to support an innovative curriculum without connecting it to teachers' current interpretations is unproductive. Like-wise, implementation is unlikely to improve if teachers' interpretations are poor. Similarly, it is important that outside support contribute to the improvement of the three other constructs. By including the construct interpretation, I believe the framework gives a clearer picture of what foundation phase teachers need to take account of to expand their ZFIs.

The construct, Interpretation of the Natural Science Curriculum has four sub-constructs, namely natural science content areas, time allocated for Natural Science in the Foundation Phase, teaching of Natural Science in the Foundation Phase and the instructional methods used to teach Natural Science. The reasons for selecting these constructs was explained in chapter five. In addition the constructs were linked to the foundation phase context. Since the teachers were the focus of the study their interpretation of each sub-construct is foreground. It is from the teachers' interpretation that we can begin to understand their implementation with respect to each of the other three constructs, namely, support from outside agencies, profile of implementation and capacity to support innovation.

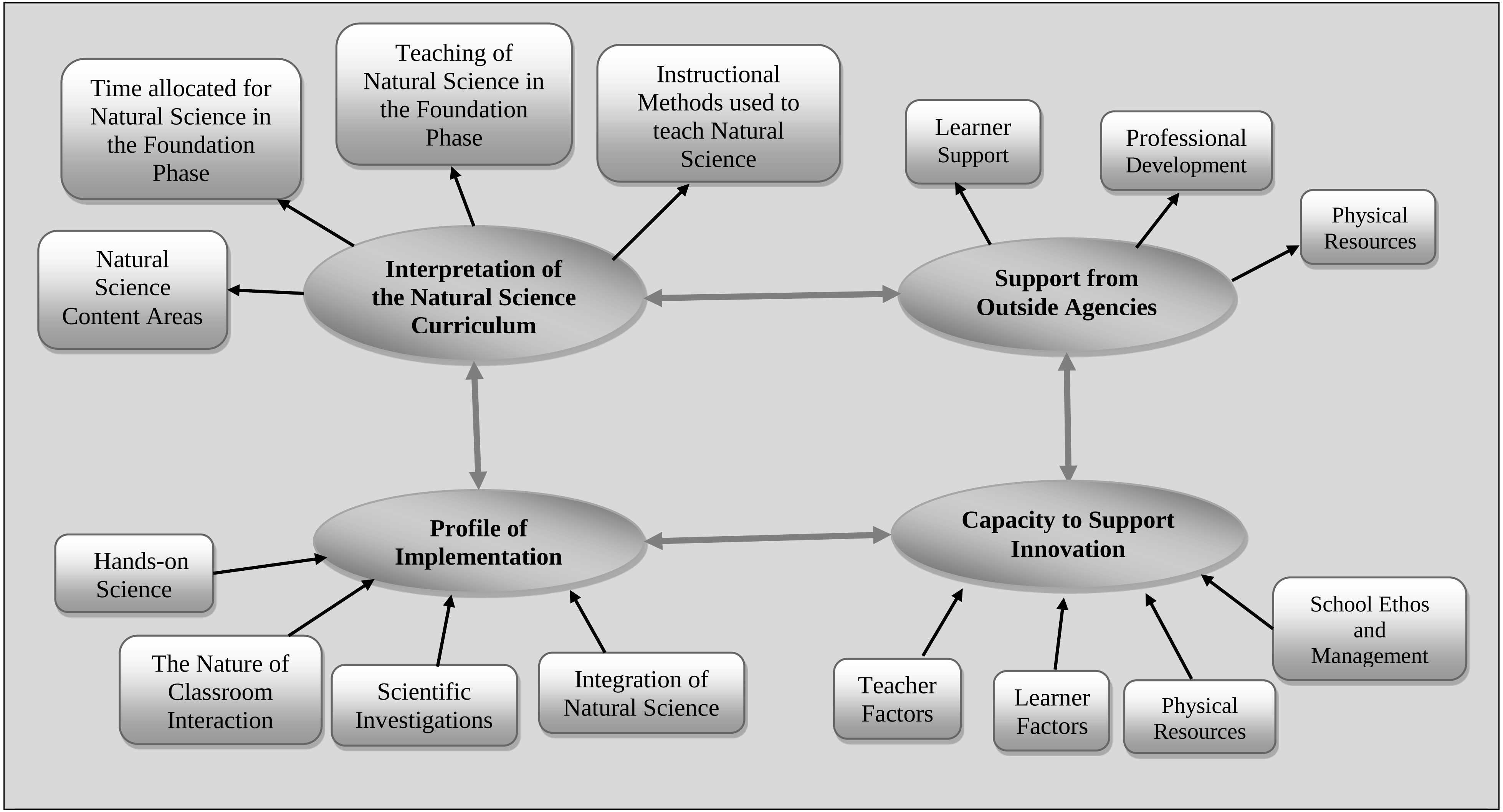

Figure 10.18: An adaptation of Rogan and Grayson's Theory of Implementation in the Foundation Phase.

