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Teachers' perceptions and use of questions in formative assessments in natural sciences lessons.

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TEACHERS' PERCEPTIONS AND USE OF QUESTIONS IN FORMATIVE ASSESSMENTS IN NATURAL SCIENCES LESSONS

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A research report submitted to the Faculty of Education, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Science.

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DECLARATION

I declare that this Master of Science thesis is my own, unaided work. It is being submitted for the Degree of Master of Science in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University.

MARGARET SANDRA CORNELIUS

11 day of MAY 2012

ABSTRACT

The study examined the relationship between grade five natural sciences teachers' perceptions and their use of questioning for formative assessment (FA). Literature indicates that formative assessment improves both teaching and learning. This study was conducted with thirty-three teachers from a district in Gauteng Province. They responded to a questionnaire in which they gave their opinions about questions and formative assessment. Their responses were documented quantitatively. Lesson observations were also conducted in two teachers' classes, in the same district, to establish the relationship between questioning practices and perceptions. Teacher questions were quantitatively analysed using Anderson/Bloom's Taxonomy (2005). Lesson transcripts and field notes of the recorded lessons were qualitatively analysed and discussed in themes. Findings based on the questionnaire indicated that most teachers had a poor understanding of formative assessment and were unaware of its teaching and learning benefits. In practice, the two observed teachers mostly used factual and conceptual knowledge questions but worked differently with learner responses. The observations indicate that questions, irrespective of their categorisation, could be more effectively used for formative assessment purposes. The study indicated that teachers believed that a role is played in the questioning practices by, for instance, learner language competency, socio-economic factors and lack of teacher reflection.

DEDICATION

To my parents Frederick William and Margaret Ethel (Peggy) Fick

and

my immediate family Steven, Justin and Natalie Cornelius.

ACKNOWLEDGEMENTS

Firstly all honour belongs to God who carried me through difficult times.

"Teach us how short our life is, so that we may become wise" Psalm 90 verse12

Secondly, I wish thank my supervisor and co supervisor, Audrey Msimanga and Tony Lelliot for their patience and invaluable advice.

The research would not be possible without the consent of the principals, teachers and learners who allowed me to conduct the research with them.

The financial support provided from the Department of Education.

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My helper, Rosina Vuma.

CHAPTER ONE

FORMATIVE ASSESSMENT IN NATURAL SCIENCES

1.0 INTRODUCTION

South Africa's post-apartheid curriculum has a constructivist perspective on learning and calls for shifts in teaching practices in order to involve learners consciously in the process of their own learning. Assessment research argues that these epistemological and pedagogical shifts should be matched by a similar shift in assessment form and practice (Shepard, 2000). Epistemology is the branch of philosophy that deals with knowledge while pedagogy deals with the theory of teaching. This view of assessment advocates an emphasis on formative rather than just summative assessment. According to Boaler and Brodie (2004), Formative assessment or assessment for learning makes both teachers and learners accountable in the learning process. Since learning cannot be alienated from teaching it implies that both the teacher and the learner are actively involved in their respective roles.

However, as with most curriculum change, these shifts are not easy to achieve, particularly in the South African context, where teachers are accustomed to traditional teaching practices. They struggle to adapt to a constructivist teaching approach and thus make attempts to use a combination of traditional and reform teaching. Their efforts at reform teaching are experimental because they have not truly understood or internalised the epistemology of constructivism. Moreover, they have a vague understanding of the differences and benefits of the different types of assessment. Research indicates that teachers are often confused between formative and summative assessment (Black & Wiliam, 1998; Singh, 1999). For example, Singh (1999) asked science teachers to differentiate between the two and to explain how they made use of formative assessment in their teaching. While some believed they were using it most of the time, they saw little difference between formative and summative assessment. In the interview they described their practices as summative in nature.

This study therefore intends to establish the perspectives South African teachers have of formative assessment, and how they use questions for it during their Natural Sciences lessons. The concepts relating to formative assessment are framed around

the definition given by Black and Wiliam (1998, p.10), who define it as "All those activities undertaken by teachers, and/or by their students, which provide information to be used to modify teaching and learning activities in which they are engaged."

There is considerable literature on formative assessment in developed countries (Black & Wiliam, 2000; Boaler & Brodie, 2004; Cowie & Bell, 2001) but not as much on developing countries like South Africa. Thus, the study intends to contribute to knowledge on this topic in the South African context, and explore factors that could impede effective formative assessment, also in this context. These factors might include teaching methodology (Boaler & Brodie, 2004), language of instruction, class size, time constraints (Bansilal & Wallace, 2008), and inadequate teacher competency in formative assessment. I investigated possible links between South African teacher questioning practices, their philosophy of formative assessment and factors that might impede or contribute to their effective use of formative assessment during the lesson.

1.1 BACKGROUND TO RESEARCH SAMPLE

The study was conducted in one of the districts in Gauteng province, South Africa, which comprises mainly township schools, with a few inner city and suburban schools. The language of instruction is mainly English, with several Afrikaans-speaking exceptions. Most learners receive tuition in a language that is not their primary one. Some in the suburban schools, who are either English- or Afrikaans-speaking, receive tuition in their primary language. Most teachers teach in English, which is not their primary language.

The schools are diverse, but two that were representative of this district were investigated. I confined myself to assembling data on teachers' perceptions of formative assessment from 33 Natural Sciences teachers from five clusters in the district. Lesson observations were conducted in two Grade 5 classes from the group of teachers who responded to the questionnaire.

1.2 RESEARCH QUESTIONS

Against the above background, the research questions are posed as follows:

Key Research Question

* How do teachers use questioning in formative assessment during Natural Sciences lessons?

Sub Research Questions

- What are teachers' perceptions of the role of questions in formative assessment?
- What types of questions do teachers ask during the lesson?
- What is the relationship, if any, between teachers' perceptions of questions in formative assessment and the types of questions they ask during the lesson?

1.3 LIMITATIONS OF THE STUDY

Despite conducting this research as proficiently as I could, I acknowledge that there may be a number of limitations which could affect the findings. Firstly, as a subject specialist in Natural Sciences I am responsible for curriculum management and implementation, and so work with the teachers who participated in this study, who answered the questionnaire and whose lessons I observed. Although they were willing to participate in the study I recognise that their responses and actions might not be dependable because my status might have intimidated them.

It is expected that when teachers and learners are observed by an outsider their behaviour will change (Emerson, 1995). The findings of this study are based on verbal interactions between teachers and learners during the lessons. What transpired during the lessons might not be a true account of what normally happens in the class because both the teacher and learners could have 'acted' for the research. This difficulty could have been minimized by visiting the class for a few lessons prior to recording the lessons. Possibly, when they were comfortable with my presence, the interaction between the learners and the educators might have normalised. Visiting the schools

was difficult to negotiate because these observations had to be conducted during teaching time and so necessitated taking off time from my working hours.

Although I used Anderson/Bloom's Taxonomy to categorize teacher questions, other readers might interpret the classification of the questions differently. However, my classification was based on the context of conversations during the teacher-learner interaction and through events in the class.

The responses on the questionnaires made me realize that I needed to clarify certain statements with the respondents. In some cases I could clarify but in other instances it was problematic because teachers did not give their details for follow up. In the process of analysing the transcripts, it became apparent that interviews with the two teachers were necessary. Appointments were made, but on each occasion the teachers cancelled the meetings. Since certain aspects could not be clarified there may be bias in my interpretation.

Apart from these limitations, my research was postponed during a spell of industrial action in 2010, when district officials were prevented by teachers' unions from conducting meetings and school visits. Unable to meet with teachers the research was rescheduled for the early part of 2011.

1.4 SUMMARY

This chapter has outlined the background to the research sample, posed the key research question and sub-questions. As a subject advisor for Natural Sciences, my motivation for doing the research is to improve the quality of teaching and learning in Natural Sciences lessons. Establishing teachers' understanding of formative assessment and how they use the principles of it in their questioning practice will be useful as part of my baseline study. This information will also assist me in designing appropriate development programmes. Early in the research the limitations of the study were given so that the reader could understand the research in context.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL BACKGROUND

2.0 INTRODUCTION

This literature review is intended to give an overview of formative assessment in the area of Natural Sciences and how it relates to questioning and teachers' perceptions of it. I discuss the perspectives of key researchers in the speciality of formative assessment and use the literature to develop a conceptual and theoretical framework for the study. The study revolves around the concepts of formative assessment, so from this point I will use the acronym FA when referring to formative assessment.

2.1 BACKGROUND

In South Africa the assessment guidelines provided to teachers by the Department of Education (DoE, 2007a), encourages teachers to implement four categories of assessment strategy in their classroom practice. These are: baseline, diagnostic, summative and formative assessment, each designed and conducted by teachers in schools. *Baseline assessment* attempts to establish what the learners know about a particular concept, and it is used before the teacher introduces a lesson. *Diagnostic assessment* focuses on isolating strengths and weakness of learners, so that nurturing or remediating action can be taken with the learner. *Summative assessment* is used for reporting progress of a learner at a given time. The purpose of the fourth type, *FA*, is to inform teachers how learners understand concepts and how to improve future learning. All these forms of assessment are used to report to parents, determine progression, identify barriers to learning, support development of learners, provide information for the evaluation of learning programmes and maximise learners' access to knowledge (DoE, 2007b).