10.7 CONCLUSION

The main aim of this chapter was to present my conclusions and recommendations of my study. My conclusions were presented as answers to my research questions. From the findings, it was evident that an innovative theory was needed to explain why teachers interpret and implement the curriculum the way that they do. I explained the emerging theory by initially attempting to locate each teachers' ZFI. This proved to be unfair to the teachers as there were aspects that were beyond their control. I then produced a model to explain why teachers do what they do. The model was shown as a barrier that has to be overcome to be able to implement an innovative curriculum. My findings show that the non-aligned curriculum documents are the major issue that is beyond the teachers' control. Once the curricula are aligned and together with professional development teachers may be able to implement curriculum transformation. I concluded the chapter by proposing a number of recommendations that arise from the findings of this study. Rogan's framework for implementation was expanded to incorporate teachers' interpretation of the curriculum.

With Science viewed as a scarce skill in South Africa, our education system has the mammoth task of producing graduates in Science and related fields. Natural Science is compulsory from Grade R to Grade Nine. It is therefore crucial that we instil the love for Science from an early age so that learners can elect to study Science in Grade 10. We need to invest in the Foundation Phase and more specifically in the teaching of Natural Science to make provision for teachers to implement the curriculum. The focus has to be on the teachers as they are the critical agents that bring about transformation within the classroom when implementing the curriculum.

It is envisaged that the findings of this study, which resulted in the development of a model that explains the barrier experienced by teachers as well as the expansion of the theoretical framework for curriculum implementation, afford curriculum planners a useful framework for developing innovative curricula.

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APPENDICES

APPENDIX A: Document Analysis Schedule - Curriculum Documents

Foundation Phase

Evidence of		
Scientific Investigations	Hands-on Science	Integration of Natural Science

Natural Science

Evidence of		
Scientific Investigations	Hands-on Science	Integration of Natural Science

Life Skills

Evidence of		
Scientific Investigations	Hands-on Science	Integration of Natural Science

APPENDIX B: Document Analysis schedule-Lesson Plans

Grade 0KA

Time Allocation (for the grade for the week as per lesson plans)

Learning Programmes	Time (%)
Literacy	
Numeracy	
Life Skills	
Natural Science	

Literacy Learning Programme

Day	Content knowledge	Instructional methods	Physical Resources	Types of Activities	Integration of Natural Science

Numeracy Learning Programme

Day	Content knowledge	Instructional methods	Physical Resources	Types of Activities	Integration of Natural Science

Life Skills Learning Programme

Day	Content knowledge	Instructional methods	Physical Resources	Types of Activities	Integration of Natural Science

APPENDIX C: Document Analysis Schedule- Learners' Books

Learners' Life Skills Books

Date	Evidence of		
	Scientific Investigations	Hands-on Science	Integration of Natural Science

Learners' Literacy Books

Date	Evidence of		
	Scientific Investigations	Hands-on Science	Integration of Natural Science

Learners' Numeracy Books

Date	Evidence of		
	Scientific Investigations	Hands-on Science	Integration of Natural Science

Learners' Books- Homework Book - Grade 3CS

Date	Evidence of		
	Scientific Investigations	Hands-on Science	Integration of Natural Science

APPENDIX D: Questionnaire

This questionnaire aims to understand your interpretation of the Natural Science Curriculum within the foundation phase classroom. The information will be treated confidentially.
This questionnaire comprises of eight sections (Section A-H). Please answer all questions honestly by ticking **(✓)** the relevant column or writing your opinion in the space provided. Please complete all items. Thank you for being willing to complete this questionnaire.

Section A: Personal Details

Surname	
First Name	
Preferred calling name	
Age	
Gender	
Home Language	
Level	
Academic qualification	
Professional qualification	
Years of experience in teaching	
Years of experience teaching in the Foundation Phase	
Grade currently teaching	
Other grades taught	

Section B: Content knowledge

1. Tick the science content that you believe that you can teach confidently. If you feel the list is incomplete, please add any topics to “other” at the end of the list.

	Very Confident	Confident	Not so confident	Not confident
Light energy and colour				
Heat energy				
Sound energy				
Magnetic interactions				
Electrical energy				
Simple machines				
Plants				
Animals				
Nutrition				
Air				
Weather				
Water				
Matter and materials				
Reactions and changes of materials				
Universe and solar system				
Earth and moon systems				
Human body (systems)				
Matter and Motion				
Atoms				
Ecology				
Other				

2. Which science content (from the list above) do you teach often? Why?

____

____

____

3. Which of the science content (from the list above) have you never taught? Why?

____

____

____

Section C: Instructional Methods

1. The following is a list of classroom methods. Please tick the box that most accurately describes how often you use these methods in your teaching of science topics. Please refer to the addendum, which will clarify what is meant by the instructional methods given below:

	Daily	Weekly	Fortnightly	Monthly	Once a term	Never
Inquiry						
Lecture						
Demonstration						
Laboratory						
Discussion						
Role- play						
Problem-based learning						
Cooperative learning						
Project base learning						
Discovery						
Scientific investigations						
Problem solving						
Hands-on						
Journal						
Learning centres						
Role play						
Scaffolding						
Simulations						
Case studies						
Graphic Organisers						
Stories/narratives						
Other						

2. Could you give reasons why you use the methods that you selected?

____

____

____

____

____

____

Section D: Learner Factors

1. Complete this table:

No. of learners in your class	
No. of boys in your class	
No. of girls in your class	
Average age of learners in your class	

2. The following is a list that could possibly describe the learners in your class. Please select the ones that could be used to describe the learners in your class. You could include others if you so wish. Write a short paragraph to explain your choice.

Well-behaved	Enthusiastic	Creative
Confident	Respects the environment	Problem solvers
Literate	Enjoys group work	Independent
Learners come from a supportive home environment	Low socio-economic background	Difficulties with the language of instruction
Numerate	Critical thinkers	

____

____

Section E: Teacher Factors

1. The following is a list that could possibly describe you as a teacher. Please select the ones that could be used to describe you as a foundation phase teacher teaching Natural Science. You could include others if you so wish. Write a short paragraph to explain your choice.

Dedicated	Confident	Conscientious attendance
Caring	Approachable	Committed
Well qualified	Tries innovative teaching techniques	Make an extra effort to improve teaching
Experienced	Plans lessons well	Competent
Attends professional development activities	Sound science content knowledge	Sound science pedagogical (teaching) content knowledge

____

____

____

2. What do you see as your greatest strength as a foundation phase teacher? Why?

____

____

3. What do you see as your greatest weakness as a foundation phase teacher? Why?

____

____

____

4. Have you attended any professional development workshops with regard to teaching Natural Science in the Foundation Phase in the last year? If you have, name them.

____

____

Section F: Physical Resources

1. The following is a list of physical resources that could assist you as a teacher. Please tick the box that most accurately describes how often you use the resource in your teaching of Science.

	Daily	Weekly	Fortnightly	Monthly	Once a Term	Never
Chalkboard						
Textbook						
Worksheets						
Whiteboard						
Science equipment						
Nature						
Videos						
Library						
Computers						
Models						
Others						

2. Do you use a textbook to teach Science? What textbook do you use? Why do you use this textbook?

____

____

3. Name the type of resources/science equipment you use to teach Science.

____

____

4. What resource would you like to have (that you do not have access to now) that you think will improve your teaching in Science?

____

____

Section G: School Ethos and Management

The following is a list that could describe the ecology and school management of your school. Please tick the box that most accurately describes your feelings about the statements:

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Well structured timetable					
Strong presence of principal is felt					
Principal is in regular contact with staff					
Strong presence of HoD is felt					
HoD is in regular contact with staff					
Good organisation of extra mural activities					
Regular staff meeting					
School is secure and access is denied to unauthorised personnel					
Colt (culture of learning and teaching) is strongly present					
School governing body is in existence					
Teachers and learners play an active role in management					
Parents play an active role in supporting the school					
Others					

Section H: General

1. What proportion of the school day do you spend on each of the Learning Programmes, i.e. Literacy, Numeracy and Life Skills?
2.

Learning Programmes	Time (%)
Literacy	
Numeracy	
Life Skills	

2. In what ways do you feel that your professional qualification and related field experience have best prepared you to be an effective foundation phase teacher?

Thank you for your cooperation

Addendum for Section C

Inquiry uses scientific reasoning and critical thinking to develop an understanding of science.

Lecture is direct Instruction is used to help students learn concepts and skills.

Demonstration involves the teacher showing students a process or procedure such a science process, a cooking procedure or a computer procedure.

Laboratory method is based on the principles “learning by doing”, learning by observation and proceeding from concrete to abstract.

Discussion is a combination of lecture and teacher questioning of students. It is designed to encourage thinking skills and allows learners to increase interpersonal skills.

Role-play deals with solving problems through action. A problem is identified, acted out and discussed.