According to Bell and Cowie (2001a), assessment in the United States of America (USA) in 1999 served summative, formative and accountability purposes. The authors also identified the purposes for assessment in New Zealand in 1993 as improving students' learning and learning programmes, feedback to parents and students, awarding qualifications and monitoring national educational standards. These

purposes are similar to those expounded of the Department of Education (DoE) in South Africa. Accountability assessment, as described by Bell and Cowie, is a driving force that directs changes in practice and policy by holding people accountable for achieving the desired reforms. Summative assessment is a means of monitoring educational progress or improvement, letting teachers, policymakers, parents and the public know how much students are learning compared to the standard of performance or to their peers. According to Bell and Cowie, (2001a) FA serves both the teachers and learners. The teachers receive feedback on the effectiveness of learning so that they can optimise learners' learning, whilst the learners use the feedback to know what they understand and are able to do. This means that teachers use the feedback from FA to review their classroom practices and the students to monitor their own learning.

My understanding of FA concurs with Bell and Cowie (2001a), in that it benefits teachers and learners in determining whether teaching and learning is effective. This is accomplished as teachers design investigative tasks to determine how effective their teaching has been or how learners have learnt. Therefore, it is crucial the teachers structure their tasks with the intention of eliciting this information. According to Black (2001), however, although there is strong evidence that FA raises the standard of learner achievement, appropriate assessment practices are not implemented in most classrooms. The assessment tasks do not provide appropriate information for the teacher to determine the efficacy of the lessons, thus, the teacher needs to establish clear objectives for them, dependent on his or her content knowledge and understanding of the reason behind them.

These aspects are relevant to all classes in South Africa, where assessment policy also expects teachers to identify and assist learners who experience learning barriers (DoE, 2007a). In Natural Sciences, examples of these barriers might include misconceptions, errors and knowledge gaps that impede future learning in the higher grades. All teachers, including those of Natural Sciences, are expected to address the learning barriers experienced by learners. My experience as a teacher placed me in the precarious position of having to recognize learners' weaknesses and strengths as well as assess the impact of my teaching. This task was daunting because I had limited capacity to do this with certainty. I had to devise my own strategies of stimulating stronger learners and remediating weaker learners in my classes. Some of the

challenges I experienced related to testing for understanding in multilingual, oversized classes with varying ability groups. Furthermore, I headed the School Based Support Team (SBST), tasked with assisting teachers to find strategies to help their learners. The only way the SBST could support their peers was to suggest strategies, collated from collaborative teaching practices. The support the SBST offered to teachers was based on experience rather than research or training.

Teachers normally try to comply with the ideals of policy (Vandeyar, 2005), but with limited support, resulting in disparity between policy and its implementation in practice. Teachers implement intervention strategies in FA for which they are not prepared. My experience confirms the gap identified by Sanders and Nduna (2010), between theory and practice in the implementation of the National Curriculum Statement (NCS). Ideally, teachers should, through their own efforts and aided by the DoE, be continuously updated on research in education in an attempt to make the implementation of policy more effective, and so inform their practice by theory or research.

Against this background, the study aims to shed light on how teachers use FA to identify learner weaknesses and strengths, and so teach more effectively. The findings should enable me as a subject specialist to encourage teachers to use FA to explore learners' thinking and to improve teaching and learning.

2.2 NATURAL SCIENCES

In South Africa, the purpose of teaching Natural Sciences, according to the NCS, is to promote scientific literacy, to use scientific knowledge, to apply process skills, and to acknowledge the relationship between science, society and the environment (DoE, 2007a).

With this purpose in mind, three learning outcomes for Natural Sciences were designed:

1. Scientific Investigations: The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.

2. Construct Science knowledge: The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.
3. Science, Society and the Environment: The learner will be able to demonstrate an understanding of the interrelationship between science and technology, society and the environment.

During the teaching of Natural Sciences, learners are expected to achieve in all these three learning outcomes with the assistance of the teacher. Teachers, on the other hand, are expected to ensure that the purposes of teaching Natural Sciences are incorporated in assessment of learners.

Although there are different forms of assessments, this study will discuss and compare four, viz., baseline, summative, diagnostic and FA. *Baseline assessment*, normally conducted by the teacher, seeks to establish the knowledge learners have before teaching begins. The teacher starts teaching appropriate material from the background learners have. *Summative assessment* tasks are commonly referred to as 'formal assessments' in South Africa, which, like assignments, projects and exams are designed by teachers to gather information on how learners processed subject content. The purpose of formal assessment is to report progress to parents, the school administration as well as the learner on his/her progress (DoE, 2007b). Vandeyar and Killen (2005) state that some teachers find designing summative assessment a mammoth task because they are unskilled. *Diagnostic assessment* has similarities to FA, seeking to determine learners' strengths and weaknesses or inappropriate teaching methodology so that appropriate intervention or remedial action can be put in place (DoE, 2007a). Specialists normally carry out this assessment to determine the nature and cause of medical barriers to learning. *FA*, on the other hand, assesses learners in an informal way. The main purpose of informal FA is to gather information during daily activities about the learning and teaching processes so as to shape future teaching and learning. Informal assessment could be planned or unplanned and the information assembled is not used for progression purposes but rather to improve teaching and learning.

Regarded as pivotal to learning, this study focuses on Grade 5 Natural Sciences teachers and their perceptions and use of FA in their lessons. The literature pertaining to it is discussed below.

2.3 TEACHERS' PERCEPTIONS OF ASSESSMENT

Teachers have their own paradigm of assessment and find difficulty adapting to change, especially when educational policy on teaching and assessment may conflict with their beliefs and value systems (Vandeyar, 2005), which according to Gipps (1994) frame how people make sense of the world and solve problems. Policy changes in South Africa following 1994 were evident as teachers tried to implement Outcomes-based Education (OBE). Vandeyar also suggests that teacher perceptions and implementation of policy with respect to teaching and assessment depends on personal and social perceptions as well as teacher competencies. Her study with teachers in primary schools demonstrated a strong correlation between professional confidence and professional consciousness. Teachers with these attributes tried to balance their professional ethics with their interpretation of educational policy and practiced assessment accordingly. Those with low professional confidence were more amendable to policy and tried to conform to it. Vandeyar and Killen (2007) classified teachers' views of assessment, and classified them as:

- useful for obtaining information from learners in order to improve their teaching and learners' learning
- useful for accountability for their learners' learning
- a process by which teachers and schools are made accountable
- irrelevant to the work of teachers and the life of learners.

My view of FA ties in with the perception that assessment is useful for obtaining information for improving teaching and learning. Vandeyar and Killen (2007) list characteristics of teachers who maintain this epistemology as follows:

- They integrate assessment into their teaching, where they cannot divorce assessment from teaching.
- They emphasize formative rather than summative assessment, which means that assessment is viewed as a tool for improving learning rather than a measure to report on it.

- They take responsibility for learning, which implies that they view their teaching instrumental in the way learners learn.
- They use informal means of assessment such as questioning and observations to determine how effective their teaching has been.
- They encourage learners to take academic risks because these are viewed as opportunities to improve learning.
- They reward academic effort and good results, which acknowledges learners' effort and encourages them to persevere.

The characteristics listed above provided guidance in understanding how teachers should practice FA in their lessons.

2.4 CONCEPTS OF FORMATIVE ASSESSMENT

Researchers in the field of FA have given their own interpretation of FA, depending on which facet of it interests them. Amongst definitions by some of the leading researchers in the field are the following:

Sadler (1989, p.120):

> Formative assessment is concerned with how judgments about the quality of student responses (performances, pieces, or works) can be used to shape and improve the student's competence by short-circuiting the randomness and inefficiency of trial-and-error learning.

For Black and Wiliam (1998, p.10) it is "All those activities undertaken by teachers, and/or by their students, which provide information to be used to modify teaching and learning activities in which they are engaged", whilst Bell and Cowie (2001b, p.536) and Cowie and Bell (1999 p.101) define it as: "The process used by teachers and students to recognize and respond to student learning in order to enhance that learning, during the learning (sic)."

The DoE (2007a, p.2) defines FA as assessment that provides:

> … information about learners that they can use to deepen their understanding and the teacher can use to shape future learning.

FA is commonly and concisely described as "assessment for learning" (Bell & Cowie, 2001a& b)

Accordingly to literature, FA has great benefits to teaching and learning. Leahy, Lyon, Thompson and Wiliam (2005), and Hargreaves (2005) suggest establishing an implicit contract of shared responsibility to learning by teachers and their learners. This strategy makes both educators and learners accountable role players. Learners are no longer viewed as passive recipients of knowledge, but rather they are expected to be actively involved in their learning, through self-assessment and working with teacher feedback. The teacher is therefore considered as the mediator between learning and the learner.

Since learning cannot be alienated from teaching it implies that the teacher and the learner are actively involved in their respective roles. Natural Sciences Assessment guidelines state that assessment is an integral part of teaching and learning. Lambert and Lines (2000) are more specific, stating that FA is an integral part of teaching and learning. Furthermore, it is an active process during the lesson as the teacher questions learners to measure their understanding. The feedback teachers get back from the learners will indicate whether the teaching process is appropriate for the learners. Depending on the responses the educator will adapt the lesson.

Black (2001) suggests that there is strong evidence that FA raises the standard of learner achievement if appropriate assessment is implemented in classes. Using questions is a common form of FA. Questions can be used economically in lessons and are time-effective in that many learners are reached in the same lesson. Through questions and answers the learners learn from their peers' answers and the teacher in turn learns from the learners' responses. It is cost-effective in that no special resources are needed. The most expensive input on the teacher's part is preparation of questions and listening attentively to learners' responses. In this manner the educator could improve teaching so that all learners benefit from their teaching method. These benefits are relevant to a multilingual, multicultural environment like South Africa, with its limited resources. The South African teacher is mandated to provide every learner with the best possible teaching and assessment approach to suit different learners and their learning styles. The advantage of FA is that the teacher can determine if the teaching is suited to the learners and can therefore change their teaching and assessment to the needs and contexts of the learners.