Problem-based learning is a collaborative learning process that presents students with complex, real world problems and provides guidance as they collaborate to develop content knowledge and problem solving skills.

Cooperative learning or group learning is an instructional strategy which organises students into small groups so that they can work together to maximise their own and each other's learning.

Project-based learning organises learning around projects. Projects are complex tasks based on challenging questions or problems that involve learners in design, problem solving, decision making or investigative activities, give learners the opportunity to work relatively autonomously over extended periods of time and culminate in realistic products or presentations.

Discovery learning is an inquiry-based learning method in which learners use prior knowledge and experience to discover new information that they use to construct learning.

Scientific investigation is the process that can be defined in five words: observation, questioning, hypothesis, testing, and explanation. These words, taken in this order, define the scientific method, the set of procedures biologists follow for sound and rational approach for proper practice of their discipline.

Problem solving as a teaching method involves alternate ways of dealing with a problem and coming up with a previously unused or novel solution. It could involve integration of different learning areas.

Hands-on learning is learning by doing. Hands-on learning involves the child in a total learning experience, which enhances the child's ability to think critically. The child must plan a process to test a hypothesis, put the process into motion using various hands-on materials, see the process to completion, and then be able to explain the attained results.

Journals are often used in classrooms to allow students to record reflections and ideas. Typically written in a notebook and recorded each day, the journal serves as a method of communication between the student and the teacher.

Learning Centers are self contained areas where students work independently or with small groups (pairs or triads) to complete a task. Centers may take the form of chairs placed around a table for group discussion, display boards that present questions/ problems/ worksheets, or computer/computers where students perform hands-on activities or research on the web.

Scaffolding, involves the teacher modeling the skill and thinking for the student. As the student increases understanding, the teacher withdraws the assistance allowing the student to take on more responsibility for the learning.

Simulations are used to put the student in a "real" situation without taking the risks.

Case studies involve groups of students working together to analyse a "case" that has been written on a particular situation or problem to find a solution.

Graphic Organisers are found in the form of diagrams, maps and webs and illustrate information in a graphical format.

Stories/Narratives as an instructional strategy are designed to convey abstract concepts through concrete experience. The narratives engage students in critical thinking and personal reflection. There is evidence that sharing ideas and concepts through story is an important way of encouraging social relations and helping students make connections between what they are learning in school and what they know of the world.

References:

O' Bannon, B. (2002). *Planning for Instruction: Instructional method*. Available from: http://itc.utk.edu/~bobannon/in_strategies.html#demonstration. Accessed on 17 October 2009.

Sidhu, K. S. (2006). *The teaching of Mathematics*. Sterling Publishers: India.

Thomas, J. T. (2000). *A review of research on project-based learning*. Available from: http://www.bobpearlman.org/BestPractices/PBL_Research.pdf. Accessed on 07 November 2009.

APPENDIX E: Observation Schedules for Classroom Observations

Day	
Date	
Time/ Duration	
Teacher	
Grade	
No. of learners	
Learning Programme	
Learning Area	
Lesson Topic	
Leaning Outcome	
Assessment Standard	
Notes:	

Relevant information to be ticked (✓) and space available to add on more information from the observation.

Table 1: Profile of Implementation (Rogan and Grayson 2003, p. 1183)

Level	Classroom interaction	Hands-on Science	Science Investigation	Integration
1				
2				
3				
4				

Table 2: Profile of the Capacity to Support Innovation (Rogan and Grayson 2003, p. 1188)

Level	Physical resources	Teacher factors	Learner factors	School ecology and management
1				
2				
3				
4				

Table 3: Support from outside agencies (Rogan and Grayson 2003, p. 1193)

Level	Types of encouragement and support		
	Physical Resources	Physical Resources	Physical Resources
1			
2			
3			
4			

APPENDIX F: Semi-Structured Interview Schedule

The semi-structured interview was based on the data obtained from the, questionnaire and classroom observations. These are some of the type of questions that were asked:

1. In the biography section of the questionnaire, you mentioned that you have ....as a qualification

1.1 Did the qualification help you as a Foundation phase teacher teaching Science?

1.2 How did it help you?

2. You mentioned in the questionnaire that you use demonstrations often as an instructional method in teaching Science.

2.1 Can you explain, using an example from your teaching how you accomplished this?

2.2 How do the learners respond when you carry out a demonstration during a science lesson?

3. You responded in the questionnaire that you attended a professional development workshop on teaching Science.

3.1 Describe the workshop you attended? What was the focus?

3.2 Explain what you learnt at the workshop?

3.3 Did you find it helpful/not helpful in your science teaching?

3.4 Why was it helpful/ not helpful?

4. From the classroom observations, I observed you did.............................. during your science lesson.

4.1 Why did you do that?

4.2 Where did you get the idea from?

APPENDIX G: Rating Scale

Items		Agree	Undecided	Disagree
Confidence				
1.	I have the necessary skills to teach Science.			
2.	I feel comfortable doing science activities in my classroom.			
3.	I fear science activities would not turn out as expected.			
4.	I understand science concepts well enough to effectively teach science.			
5.	I find it difficult to explain to learners some science concepts.			
6.	I am typically able to answer learners' science questions.			
7.	Given a choice, I would not invite the principal/head of department to evaluate my science teaching.			
8.	I have a difficult time understanding Science.			
9.	I enjoy teaching Science.			
10.	When teaching Science, I usually welcome student questions.			
Classroom Preparation				
11.	I enjoy reading resource books to obtain ideas about science activities for young children			
12.	I am willing to spend time setting up materials for scientific exploration.			
13.	I am happy to help children construct science equipment for hands-on science.			
14.	Teaching Science takes too much time.			
15.	I am ready to learn and use scientific knowledge and skills for planning hands-on science.			
16.	I like to discuss ideas and issues of science teaching with my colleagues.			
17.	Teaching Science takes too much effort.			
18.	I am familiar with raising open-ended questions to encouraging children's scientific exploration			

19.	I use many hands-on activities to help my learners learn Science.			
20.	I am able to take my learners outside the classroom to learn Science			
21.	Preparation for science teaching generally takes more time than other subject areas.			
22.	I integrate Science into other subject areas			
23.	I integrate other subject areas into Science			
Managing Hands-on Science				
24.	I am not afraid of demonstrating experimental procedures in the classroom			
25.	I enjoy collecting materials and objects to use in my science teaching.			
26.	I am interested in handling certain animals and insects to teach Science.			
27.	I am comfortable using any classroom materials (e.g., blocks, toys, boxes, etc.) for science activities.			
28.	I do not mind the messiness created when doing hands-on science in my classroom.			
29.	Teaching of science process is important			
Developmental Appropriateness				
30.	I do not believe it is appropriate to introduce Science to children at an early age.			
31.	I am comfortable with determining the science curriculum that is developmentally appropriate for young children.			
32.	I do not feel that young children are curious about scientific concepts and phenomena			
33.	I am familiar with the processes and ways that young children learn Science.			
34.	I feel that young children cannot learn Science until they are able to read.			

APPENDIX H- Ethical Clearance from UKZN

UNIVERSITY OF
KWAZULU-NATAL

RESEARCH OFFICE (GOVAN MBEKI CENTRE)
WESTVILLE CAMPUS
TELEPHONE NO.: 031 – 2603587
EMAIL : sshrec@ukzn.ac.za

22 JANUARY 2010

MRS. S BENI (931355853)
SCIENCE, MATHEMATICS AND TECHNOLOGY EDUCATION

Dear Mrs. Beni

PROTOCOL REFERENCE NUMBER: HSS/0922/09D
PROJECT TITLE: "INTEPRETATION, IMPLEMENTATION, INTEGRATION: TEACHING NATURAL SCIENCE IN THE FOUNDATION PHASE"

EXPEDITED APPROVAL

This letter serves to notify you that your application in connection with the above has been granted full approval through an expedited review process.

Any alteration s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study must be reviewed and approved through the amendment /modification prior to its implementation. Please quote the above reference number for all queries relating to this study.

PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years

Best wishes for the successful completion of your research protocol.

Yours faithfully

....

PROFESSOR STEVEN COLLINGS (CHAIR)
SOCIAL SCIENCES & HUMANITIES RESEARCH ETHICS COMMITTEE

Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

APPENDIX I: Ethical Clearance from the Department of Education

kzn education

Department:
Education
KWAZULU-NATAL

MRS S BENI
1 HIGHGATE
11 AUDLEY GARDENS
MORNINGSIDE
DURBAN
4001

Enquiries: Sibusiso Alwar

Date: 23 November 2009

Reference: 0077/2009

RESEARCH PROPOSAL: FOUNDATION PHASE TEACHERS' INTERPRETATION AND IMPLEMENTATION OF THE NATURAL SCIENCE CURRICULUM IN THE LIFE SKILLS LEARNING PROGRAMME: A CASE STUDY

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

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educator programmes are not to be interrupted.
5. The investigation is to be conducted from 23 November 2009 to 23 November 2010.
6. Should you wish to extend the period of your survey at the school(s) please contact Mr Sibusiso Alwar at the contact numbers above.
7. A photocopy of this letter is submitted to the principal of the school where the intended research is to be conducted.
8. Your research will be limited to the schools submitted.
9. A brief summary of the content, findings and recommendations is provided to the Director: Resource Planning.

...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 G25; 188 Pietermaritz Street; Metropolitan Building; PIETERMARITZBURG 3201

TEL: Tel: +27 33 341 8610/8611 | Fax: +27 33 341 8612 | E-mail:

kzn education

Department:
Education
KWAZULU-NATAL

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

The Director: Resource Planning
Private Bag X9137
Pietermaritzburg
3200

We wish you success in your research.

Kind regards

R. Cassius Lubisi (PhD)
Superintendent-General
8/12/2009

...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 G25; 188 Pietermaritz Street; Metropolitan Building; PIETERMARITZBURG 3201
TEL: Tel: +27 33 341 8610/8611 | Fax: +27 33 341 8612 | E-mail:

kzn education
Department:
Education
KWAZULU-NATAL

MRS S BENI
1 HIGHGATE
11 AUDLEY GARDENS
MORNINGSIDE
DURBAN
4001

Enquiries: Sibusiso Alwar

Date: 23 November 2009

Reference: 0077/2009

PERMISSION TO INTERVIEW LEARNERS AND EDUCATORS

The above matter refers.

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

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

The KZN Department of education fully supports your commitment to research: **Foundation phase teachers' interpretation and implementation of the natural science curriculum in the life skills learning programme: a case study**

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

Best Wishes

R Cassius Lubisi, (PhD)
Superintendent-General
02/12/2009

...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 G25; 188 Pietermaritz Street; Metropolitan Building; PIETERMARITZBURG 3201
TEL: Tel:+27 33 341 8610/8611 | Fax: +27 33 341 8612 | E-mail

APPENDIX J: Consent Letters

Date: February 2010

Dear Principal

RE: Consent to conduct research at your school

I am a lecturer at the Embury Institute for Teacher Education. I am currently studying towards a PhD in the Faculty of Education at the University of Kwa-Zulu Natal. My proposal, Interpretation, Implementation, Integration: Teaching Natural Science in the Foundation Phase has been accepted. The focus of the research will be teachers' interpretation and implementation of the Natural Science curriculum in the Foundation Phase programme. I request your permission to conduct the research in your school. This school was chosen for the study, as it is a government school that has grade R as well as grades 1, 2, and 3, not all government schools have a grade R class. It is also a school that has an explicit culture of learning and teaching. The sample will include the Foundation Phase HoD and teachers from grades R, 1, 2 and 3.

The duration of data collection will be based on a program of work according to a theme or context as designed by the Foundation Phase teachers and should not exceed a month. The study will consist of taking photographs and videotaping during classroom observation. Lesson plans, and learners' books will be analysed in the document analysis. Interviews will be conducted with the HoD and teachers involved in the study. The data will be stored in the School of Education at UKZN and will be destroyed after a period of five years. The project will be explained to all in terms that can be understood. Participation in this study is voluntary. Only my promoters and I will have access to information from the video and tapes.

Anonymity of the school and all the participants in the study will be maintained by using pseudonyms. The data obtained will be treated confidentially and will only be disseminated within the research community. Participants will not be placed in harm's way. As this is a study towards the fulfillment of a PhD there is no financial gain to be obtained. The school will not be implicated in any of the cost involved in this study. Participation is voluntary and all participants are free to end their involvement at any time.

Should you have any questions or desire further information, please contact:

Researcher:	Mrs Saritha Beni	Telephone: 0845776620	Email: sarithabeni@telkomsa.net
Promoter:	Dr Michèle Stears	Telephone:0312603444	Email: Stearsm@ukzn.ac.za
Promoter:	Dr Angela James	Telephone:0312603438	Email: jamesa1@ukzn.ac.za

Sincerely,

____

Saritha Beni

I, _____________________________________ (Principal) give permission for Saritha Beni (student number 931355853) to conduct the study on Foundation Phase teachers' interpretation and implementation of the Natural Science Curriculum in the Life Skills Learning Programme at my school.