Cowie and Bell (1999) distinguish between two kinds of FA, namely *planned* and *unplanned* (interactive assessment). They describe planned FA as eliciting

information from learners using planned, specific assessment activities, interpreting and acting on the information. Unplanned FA, also known as 'interactive assessment', entails taking notice of learning in the context of learning activities, recognizing and responding. A difference between the two relates to the use of physical evidence from learners' work. In planned FA physical evidence is required, whereas in unplanned assessment the emphasis is on interaction between the teacher and learner. They state that in planned FA teachers prepare before the lesson, for example an oral test of ten short questions. As the name indicates, the teacher does not need to prepare before the lesson for unplanned or interactive FA, but during the lesson acts responsively during interactions with learners. From this point on, I will be using the terms 'unplanned FA' and 'interactive questioning' interchangeably, and as the focus of the research.

2.5 CONCEPTUAL FRAMEWORK

My conceptual framework is based on work by Black and Wiliam (1998), Cowie and Bell (1999), Bell and Cowie (2001), and Hargreaves (2005). They all concur in principle that FA is a means to improve teaching and learning through the process of assessment. Therefore, my framework is structured around the ideas teachers have about FA and how it influences the questions they use in their lessons. Research conducted by Hargreaves (2005), on the conceptions of teachers of FA, proved beneficial to my study. Her study contributes to the understanding of teachers' ideas about FA. She also claims that teachers' conceptions lay the foundation of assessment practices in classes. Her discussion on FA is thorough but ultimately she concludes that its practices are driven by two conceptions of learning. Some teachers' assessment practices are influenced by learning to attain objectives. These teachers will be motivated to improve learners' learning to reach certain targets through such strategies as monitoring, using assessment to inform them what steps to follow next and give feedback. Other teachers' assessment practices will be motivated to assist their learners to learn for constructing knowledge. These teachers would want to know how learners learn, help them to take control of their own learning (Sadler, 1989), and turn assessment into a learning event.

It was anticipated that determining teachers' thoughts of FA would be difficult because they might not be able to articulate themselves in their responses. With this in

mind, interpreting their responses was crucial to the study. The validity of the interpretation relied on the clarity of questions posed in the questionnaire and the impartiality of the researcher when analysing the responses.

Black and Wiliam (1998) hold strong views about the importance of feedback in FA to both the teacher and the learner. Through it, the teacher is able to assess how effective the teaching has been and how to modify future teaching. On the other hand, feedback to learners enables them to assess their own learning. Feedback therefore formed an essential part of the theoretical framework in this study. The research investigated this through teacher responses in the questionnaire and through analysing questions used in the observed lessons.

In the light of such arguments as posited by Black and Wiliam (1998), and Bell and Cowie (2001), Dunn and Mulvenon (2009) agree that FA results in the improvement of learners. However, Dunn and Mulvenon (2009) differ slightly in opinion in that they believe there is insufficient empirical evidence to support the claim that FA always results in the improvement of learners. In their article, Dunn and Mulvenon (2009, p.9) say that:

> …they do not argue that formative evaluation is unimportant, only that limited empirical evidence exists to support the "best practices" for formative evaluation. In particular, limited evidence investigates the group that may benefit the most from formative evaluation, low performing students.

Underlining the theory of FA is the notion that teachers' pedagogic content knowledge (PCK) plays an important role in formative questioning. According to Van Driel et al., (1998), this is how teachers interpret and transform subject-matter knowledge in the context of facilitating student learning. Shulman (1986) categorises PCK into subject matter, pedagogical knowledge and curricular knowledge. These three categories are important for teaching and essential for FA, because the teacher uses experience and subject matter to select the best methods of presenting and extracting information from varied learners. Therefore, PCK played an important part of my theoretical framework.

The use of PCK is illustrated by a study conducted in South Africa by Bansilal and Wallace (2008), who used interactive questioning and observed interactive FA to examine how the teacher interpreted and implemented the National assessment in a

diverse South African Mathematics class. The teacher used her teaching experience and knowledge of her learners' background to pose questions and guide them in responding to common assessment task. The analysis of the study indicated that there are numerous learning hindrances and that teachers must be aware of them when questioning learners. The study concluded that teachers' knowledge of the learners and their home environments will influence the questions asked. This feature needed to be considered to see how the teacher integrates the learners' social situation with appropriate questions, and whether the teacher scaffolds their learning through appropriate questioning. Teachers will most likely pitch their questions according to the level of their knowledge and confidence in the subject. It is for this reason that types of questions teachers pose and how they interact with the responses learners give was considered in the study.

Cowie and Bell (1999) identified teacher experience as pertinent to implementing FA. Studies by both Taber (2005) and Bansilal and Wallace (2008) concur with those of Cowie and Bell (1999), that teachers' pedagogical content knowledge, as well as preparedness, intent and knowledge of learners, are essential factors for designing effective FA. Questioning, according to Boaler and Brodie (2004), is a critical and challenging aspect of teachers' work. Asking good questions makes a demand on teachers' cognitive, pedagogic content knowledge.

2.6 ANDERSON / BLOOM'S TAXONOMY

Anderson/Bloom's Taxonomy was selected for analysing questions because questions are multifaceted, for example, a learner's conceptual knowledge can be assessed on different cognitive levels. Anderson and her colleagues addressed this type of scenario by revising Bloom's taxonomy to accommodate additional educational objectives and advances in cognitive psychology. Firstly, they changed Bloom's cognitive noun forms (knowledge, comprehension, application, analysis, synthesis, and evaluation) into verbs, which explain the actual assessment activity that takes place (remembering, understanding, applying, analyzing, evaluating and creating). They then refined knowledge into four sub-categories, viz., factual knowledge, conceptual knowledge, procedural knowledge and meta-cognitive knowledge domains. This refinement will be referred to henceforth as 'Anderson/Bloom's Taxonomy'. These

modifications and improvements were organized into a two dimensional table (below):

Table 2.1: Modifications and improvements of Anderson/Bloom's Taxonomy

The Cognitive Process Dimension						
Knowledge dimensions	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual knowledge						
Conceptual knowledge						
Procedural knowledge						
Meta-cognitive knowledge						

Source: Anderson, Krathwohl et al. (2001)

Six lessons were observed and recorded, and transcripts made of each to document all the verbal interactions. All the teacher questions were extracted from the transcripts and analysed using Anderson/Bloom's (2005) taxonomy, in the context of teacher-learner talk.

2.7 QUESTIONING

The teaching method used during a lesson sets the scene for assessment to include questioning. In a study conducted by Boaler and Brodie (2004) it was observed that teachers who taught traditionally questioned learners less and largely used factual questions. Those who used reform teaching methods, such as learner-centred teaching, learner discussions, group work, and self-discovery methods, questioned more and addressed more probing and conceptual type questions. Teachers who taught traditionally used lower order questioning for assessment as opposed to teachers who used reform teaching. Different levels of questioning can be assessed using Bloom's taxonomy. Bloom and his colleagues, according to Krathwohl (2002), believed that this taxonomy provided a common language communication about learning goals across subjects and grades. The taxonomy grouped similarity of activities and assessments in various curricula and gave various views of educational possibilities. The original taxonomy provided carefully developed definitions for each of the six

major categories in the cognitive domain, namely knowledge, comprehension, application, analysis, synthesis, and evaluation. Knowledge was considered generic in Bloom's original taxonomy.

Generally, teachers use questions continuously during the course of their lessons, at most times unplanned as they assess their learners but are unaware that this is FA (Bell & Cowie, 2001). Teachers' lack of awareness of doing FA shows the tacit nature of FA described by Bell and Cowie (2001). From the responses by learners, teachers may take cognizance of learners who have or have not grasped concepts. They may also sense whether that they have successfully conveyed concepts of the subject by the way learners respond to questions (Bell & Cowie, 2001). The responses the learners give calls the teacher to action, which may benefit the learner if the teacher simplifies questions or scaffolds the questions to guide their thinking when the learner has difficulty in responding to them. Alternatively, the teacher could use the responses to challenge learners who show clear knowledge and understanding of the concepts. Teachers need to be flexible in their questioning strategy by addressing challenges and improving teaching to cater for the needs of all the learners. Learner responses could simply be a rehearsal of existing knowledge rather than creating or applying scientific knowledge to real-life experiences. Lealhy et al. (2005) suggest that teachers listen for preconceived correct answers instead of listening to find out how their learners have processed knowledge. The authors therefore suggest that teachers prepare well-orchestrated questions that seek to assess learners understanding. Apart from preparing explorative questions, Robertson (2009) suggests that teachers need to probe learners' answers because correct ones do not necessarily mean that learners understand concepts.

Questioning can be conducted in different ways for FA. Learners could be questioned individually, focusing on one learner at a time, or the teacher could question learners while doing tasks or questioning groups as they carry out activities. Questioning can be done as learners work in groups, by listening to their discussions and asking group questions. Lessons could also involve unplanned and planned question and answer sessions. Whichever questioning approach the teacher selects, the emphasis should be on maximizing learning. Therefore, the responses learners give should provide teachers with feedback on enhancing teaching or helping learners to understand how to improve their learning. This approach I believe is non-threatening and provides

learners with opportunities to express their thinking freely. In addition, this approach enables the teacher to achieve a realistic understanding of learners' progress.

This study intended to establish the relationship between teachers' views of FA and their teaching practices in the light of the previous discussion. I observed lessons and analyzed teachers' questions to determine if they matched all levels of Anderson/Bloom's taxonomy.

2.8 SUMMARY

This chapter has presented the background to selecting this topic for research purposes. The literature discusses the expectations of the Natural Sciences teachers in assessment in the South African context. Discussions about previous research highlight the concepts and benefits of FA, and provide the conceptual and theoretical frameworks for the study. Questioning strategies for implementing FA were discussed to emphasise how teacher perceptions can influence questions they use in their lessons.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 INTRODUCTION

A research methodology provides a philosophical framework for the researcher, which guides and influences the collection and analysis of data. The data is collected[1] in a systematic and purposeful manner then analysed in response to a specific research question (McMillan & Schumacher, 1993). This chapter describes the methodology used to execute the research and explains the selection criteria of the participants, the methods employed, and the instruments used to measure and analyse the observations.

3.1 RESEARCH DESIGN

A quantitative questionnaire investigated 33 teachers' perceptions and use of questions in FA. From this group two teachers were selected for the qualitative study because their responses seemed interesting to pursue. They gave information willingly and agreed to be observed. The quantitative study was followed by a qualitative study of six lesson observations, comprising three lessons in each of the two teachers' classes. The interaction between the learners and teachers was audio recorded and analysed. During the lesson observations, field notes were documented to capture salient information about the classroom context. Data was assembled from quantitative and qualitative sources to evaluate whether the two sources supported each other (Maree, 2007). Mixed methods were employed as part of a research design intended to collect information from various settings, sources and perspectives. By using varied data collection methods a relatively holistic view of the research question can be determined. Collection of quantitative and qualitative data can be done sequentially or, as in this case, concurrently, which allowed that gathered from the one method to guide further investigation. For example, the responses from the questionnaire helped clarify the nature of the research problem and further assisted in

[1] Although 'data' is the Latin plural of datum it is generally treated as an uncountable 'mass' noun and so takes a singular verb (*Concise Oxford English Dictionary*, 2011, Eds. Stevenson & Waite).

understanding the qualitative dynamics of questioning during the lessons. Thus, mixed methods combine with philosophical understanding to answer the research question.

3.2 RESEARCH PARADIGM

Opie (2004) defines a paradigm as a basic set of beliefs or views that guide action. Researcher's beliefs can be determined by the way she/he acquires knowledge and communicates it to others in the context of the research. The acquisition and communication of knowledge to others is referred to as *epistemology*. This study was conducted from an anti-positivist position because it dealt with teachers' practices and their ideas about FA. Teachers' comments about their teaching practices could not be measured or quantified, thus the information they provided was subjective. Their comments about their teaching were likely to be individualistic and incorporate their own value systems. In addition, the interpretations I made from the lesson observations revolved around my personal views and experiences, which were also subjective. Looking at the nature of the subjectivity of the data, the best approach was therefore considered to be anti-positivist.

3.3 THE SAMPLE

Purposeful sampling was used because the respondents (Grade 5 Natural Sciences teachers) were more likely to have some knowledge about assessment practices and thus provide me with useful information needed to answer the research questions (McMillan & Schumacher, 1993). The sample was chosen from a district of Gauteng, which consists of 98 schools distributed in five clusters. As a subject specialist in Natural Sciences it is expected that I hold meetings with teachers to inform them of curriculum changes and to offer them support. Normally a meeting of this nature is arranged once a term in each of the five clusters. I used the opportunity to distribute the questionnaires to approximately 98 Grade 5 Natural Sciences teachers at these meetings and 33 teachers responded voluntarily. Two teachers were selected from two different clusters to collect qualitative data based on lesson observations. One teacher defined FA reasonably well while the other had difficulty doing so.

3.4 THE QUESTIONNAIRE

The questionnaire (see Appendix 4) was divided into three sections. *Section A* solicited demographic information, for example, the primary language of the learners, language of instruction, class size and qualification of the teacher. The demographic information was assumed to reveal relationships on how teachers used their training and experience to assess learners within their various contexts.

Section B requested teachers to reflect on their questioning strategies and to provide support for their responses. Generally people have varying degrees of beliefs and opinions which reflect fairly accurately (McMillan & Schumacher, 1993). A Likert scale was used to allow them to express how strongly or weakly they felt about a statement relating to assessment strategies (McMillan & Schumacher, 1993). Section B further explored their motivation and strategies for assessing learners' prior knowledge, and how they posed different questions (Anderson, 2005). According to Anderson (2005), many teachers are familiar with Blooms taxonomy: knowledge, comprehension, application, analysis, synthesis and evaluation, so the questionnaire aimed to ascertain whether this was true for the sample of teachers and how they motivated for using different questioning strategies in their lessons.

Open-ended questions in *Section C* required teachers to reflect and express their thoughts or opinions of FA. This section of the questionnaire aimed to reveal the types of question teachers thought their learners would best be able to answer and why. Open-ended questions give respondents an opportunity for personal reflection and allow them to answer freely without the researcher influencing them with preconceived ideas (Opie, 2004). The responses would be more challenging to analyse but different perspectives, which would emerge from the teachers, would enrich the study.

The main reason for dividing the questionnaire into three sections was to gather different types of data. Furthermore, answering similarly styled questions could lead to boredom and fatigue by the teachers and thus affect the reliability of the responses. Each of the three sections had variation in question styles and the length of the questionnaire was also considered. Maree (2007) suggested completion time for an adult to answer a questionnaire as less than 30 minutes, which would have given the

respondents approximately one and a half minutes to answer each of the 17 questions, however, they were allowed to finish at their own pace with no time limit.

3.4.1 Piloting the Questionnaire

Piloting a questionnaire is strongly recommended (McMillan & Schumacher, 1993; Opie, 2004), in this case with three teachers, subsequently excluded from the main study. Appointments were made with each at their respective schools, and the questionnaires completed in my presence. When they encountered problems with the questions they were allowed to seek clarification and potential problems were solved with the teacher. Based on the combined suggestions of the three piloted teachers, the questionnaire was refined and amended. In doing so the suggestions given by Opie (2004) to improve the validity and reliability of the final instrument were adhered to.

3.4.2 Administering the Questionnaire

The initial distribution and collection of the questionnaire was planned for the third term of 2010 but, as mentioned above, industrial action by a teachers' union prevented district officials conducting meetings, so the research was delayed until the first term of 2011.

The questionnaires were handed out during cluster meetings with teachers in 2011, with some teachers completing them at the meetings and others requesting me to collect them at a later stage. They were informed that answering the questionnaire was voluntary and they could choose to remain anonymous. The questionnaire, took approximately 40 minutes to complete during the meetings, but it was not possible to determine how long was taken by those who answered in their own time. Nor was it possible to determine if the latter used resources or consulted their peers when answering the questionnaire.

After the questionnaires were collected and scrutinised, two teachers were selected and invited for the lesson observation. The observation looked for patterns of social dynamics between teacher and learner in relationship to FA behaviour, and to understand and make sense of the interaction from a participant observer's viewpoint

(Maree, 2007). The data gained from the observation was used to acquire a deeper insight and understanding of the formative questioning interaction being observed.

3.4.3 Analysis of the Questionnaire

The questionnaire was divided into three sections, Section A, Section B and Section C. *Section A* was generic but Section B and C specifically dealt with information regarding Natural Sciences. The information obtained in Section A, enriched the analyses of the study by showing the demographics of the schools. It deepened understanding of how the teacher dealt with the dynamics of language and class size.

Section B dealt with structured questions to elicit responses from teachers about their questioning practices, and further explain their responses. The questions particularly solicited information about how they dealt with learners' prior knowledge, the questions teachers frequently used and how often they questioned learners to show integration and application of what they had been taught. An ordinal scale (McMillan & Schumacher, 1993) was included so that teachers could approximate how often they rated themselves in terms of the questions. The responses from this section were counted and the raw data is given in Appendix 5. Chapter 4 discusses these three questions in relation to the responses, explanations and their frequency.

Section C posed open-ended questions related to questioning practices in formation assessment. The responses varied as expected, but similar ideas emerged which were grouped and counted (the raw data is given in Appendix 5). Each question was discussed in relation to the number of respondents who had similar responses. These questions were only discussed if the responses were more prevalent. The rationale for this selection was to consider what most teachers believed. The other responses are interesting and would have enriched the study, and could be investigated in further research papers at a later stage.

3.5 SELECTION CRITERIA FOR LESSON OBSERVATION

The second part of the research entailed lesson observations. To determine how the selected teachers use questioning in FA, data was collected using field notes and audio recordings of the lessons. Together with responses from the questionnaire, these

sources provided 'triangulation', which Opie (2004) defines as a method of checking for data quality or credibility. More specifically, I employed 'procedural triangulation', by which the subjects and the researcher remained constant but the procedures used to collect the data were different.

Fifteen of the 33 teachers wrote their names and those of their schools on the questionnaires. They had been told that by doing they would be conveying their willingness to participate in the study and to the observations in their classes.

The selection of the two teachers for this study was based on the analysis of their answers from the questionnaire. Schools from which they were selected were given pseudonyms. Previously a model C school accommodating Afrikaans learners prior to 1994, "*Geranium*" Primary School was located in the suburbs. Many of the Afrikaans classes have since been replaced by English ones, in part because of the number of African learners enrolled in the school. The school governing body (SGB) adapted the language policy to cater for the African learners. The LOLT's in the school were English and Afrikaans, though the learners involved in this study were taught in English. The teacher at Geranium Primary indicated that FA was used to monitor the learning and teaching process as well as keeping the teacher in line with performance.