Printed Principal's Name	Signature of Principal	Date

Date: February 2010

Dear Teacher

RE: Consent to participate in research

I am a lecturer at the Embury Institute for Teacher Education. I am currently studying towards a PhD in the Faculty of Education at the University of Kwa-Zulu Natal. My proposal, Interpretation, Implementation, Integration: Teaching Natural Science in the Foundation Phase has been accepted. The focus of the research will be teachers' interpretation and implementation of the Natural Science curriculum in the Foundation Phase programme. This school was chosen for the study, as it is a government school that has grade R as well as grades 1, 2, and 3, not all government schools have a grade R class. It is also a school that has an explicit culture of learning and teaching.
The duration of data collection will be based on a program of work according to a theme or context as designed by the Foundation Phase teachers and should not exceed a month.
The study will consist of taking photographs and videotaping during classroom observation. Lesson plans, and learners' books will be analysed in the document analysis. Interviews will be conducted with the HoD and teachers involved in the study. As part of the data collection, you will be asked to be part of focus group interviews. Your participation in these focus groups should not exceed half an hour. The focus group discussion will be videotaped so the comments can be captured in transcript for analysis. Every effort will be taken to protect your identity as a participant in this study. Every endeavour will be made to protect your confidentiality. The data will be stored in the School of Education at UKZN and will be destroyed after a period of five years. The project will be explained to all in terms that can be understood. Participation in this study is voluntary. Only my promoters and I will have access to information from the video and tapes.
Anonymity of the school and all the participants in the study will be maintained by using pseudonyms. The data obtained will be treated confidentially and will only be disseminated within the research community. Participants will not be placed in harm's way. As this is a study towards the fulfillment of a PhD there is no financial gain to be obtained. The school will not be implicated in any of the cost involved in this study. Participation is voluntary and all participants are free to end their involvement at any time.
Should you have any questions or desire further information, please contact:

Researcher:	Mrs Saritha Beni	Telephone: 0845776620	Email: sarithabeni@telkomsa.net
Promoter:	Dr Michèle Stears	Telephone:0312603444	Email: Stearsm@ukzn.ac.za
Promoter:	Dr Angela James	Telephone:0312603438	Email jamesa1@ukzn.ac.za

Sincerely,

____

Saritha Beni

I, ____________________________________ agree to be part of the research to be conducted by Saritha Beni (student number: 931355853), titled Foundation Phase teachers' interpretation and implementation of the Natural Science Curriculum in the Life Skills Learning Programme, at my school. I understand my participation is voluntary and I am free to end my involvement at any time.

________________________	________________________	______________________
Printed Teacher's Name	Signature of Teacher	Date

Date: February 2010

Dear Parent or Guardian

RE: Parental Consent

I am a lecturer at the Embury Institute for Teacher Education. I am currently studying towards a PhD in the Faculty of Education at the University of Kwa-Zulu Natal. I am conducting a research project on teachers' interpretation and implementation of the Natural Science in the Foundation Phase programme. Your child is a learner in the class that I will be conducting my research. I request permission for your child to participate in the research.

The study consists of videotaping and taking photographs of your child during classroom lesson observations. The project will be explained in terms that your child can understand, and your child will participate only if he or she is willing to do so. Only my promoters and I will have access to information from the video.

The teacher is the focus of the study. The observation will not affect or harm your child in any way. Participation in this study is voluntary. Your decision whether or not to allow your child to participate will not disadvantage your child in any way. Even if you give your permission for your child to participate, your child is free to refuse to participate. If your child agrees to participate, he or she is free to end participation at any time.

Should you have any questions or desire further information, please contact:

Researcher:	Mrs Saritha Beni	Telephone: 0845776620	Email:	sarithabeni@telkomsa.net
Promoter:	Dr Michèle Stears	Telephone:0312603444	Email:	Stearsm@ukzn.ac.za
Promoter:	Dr Angela James	Telephone:0312603438	Email:	jamesa1@ukzn.ac.za

Keep this letter after tearing off and completing the bottom portion and returning it to your child's class teacher.

Sincerely,

____

Saritha Beni (student number: 931355853)

Please indicate whether or not you wish to allow your child to participate in this project by checking one of the statements below, signing your name and returning this portion to your child's class teacher. Sign both copies and keep one for your records.

☐ I grant permission for my child to participate in Saritha Beni's study on teachers' interpretation and implementation of the Natural Science in the Foundation Phase programme.

☐ I do not grant permission for my child to participate in Saritha Beni's study on teachers' interpretation and implementation of the Natural Science in the Foundation Phase programme.

__________________________________ __________________________________

Printed Parent/Guardian Name — Signature of Parent/Guardian

__________________________________ __________________________________

Printed Name of Child — Date

Date March 2010

Dear Parent or Guardian

Ngenza izifundo ze PhD emkhakheni wezemfundo eNyuvesi yase KZN (UKZN). Ngenza ucwaningo lokuhlolisisa kahle indlela othisha abafundisa ngayo isifundo se Natural Science emabangeni aphansti okufunda. Kulolu cwaningo sidinga izingane ezifundayo njengamanje. Kuchaza ukuthi ingane yakho izoba ngomunye wezingane esizokwenza nazo ucwaningo ngemvume yakho.