The other school, "*Rose"* Primary, was located in the township and traditionally catered for African learners who were previously (and still are) disadvantaged. As with Geranium Primary, the learners here are taught in English, even though it is not their first language. The teacher at Rose Primary indicated that FA was for recording purposes, covering all the assessments standards and learning abilities of the class. Based on these responses it seemed that the teacher at Geranium Primary understood the concept of FA better than those at Rose Primary.

The second reason for selecting these two teachers was that they taught in two different contexts. Geranium Primary was a suburban fee-paying school, so it was assumed the learners came from families who were on average economically well off. The teacher was Coloured and could not speak any African language, which meant that she was unable to code switch for her learners. On the other hand, Rose Primary was situated in the township. It is a non-fee paying school and the learners come from families who are on average economically disadvantaged. The teacher was African and able to code switch for her learners.

3.6 SEQUENCE OF CLASS ROOM OBSERVATION

Data collection of the lesson observation took place over a period of two and a half weeks (Table 3.1, below), and focused on two Grade 5 Natural Sciences classes. Single 30-minute periods were audio recorded and field notes taken. Deviation from the scheduled class observations occurred at both schools at the teachers' request.

The continuity of the lessons at Geranium Primary was interrupted by a scheduled class test and a sporting event which the teacher attended. In addition, the teacher indicated that she had personal problems, which might have impacted on her teaching.

At Rose Primary the continuity of the lessons was interrupted by one day, on which no Natural Sciences lessons took place and the teacher telephoned to cancel the lesson.

Table 3.1: Sequence of the lessons

School	Date	Type of Lesson	Content
Geranium Primary	28 February	Question and answer on homework activity.	Identify, classify animals and say something about them.
Geranium Primary	2 March	Discussion. Question and answer lesson.	Vertebrate and Invertebrates
Geranium Primary	7 March	Revision of a test through question and answer.	Seeds, weathering, soil, ecosystem and pollination.
Rose Primary	8 March	Revision combined with question and answer lesson.	Habitats
Rose Primary	10 March	Show and Tell with question and answer.	Animal and its adaptation
Rose Primary	15 March	Question and answer lesson.	Adaptation

3.7 THE LESSON OBSERVATION

Each lesson was observed and recorded over three teaching days, (see Table 3.1, above). All six lesson recordings were transcribed and analysed to identify different

types of questions, many of which could be categorised according to Anderson/Bloom's taxonomy but some not. All the question types were documented and counted.

Three audio recorders were used in the class but the three recordings of each lesson were very similar. Much of the learner talk was not captured in the recordings because it was indistinct. Interactive conversations between the teachers and the learners were mainly captured by the recorders. In many cases the learners answered softly, perhaps because they were normally passive and do not like answering, had a fear of being recorded, or because of my presence. To minimise the effect of the latter I sat on a learners' bench at the back of the class. The transcripts therefore reflect only part of the dialogues during the lessons.

3.8 FIELD NOTES

Records were taken during the lesson observations and recorded in a journal. Maree (2007) suggests that the researcher keep accurate records by making use of all senses, noting the social setting, and capturing events that the recordings are not able to capture, for example, seating arrangements, teaching aids, class size and interactions between the subjects being observed. Emerson (1995) advocates taking field notes discretely so that subjects are not aware that they are being studied, and suggests writing notes shortly after the events to retain the crispness of the interactions.

The observations were reflected on every evening after the lesson in order to maintain the freshness of the events. Although the field notes were not the main source of data, they provided triangulation together with the audio recordings and questionnaire responses. The notes were dated and the location, rough drawings of the seating arrangement and resources given to the learners recorded to link the context with the audio recording of the day when the observation was complete. These notes provided me with guidance when I analysed the transcripts. When a problem was encountered with transcription the field notes would assist in putting the events and conversations into perspective. This provided the perspective of interactions, which I believe allowed me to analyse the transcripts. It also assisted capturing the events of that particular day of the observation. Maree (2007) suggests that observations are highly selective and subjective, and suggests that the researcher be aware of personal biases

and so devise means to limit them. McMillan and Schumacher (1993) suggest making notes on when, who, what, how and why an activity occurred. During the observations, the interaction of the teacher and the responsive learners were mainly focused on. It was impossible to note discreet interactions between the teacher and other learners.

3.9 ANALYSIS OF THE TRANSCRIPTS

Transcripts were made of each lesson. All types of questions asked by the teacher in each lesson were selected and classified using predetermined categories, a process of sorting data known as *a priori* coding (Maree 2007). The categories were derived from Anderson/Bloom's taxonomy (2005), with the six original categories subdivided into four different knowledge dimensions (Table 3.2, below):

Table 3.2: Anderson/Bloom's taxonomy

The Cognitive Process Dimension						
Knowledge dimensions	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual knowledge						
Conceptual knowledge						
Procedural knowledge						
Meta-cognitive knowledge						

Source: Anderson, Krathwohl et al. (2001)

Questions were counted and coded based on this classification. Every lesson had its own table with an analysis of questions recorded in that lesson. Apart from the questions defined in Anderson/Bloom's taxonomy, other types of questions arose. They were analysed in context of the lesson and grouped into the following categories: validation, instructional, confirmation, articulation and clarification. In these cases they were counted and added to the table under their own categories. This is an example of emergent categories, which Maree (2007) describes as 'inductive

coding'. All the transcripts were examined holistically to investigate themes that consistently emerged in both classes. Extracts from the transcripts were selected and discussed, to illustrate these themes in line with the literature and observations.

At times, statements that would normally not be regarded as questions were included, because teachers would add "*ne*?" or "*akere*?", respectively "is it not?" and "do you agree?" These question tags were used rhetorically by the teacher, given as a signal for learners to express agreement. In some instances, questions could not be classified according to Anderson/Bloom's taxonomy, in which cases I constructed my own categories. In other cases I used categories devised by Mortimer and Scott (2003).

3.10 SUMMARY

Mixed methodology, with both quantitative and qualitative data collection, was used to answer the research question. Thirty-three teachers responded to a questionnaire in which they gave their opinions on questions and FA. Their responses were documented quantitatively. Qualitative observations were conducted in two teachers' classes, as were the questions teachers asked. These were categorised using Anderson/Bloom's taxonomy. Field notes were taken to assist recalling the context and record certain classroom scenarios. Analysis of the quantitative and qualitative findings followed in an attempt to answer the research questions.

The analysis and discussions will follow in the next chapter.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.0 INTRODUCTION

In this chapter, I briefly set the scene by describing the context of the schools and lessons, and discussing the guiding concepts. I then discuss the findings of this research conducted in one of the districts in Gauteng Province. The results and the findings of the questionnaire, administered during cluster meetings, are discussed first, followed by the results and findings of lesson observations conducted at Geranium and Rose Primary.

4.1 Overview of school contexts and lessons

Three lessons were audio recorded in each of these schools on six separate days. In total, six lessons were recorded, transcribed, and analysed. Questions from the transcripts were analysed using Anderson/Bloom's taxonomy. The schedule and particulars of the lessons are given in Table 4.1 below:

Table 4.1: Summary of Lessons

School	Date	Type of Lesson	Content	Number of questions per 30 min lesson
Geranium Primary	28 Feb	Question and answer on homework activity	Identify, classify animals and say something about them.	107
Geranium Primary	2 Mar	Discussion. Question and answer lesson	Vertebrate and Invertebrates	80
Geranium Primary	7 Mar	Revision of a test through question and answer	Seeds, weathering, soil, ecosystem and pollination	86
Rose Primary	8 Mar	Discussion combined with question and answer lesson	Habitats	124
Rose Primary	10 Mar	Show and tell with question and answer	Animal and its adaptation	98
Rose Primary	15 Mar	Question and answer lesson	Adaptation	186

To frame my study I used the concepts of FA as defined in Chapter 1. I also draw on the definition by Gipps (1994, p.124): "Using assessment information to feed back into the teaching / leaning process", although it is incomplete because it neglects the role of learners in their own learning and gives the impression that FA is mainly a teacher activity. Nevertheless, I did use it because it includes such features as valuing and mediating learners' capabilities, which facilitates them disclosing their thinking irrespective of whether they are right or wrong.

I used the above definitions to analyse my findings and answer the research questions posed in Chapter 1. A brief summary of the LoLT as well as the class size in the various schools is indicated in Table 4.2 (below).

Table 4.2: Summary of LoLT and Class size

Question	Question	Most frequent responses
	Section A	
5	What is the language of Learning and teaching (LOLT)?	18 English 5 English and Afrikaans 5 English and Setswana
6	What are the home languages of learners?	Varied South African languages including French and Portuguese (reported by one teacher from one school)
7	What is the Class Size?	27 min 70 max

Source: Derived from the raw results found in Appendix 1

4.2 Analysis of data relating to the first research question: Teachers' perceptions of the role of questions in FA

This discussion focuses on Section B of the questionnaire, which summed up the views and perceptions of FA held by the 33 selected teachers. Open-ended questions allowed them to express their ideas freely. The advantage of using open-ended questions, according to Opie (2009), is that they permit respondents to respond freely without any preconceived replies. The disadvantage is that they are difficult to analyse. To minimise any misinterpretation of the responses, structured questions were posed to qualify them. This provided the information I needed to understand their perceptions of FA and the role of questions.

Since teachers use questions as a tool in their assessments I reasoned that they should have some opinion of assessment. Assessment has many facets so I specifically narrowed the question to FA in order to get responses to my first research question. Table 4.3 (below) reflects what teachers understood about FA.

Table 4.3: Perceptions of FA

Question	Section B	
5	What do you understand by FA?	One teacher indicated FA was identifying strengths and weakness and so help to shape future teaching and learning
		Five teachers indicated that FA was used for continuous information gathering
		14 teachers indicated that FA was used for recording purposes
		11 teachers gave miscellaneous responses
		Two teachers did not respond

The teacher who said that FA was used to identify strengths and weaknesses and so shape future teaching and learning (representing 3% of the sample) clearly had a concise understanding of FA similar to that of Black and Wiliam (1998, p.10), for whom it is "All those activities undertaken by teachers, and/or by their students, which provide information to be used to modify teaching and learning activities in which they are engaged".

It was unfortunate that the teacher who made this statement did not identify him or/herself as he/she might have offered interesting FA practices in the lesson observation section of the study.

I found that five of the 33 teachers (15%) linked FA to continuous information gathering. These teachers' responses indicate that FA is linked to many assessment activities and opportunities as opposed to one defining assessment. Making use of a wider range of assessment tasks for assessment was a suggestion made by Bell and Cowie (2001) as a response to high stakes standardised testing. The teachers' answers did not clarify whether they were referring to continuous assessments for summative purposes or for formative purposes, though as Nakabugo and Siebörger (2001) state, continuous assessment could be used for both. Continuous assessment in this study is understood to be information gathering to improve teaching and learning, therefore I could not conclude decisively if they understood the concept of FA.

Fourteen teachers, 42.2% of the sample, associated FA with summative assessment. An illustration of this misconception emerged when an anonymous teacher responded that FA was "formal assessment". It was not clear whether the teacher was making an inference from the word "formative" or linking the word "formal" to literature. Cowie and Bell (2001) make a distinction between formal assessment and informal assessment, with the latter not linking assessment to scores while the former refers to scores being gathered and recorded. The DoE advocates in the Assessment Guidelines (2006) that formal assessment is carried out to obtain reliable records that will enable the teacher to determine a learner's overall competence in the Learning Area and Assessment Standards. Informal assessment, on the other hand, is described as the monitoring of a learner's progress during daily activities in order to shape future teaching and learning. It is expected that these terms are understood by teachers because they are frequently used within this sample.

Eleven other teachers (33.3%) had some ideas about the outcomes of FA, responding that it was related to the following: providing room for remedial lessons and expanded opportunities; identifying learning barriers; developing learners' knowledge and understanding; and applying what they had been taught. These responses indicated that the teachers were considering what actions they would take as a result of FA. Some other responses, such as judging learners progression in the subject matter or grade, and seeing if learners understood what they were taught, were assumed to be

measuring assessment for accountability purposes. Further interrogation would be necessary to determine why they gave these answers. Two teachers (6%) did not answer the question pertaining to their understanding of FA.

A fundamental aspect of FA did not surface in all the teachers' responses. They did not mention learners' involvement in their own assessment, nor did any link FA to learners assessing themselves or their peers. According to Black and Wiliam (2001), self-assessment is not a luxury but an essential component of FA. They add that learners should be trained to assess themselves so that they can rationalise their learning and know what they need to achieve. Cowie and Bell (2001) echo these sentiments that learners must be responsible for their own learning and assessment. It cannot be assumed that all teachers disregard self-assessment, with Cowie and Bell (2001) amongst those to have found teachers referring to learners' use of it. It is most likely that the teachers in this study did not mention self or peer assessment because they probably see themselves as the main or only role players in assessment of the learners. The teacher-centred approach in the two classes observed was evidence of this. The lack of expression by teachers of the need for self and peer assessment in the questionnaires is an indication that this aspect of FA is not used constructively as a practice in classes. It is therefore apparent that teacher development in this area is necessary for effective FA.

The next question investigated the teachers' views of the purpose of questioning, and was generic rather than specific to FA. The responses were grouped according to the *Assessment Guidelines*, a document provided to teachers by the DoE. The responses were grouped into three of the categories of assessment, viz., diagnostic (DA), summative (SA) and FA (FA). The assessment types were discussed in the literature review in Chapter 2 and the teachers' responses are recorded in Table 4.4 (below):

Table 4.4: Purpose for questioning

4	Purpose for questioning.		Varied answers were given, the responses are grouped below	
	Summative	**Diagnostic**	**Formative**	**Miscellaneous**
	* Assessment purposes.	*Assessment purposes.	* Assessment purposes.	* Solve environmental

	* Testing knowledge * Learning outcomes are achieved	*Understanding diagnostic assessment *Strengths weakness and needs of the learners	* Sort out problems * Lead children to correct answers * See if teaching method is relevant * Reflect on teacher presentations * Strengths weakness and needs of the learners * Learning outcomes are achieved *Gauge prior knowledge. *Broaden their knowledge * Interact with learners	problems * Sort out problems * Make them curious *Encourage and participate * Draw attention * Provoke thought * Broaden their knowledge

Some teachers linked the purpose of questioning to summative assessment, responding that questions were useful for assessment purposes, testing knowledge, and seeing if learning outcomes are achieved. These teachers probably used assessment as a tool to measure what their learners knew to meet objectives or standards. They probably used assessment for accountably purposes. Summative assessment can be used to gather information about learner performance by analysing common errors or determining weaknesses in learners. From this analysis, teachers could strategise how to address these problems.

Other teachers linked questioning to diagnostic assessment in the belief believed that it was for assessment purposes, i.e., understanding diagnostic assessment and identifying strengths, weakness and needs of the learners. Measurement of learners'

knowledge was not important for these teachers but rather they wished to determine what problems learners experienced so that they could assist them through remediation or referral to a specialist.

Some teachers' views that did not fit neatly into these categories, and were therefore placed into a miscellaneous one, included: solve environmental problems; sort out problems; make them curious; encourage and participate; draw attention; and provoke thought. Such responses are exciting, as they indicate that teachers are aware of the potential of questions in engaging learners in lessons. Teachers who saw questioning as solving environmental problems probably perceive it as a tool for learning in an integrated manner.

The final group responses appeared to be linked to FA. Examples of comments given by teachers are recorded as: assessment purposes; sort out problems; lead children to correct answers; see if teaching method is relevant; reflect on teacher presentations; strengths, weakness and needs of the learners; learning outcomes are achieved; gauge prior knowledge; broaden their knowledge; and interact with learners.

Because they were not specific, certain responses could fit into two or three categories simultaneously. I placed them twice or thrice under different categories. For example, some teachers said that questioning was for assessment, a response that I placed in all three categorises since I was not sure what it meant. Similarly, identifying strengths and weaknesses could be associated with both diagnostic and FA, because their definitions are so closely linked. Diagnostic assessment (DA), according to *Assessment Guidelines for Natural Sciences* (p.2) is "… often baseline assessment, since its application will always lead to some form of intervention or remedial action or programme".

Both DA and FA therefore imply that teachers would plan intervention strategies to assist learners in new learning. This information is based on what teachers have discovered about their learners. Placing a response such as "learning outcomes are achieved" into one specific category was difficult because it could be linked to both SA and FA, depending if the achievement of learning outcomes was formal or informal in nature. The fact that teachers could provide numerous functions for questioning was impressive. It appeared that teachers used questions to fulfil many

teaching objectives, e.g., simulating learners and diagnosing learning problems, to mention a few. I therefore believe that teachers do participate willingly in questioning.

I also wished to find out what factors, either positive or negative, affected their questioning. These responses are reflected in Table 4.5 (below).

Table 4.5: Positive and negative effects on teachers' questioning

10a	What negative factors influence the questions you ask in the class?	8 Learners lack of English vocabulary 6 LoLT differs from Home language 2 Socio-economic problems, no support 2 If the teacher is unprepared
10b	What positive factors influence the questions you ask in the class?	4 Making use of various questioning levels for different learners 2 Teacher knowledge of questioning strategies, subject matter and understanding learners

Three teachers (9%) did not answer the question at all, and at times the teachers did not explain or elaborate on their responses, making analysis difficult. For example, one teacher wrote "family, relations and society background". This could mean that family, relations and society influenced questioning positively and/or negatively by providing or not providing a supportive and stimulating environment. I was uncertain about my interpretation since I did not conduct follow-up interviews with the teachers.

Ten teachers (30%) only discussed negative factors that influenced their questioning, which raised the possibility that they were disillusioned with the contextual factors in their classes. I only discuss these negative factors where two or more teachers expressed similar views and have purposely overlooked other perspectives reported by individual teachers because they will make this discussion lengthy. These responses are reflected in Appendix 1. The areas of language competency and socio-economic background emerged prominently in relation to this question.

Two teachers (6%) said that socio-economic problems and lack of parental support impacted negatively on questioning, a response perhaps based on the context of many schools in this district, where food was provided daily to learners because they did not

have a meal before school. Hungry or malnourished children are unable to concentrate during lessons.

Relating this question to language competency, eight teachers (24%) said questioning was influenced by the learners' lack of English vocabulary. Six teachers (18%) said that the LoLT differed from the learners' home language. One teacher made an interesting comment that using different types of questions would only be effective if the questions were posed in their mother tongue. The characteristics of FA given by Bell and Cowie (2001) and Black and Wiliam (2001) do not take language into consideration. I align myself with this teacher and believe that FA can only be effective if the learner being assessed has knowledge of a language in which he or she is assessed. Language therefore should be considered as a criterion for effective FA. Ideally, a teacher should use a language with which both she and her learners are comfortable. If the learners cannot understand the language of instruction, determining their understanding of science concepts would be difficult. From the questionnaire it was reported that the learners spoke the following languages at home: Setswana, Sepedi, Isizulu, Xitsonga, South Sotho, Pedi, Venda, Ndebele, English, Afrikaans, Swati and others such as Portuguese and French. The multilingual backgrounds of learners in one class where lessons are taught in an unfamiliar language present new challenges to South African teachers.