Kuzoba nesikhathi lapho sithwebula izithombe nevideo uma senza lomsebenzi. Izingane zizochazelwa kahle ngocwaningo nokuthi luzokwenzeka kanjani senzele ukuthi ofuna ukubamba iqhaza angene kahle enolwazi. Konke okuqoshiwe kuzosetshenziswa yimina nabangiphethe kuphela.

Lokhukufunda kuzobe kugxile kakhulu kuthisha. Unelungelo lokusivumela okanye ungasivumeli ukusebenzisa ingane yakho kodwa akuphoqwa muntu.
Uma kukhona ofuna ukukuqondisisa kahle ungashayela kulezinombolo:

Researcher:	Mrs Saritha Beni	Telephone: 0845776620	Email: sarithabeni@telkomsa.net
Promoter:	Dr Michèle Stears	Telephone:0312603444	Email: Stearsm@ukzn.ac.za
Promoter:	Dr Angela James	Telephone:0312603438	Email: jamesa1@ukzn.ac.za

Sicela uyigcine kahle lencwadi engasentla bese ugwacwalise lena engezantsi uyithumele.

____

Saritha Beni (Student Number: 931355853)

Cacisa lapha ngezantsi ukuthi uyavumayini ukuthi ingane yakho ibe ingxenye yocwaningo nomacha. Khetha lapha ngezantsi ubhale negama lakho.

☐ Ngiyayivumela ingane yami ukuthi ibe ingxenye yocwaningo.

☐ Angiyivumeli ingane yami ukubayingxenye yocwaningo.

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Igama Lomzali Kusayina Umzali

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Igama lomfundi Date

APPENDIX K: Turnitin Report

Turnitin Originality Report

Foundation Phase teachers interpretation and implementation by Michele Stears

From foundation Phase teachers interpretation and implementation (Beni)

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CHAPTER ONE SETTING THE SCENE 1.1 INTRODUCTION Early Childhood Development (ECD) has been acknowledged as an essential focus theme for "the country's social and economic transformation and development," since the new South African political dispensation in 1994. (Department of Basic Education, 2009, p. 11) The government together with non-government organisations have formed joint affiliations to generate policies and programmes that have facilitated the advancement of ECD services. UNICEF (2006) maintains that for young children to have the best possible "start in life means ensuring them good health, proper nutrition and early learning". South Africa's ECD programme makes provision for the holistic development of children. The main purpose is to protect children's rights and to develop their full emotional, social and physical potential. Hence, the focus of ECD is to develop an "educated and healthy South African society" (UNICEF, 2006, p. 2). ECD is the initial stage of development from birth to nine years. The Foundation Phase in South Africa constitutes the latter four years of the ECD phase and thus the initial stage of schooling. This is where the "foundation for further learning is laid" (Department of Education, 2003, p. 19). The learner at this stage acquires skills, knowledge and values, which will form the basis of his or her future learning. Learners in the Foundation Phase, Grades R (reception year) - Three, could "range between 5 and 10 years of age" (Department of Education, 2003, p. 19). This is the phase when the learners' love for science should start and be nurtured so that they may develop a curiosity about the world and also become critical thinkers. It was anticipated in the RNCS (Revised Statement), the school curriculum policy approved in 2002 and implemented in 2004, that the Life Skills Learning Programme was to facilitate young learners to "develop skills, knowledge, attitudes and values" with the purpose of allowing them to "identify and solve problems and make decisions" (Department of Education, 2003, p. 74). 1.2 BACKGROUND TO THE STUDY Preceding 1994, South Africa's education system was openly segregated along racial lines. While most white learners were advantaged by a highly resourced education system with well-qualified teachers, African, Indian and Coloured1 learners were forced to accept an inferior system with few resources. Most white teachers received pre- and in-service training at well-equipped urban universities or colleges of education, while "most black teachers started teaching without even completing their own secondary schooling, much less the tertiary education that they needed" (Keevy, 2006. p. 2). The South African education and training sector started to go through momentous changes in the early 1990s due to increased pressure from the global community for transformation. According to Keevy (2006), "these developments set in motion significant systemic transformations that were formalised with the advent of the new political dispensation in 1994" (p. 2). Under this dispensation, extensive transformations were "necessary to systematically redress the inequalities that 1 African-a person from Africa, especially a black person or a black South African Coloured-a person of mixed descent. Indian- a person of Indian descent living in South Africa. 1 apartheid

APPENDIX L: Letter from Editor

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Date: 25 November 2014

To whom it may concern

This is to certify that the Doctoral thesis entitled: How foundation phase teachers interpret and implement the Natural Science Curriculum within the Life Skills Learning Programme written by Saritha Beni has been edited by me for language.

Please contact me should you require any further information.

Kind Regards

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