Five schools reported that they used English and Setswana as the LoLT, however three of the teachers from these schools did not complete the demographic section so I was unable to confirm this information. On consultation with the remaining two teachers they indicated that they had started using English as the LoLT from Grade 4. They said they misunderstood the question and thought the question pertained to the Primary School as a whole. Primary schools normally include the Foundation and Intermediate phases. In South African schools (DoE, 1997), the school management team (SMT) together with the SGB decide the language policy. In township schools the Foundation Phase learners receive their tuition in their home language, with English introduced in Grade 3 as an additional language. When the learners begin Grade 4 they receive tuition in English in all their learning areas. The learning area English is taught as an additional language with one of the vernacular languages as their first language. This means that all the learners in the sampled Grade 5 township schools had one year's formal teaching in English. The use of English in all the

sampled schools in which it is not the primary language could be seen as a hindrance to the questions teachers ask.

Another 6% of teachers indicated that lack of teacher preparation would impact on questioning. It is difficult to interpret exactly what the teachers meant in this statement, and whether they were referring to preparation of lesson plans or being equipped with content knowledge or PCK. According to Taylor (2009), evidence exists that many South African teachers' content knowledge does not meet the curriculum standards set for the learners they are teaching. Van Driel, Verloop and de Vos (1998) explain that teachers should have developed adequate PCK to interpret and transform subject-matter knowledge in order to facilitate student learning. Whichever way one interprets unpreparedness, it is clear that teachers need to enter the class with appropriate content knowledge and a strategy to teach effectively. Questioning should form part of this strategy.

Leahy, et al, (2005) suggest that teachers need to plan questions with interpretive rather than evaluative objectives in mind for learner understanding. Using interpretive questions is an important feature of FA. By teachers indicating that preparation is important, they indicate that they are critical and reflective of themselves and their peers. This is the first step to self-improvement.

One other contextual factor reported by two teachers (6%) was that learners are distracted by other disruptive learners and probably lose their focus. During the last lesson at Rose Primary I had firsthand experience of this disruption. The learners in the neighbouring class were unsupervised, noisy, and slammed against the galvanised garage door separating the two classes. Whether this disturbance distracted the learners' thinking and teachers' teaching could have been determined through interviews.

Five teachers (15%) reported on factors that influenced questioning positively. These teachers were fewer than those discussed above. I will only discuss two or more similar responses. Four teachers (12%) believed that questioning at different levels for different learners impacted positively on questioning. This response was interesting because it could imply that teachers addressed different learner needs based on their knowledge of the learners. It also implies that they were willing to explore different levels of questioning.

The majority of the teachers (91%) agreed with the statement that different questioning strategies should be encouraged to explore learners' understanding of concepts. Fourteen of the teachers (42%) said that using different questions would accommodate learners who understood, learned differently or had different abilities. This is consistent with research by Leahy et al. (2005), who found that teachers used different strategies to suit their contexts. Strategies cannot be prescribed because situations differ. Different strategies were successful in some contexts but not in others. Two (6%) teachers reported that knowledge of questioning strategies, subject matter and understanding learners impacted positively on questioning. This statement supports the statement above that when a teacher has good teaching skills, questioning will be used effectively in lessons.

The questionnaire further explored the teachers' questioning practises. I expected that the responses to these questions would indicate the type of questions teachers would ask during their lessons. Table 4.6 (below) reflects the responses of the teachers.

Table 4.6: Teachers' questioning practises

	Section B	
Question number	Question	Most frequent responses
1	When do you question learners to establish what they already know about a certain concept?	16 most of the time 14 always 3 sometimes
2	How often do you ask questions that require straight forward answers?	7 always 15 most of the time 10 sometimes 1 no response
3	How often do you pose questions that require learners to integrate and apply what they were taught?	16 most of the time 8 sometimes 8 always 1 no response

In each question I requested that teachers give an example from their experience in the class to explain their response. The first question dealt with prior knowledge, a concept first expounded by Piaget (2003) as a way children use experiences and prior

knowledge to make sense of their worlds and new knowledge. They try to take new knowledge and fit it into their existing knowledge in order to create a schema or mental map.

One method of accessing this knowledge is through baseline assessment (BA), defined by the DoE Assessment Guidelines as:

> assessment usually used at the beginning of a phase, grade or learning experience to establish what learners already know. It assists the educator with the planning of learning programmes and learning activities (DoE, 2007a: p.2).

All the teachers reported having used BA as part of their teaching strategy, but I was interested in when and how they implemented it, since it gauges what learners know about a specific topic. Bernstein (2005) explains that Piaget's cognitive theory is rooted in his claim that learners' heads are not empty vessels which ought to be filled by the teacher. Rather, they have different ideas of phenomena and the teacher should establish what they know before new information is introduced. There seems to be a fine line between BA and FA, with the former having an element of the latter as the teacher uses the information to prepare for future teaching. For purposes of this research, the two forms will be differentiated based on the understanding that BA is time-specific, performed only at the beginning of a stage, lesson, or theme, whilst FA is not time-specific and it could be used continuously, at the beginning, during and at the end of lesson, section, or theme. Responding to the question of BA or determining prior knowledge, all of the teachers reported using this teaching strategy.

Fourteen teachers (42%) said that they always probed learners' prior knowledge. A breakdown of these responses is given in Table 4.7 (below). Twenty-three (70%) teachers said they always used BA at the beginning of a lesson. One teacher (7%) said that he/she used BA at the beginning of a new section. Two teachers (14.5%) used BA throughout their lessons, and one teacher said he/she used BA after the lesson. The way they implemented BA differed, with one using it to see that the goals of the lesson were achieved and to wrap up. Other teachers used it orally or written in learners' workbooks.

Sixteen teachers (48%) said that they established prior knowledge most of the time, twelve of whom (75%) said that they used BA at the beginning of a lesson. One teacher (6%) said he/she used BA at the beginning of a new section, another (6%)

after a lesson, while two (14 %) used it during the lesson. They expressed the following reasons for using BA: “to revise previous work”, “to listen to learners’ own voice”, and “expressing their learning in their own words”.

Only three teachers (10%) said that they used BA sometimes. One teacher specified that he/she used BA at the beginning of a lesson while the other two did not mention when they used it. One teacher mentioned that learners were asked to collect information and resources from home or the environment to obtain prior knowledge. This teacher encouraged learners to find links between homes, social environment, indigenous knowledge, culture, religion, and school.

Generally, it appears that teachers are aware that they need to establish what concepts their learners have. They could refine these concepts or build onto them. They differed on the implementation as to when and how they used BA, but understood that BA informed them about content gaps and learner misconceptions, which teachers use to prepare for future teaching. Bell and Cowie (2001b) refer to information gathered to use or to act upon, or responds to, as ‘responsiveness’, and as a characteristic of FA. However, teachers used the same information in their BA practice.

In Section B of the questionnaire, Question 2 asked teachers how often they asked questions that required recall or straightforward answers. Seven (21%) reported that they frequently posed recall or straightforward questions but differed on how often, when or how they used this questioning methodology. Two of the seven teachers (28%) said they always used recall questions, frequently at the end of lessons, another two (6%) at the beginning. The remaining three (43%) said they used it frequently during the lesson. Generally, they used this method to check if learners were attentive by answering question, to assess learners’ understanding, or to explore prior knowledge. Literature reports that learners will be attentive if they know that they might be called upon at any time to answer questions. If they fail to answer the teacher will know that they are inattentive or not grasping what is being taught.

Fifteen teachers (45%) said they posed recall or straightforward questions most of the time, the purpose of which was similar to the discussion above. In addition, some added that recall questions helped the teacher build onto concepts. It seems that teachers used these questions to scaffold onto foundational knowledge, where learners were ready to develop. Some teachers said scaffolding helped teachers and learners

move from the known to the unknown. My understanding is that teachers attempted to measure and compare learners' existing knowledge with what they ought to know. Similarly, the learners linked what they know to what they do not know. Teachers added that recall questions helped clarify concepts and refresh learner's memory, and learners could handle them. Four of the 15 teachers (27%) said they used recall questions most of the time at the beginning of a lesson, another four (27%) at the end of a lesson, and the remaining seven (46%) during a lesson.

Ten teachers (30%) claimed they used recall or straightforward questions infrequently. Once again, this group echoed the others. Of note, one teacher added that she used recall questioning as part of a range of questions, and addressed questions of different levels in her lessons. Thus, it appeared that she assessed the situation and used different questions for different situations. Only one teacher did not respond to this question.

In summary, the intention of the question in Section B Question 2 was to determine how often teachers posed recall or straightforward questions. These required learners to recall content taught without having to apply higher order thinking skills. The data indicates that recall or straightforward questions are part of the armoury of every teacher, used for practical purposes at various times in their lessons.

Section B Question 3 asked how often teachers posed questions that required learners to integrate and apply what they were being taught. Teachers claimed that in addition to lower order questions they often posed higher order questions involving integration and application. Eight teachers (24%) claimed they always used such questions, sixteen (48%) most of the time and eight (24%) sometimes. One did not respond. A teacher claimed that this type of question was used seldom because the learners were unable to answer questions on this level.

Section C in the questionnaire was based on the context in different classes. Table 4.7 (below) translates some of the data from the questionnaire. It was important to understand which types of question learners were able to answer with and without difficulty, what teachers thought was the reason for learners answering questions successfully or not, and how teachers helped their learners to respond to questions.

Table 4.7:

	Section C	
6	Comment on: Teachers ought to use different questioning strategies to encourage their learners explore their understanding of concepts.	30 teachers showed that they agreed in principle with the statement. Fourteen teachers said different questioning was used to accommodate learners who understood, learned differently or had different abilities. One interesting comment was that it would only benefit learners whose mother tongue was English.
7	Which types of questions are learners more able to answer correctly?	7 Simple recall 6 Describe or explain
8	Which questions are learners least able to answer correctly?	7 Explaining or defining questions 4 Thought-provoking questions 4 Research and investigative questions
9	In what ways do you assist learners to help them respond to your questions?	11 Provide leads, guides or give clues 6 Explain question and/or concepts

Thirty teachers (91%) agreed that using different questions was a good strategy to explore learners' understanding of concepts. Thus, the majority thought questioning was very important. The questionnaire further uncovered how they felt about learners' abilities to answer different questions. Seven teachers (21%) said that the learners found simple recall questions easy to answer, while six (18%) thought that learners found describing and explaining answers easy. It is most likely that learners were successful in answering these questions because they were accustomed to such.

Teachers, according to Van Hees (2007), ask questions when they are confident of the answers. Simple recall questions and definition type questions have fixed answers and their purpose is to find out if learners know those answers. Torrance and Pryor (2001) describe this as convergent assessment. Teachers anticipated that questions associated with divergent assessment were more difficult for learners, as was evident in the analysis, in which seven teachers (21%) felt explaining or defining questions was difficult for learners. Four other teachers (12%) said that thought-provoking questions were difficult for learners. Difficulties with research and investigative questions were experienced by learners, according to four (12%) other teachers. Van Hess (2007) suggests that both teachers and learners need skills taught to them for preparing and

answering divergent questions. They should be comfortable using this form of assessment. Divergent assessment, Torrance and Pryor (2001), proposes that divergent questioning focuses on what the learner knows, and revolves around the learner learning rather than the teacher teaching.

Section C Question 9 in the questionnaire takes into consideration the challenges relating to questioning. I wished to find out in what ways teachers assisted learners to answer questions. Eleven teachers (33%) indicated that they provided leads, guides, or gave clues to assist learners' to answer their questions. Six teachers (18%) said they explained the question and/or concepts to their learners. Another five (15%) said they rephrased the questions. Three teachers (9%) also tried simplifying the questions. In addition, there were some individual responses, which came through during the lesson observations, such as drilling important words, using the home language, using body language, giving examples, and relating questions to the environment. Teachers all gave positive indications that they helped learners to respond to the questions.

4.3 Analysis of data relating to the second research question: What types of questions do teachers use during their lessons?

This section discusses the results of the investigation of the different types of questions teachers use in their lessons. The strategy of lesson observations was selected for the following reasons. Teachers use teaching strategies they consider effective and with which they are comfortable. Their beliefs and epistemology shape their professional practice, reflected in their teaching, and their learners may become familiar with the teacher's methodology (Davis & Andryewski, 2003). When teachers deviate from their regular practice learners will react to the unfamiliar situation and it will be clear that the teaching is not authentic. A true reflection of the questions teachers use will be reflected in a lesson by observing and recording. During six lessons with two teachers from Geranium and Rose primary schools, lessons were recorded and transcribed. Questions were analysed from the transcripts for each lesson using Anderson/Bloom's Taxonomy. Before examining the individual lessons, a brief background is provided of the two teachers at Geranium and Rose Primary schools.

Although the teacher at Geranium Primary was Afrikaans she taught in English and seemed to have language difficulties. Occasionally she used Afrikaans informally with her learners, who were African except for one who was Coloured. This means that English was not the primary language of the majority of the class. Assuming they had all attended Geranium Primary from Grade 1 they would have been taught in English and would have had a longer exposure to English than those at Rose Primary.

Similarly, the teacher at Rose Primary was Tswana-speaking, but taught in English. She sometimes used Tswana to clarify herself. Of interest was that she made it clear to her learners that she expected them to respond in English, once saying, "Natural Sciences is in English." This seems like a contradiction, because she used Tswana but they could not. None came from an English background and their length of exposure to it was not determined in this study. If they had attended the school from Grade 1 they would have been exposed to English for two years since Grade 3.

The first lesson at Geranium Primary on February 28 Feb analysed in Table 4.8 (below), supplying evidence of the question types used in this lesson. The caption to the table indicates the name of the school, the date of the observation (as abbreviation) and the Grade. Explanations of the abbreviations are given in the following example: Geranium 28/2 Grade 5/4 indicates that the observation took place at Geranium Primary school on February 28 in the Grade 5 class. At Geranium, there were four grade five classes. 5/1; 5/2; 5/3 and 5/4. The fourth Grade 5 class was observed.

Table 4.8: Analysis of the question types used in this lesson Geranium 28/2 Grade 5/4

The Cognitive Process Dimension				N = 107 questions		
Knowledge dimension	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual knowledge	8	0	0	0	0	0
Conceptual knowledge	60	0	0	0	4	0
Procedural knowledge	0	0	0	0	0	0
Meta-cognitive	0	0	0	0	0	0

knowledge						
	Other question types					
Instruction	11	Instruction questions pertain to classroom management				
Validation	6	A validation or seeking consensus question. The teacher wishes to establish whether the learners are in agreement with him/her. (Mortimer & Scott, 2003)				
Clarification	2	A clarification type question, the teacher wants the learners to elaborate and explain their responses.				
Confirmation	14	A confirmation type question, the teacher enquires from the learners if she or they understood what was happening in the lesson.				
Other	2	Learners ask the teacher to proceed with the next question.				

This was the first lesson I observed at Geranium Primary School. In the previous lesson the teacher had given the learners a homework activity. Pictures of 11 animals were shown on the worksheet: springbok, hippopotamus, fish, earthworm, lizard, giraffe, spider, snake, bee, lion, and a sea anemone. On the day of my lesson observation the learners had to name and classify the animal, then say something about it. In this lesson she mostly assessed their conceptual understanding.

The teacher indicated on her questionnaire that FA meant "monitoring and assisting with the learning and teaching process", adding that it "keeps the teacher in line with performance". I interpreted from her response that she considered herself as an aid to her learners' learning process by monitoring how they learn. It seemed that she had a reasonable understanding of FA, therefore I expected her to use FA strategies in her lessons.

The lesson consisted of 60 conceptual remembering questions, examples of which are listed below:

Question 34: Is it a mammal?
Question 35: Or what does it belong to?
Question 36: The mammal, why is it a mammal?
Question 37: Why do you say mammal?

The learners were taught the classification of animals so the teacher expected them to be familiar with the concept of mammals and association to different animals. Many of the questions focused on reasons for the classification. During the question and

answer discourse the teacher did not explore the learners' responses, but after each moved to the next learner. She seemed content with the responses and it appeared that she asked questions to match what she expected from the learners. She focused on their remembering the concepts she had taught.

Nystrand et al. (1997, cited by Brodie, 2004) explain that there are two types of questions: *test* and *authentic*. The former aim to find out what learners know and how closely their responses correspond to what the teacher requires, while the latter have no pre-specified answers but rather serve to show interest in what the learners say and allow them to prove their ideas. This teacher hardly made use of authentic questions. Although she gave them the opportunity to express themselves she did not allow them to validate their responses nor did she challenge them. She assessed conceptual remembering because she wanted to see how much they remembered about the concepts she had taught. Nor did she place other higher cognitive demands on her learners.

On four occasions she used evaluative questions, which accounted for 4% of the lesson. These were used sequentially where the learners had to decide whether snakes were useful, based on the previous discussion. Evaluation is defined as making judgments based on criteria and standards. The criteria most often used are quality, effectiveness, efficiency, and consistency (Mayer, 2002).

Question 51: So, so you actually, saying that snakes can be useful?
Question 52: Are, do you agree?
Question 53: Okay, those who don't agree must find out why not?

Evaluative questions allow learners to demonstrate that they have understood all the concepts and can make their own judgement. In the transcript, the learners answered collectively and did not take the opportunity to offer their judgement. This is illustrated in the following scenario: the learners gave 'yes' and 'no' responses and did not clarify themselves. In spite of them not agreeing, the teacher did not enquire how they made their decisions, nor give them convincing evidence as to why snakes were useful. However, they finally agreed with her, that snakes were useful. When she expressed doubt they became confused and suddenly changed their response and disagreed. The teacher abandoned this line of questioning and instructed them to find out for themselves.

Teacher:	Are all snakes poisonous?
Children:	No ma'am
Teachers:	Not all of them?
Children:	Yes, No
Teacher:	Ssh, Ssh
Child:	Speaks inaudibly
Teacher:	Stand up, and then you tell them, you must listen! (*Referring to the other children*) You must speak louder *ne*? (*Referring to the speaker*)
Child:	There's also a … (*inaudible*)
Teacher:	So, so you actually, saying that snakes can be useful?
	Are, do you agree?
Children:	Yes
Teacher:	Hmm
Children:	No
Teacher:	Okay, those who don't agree must find out why not?

The teacher abandoned this question and instructed them to find out for themselves. In the questionnaire she did not mention that she used evaluative questions but demonstrated this skill in her lesson. This observation makes me believe that the teacher is capable of constructing higher order questions. Another aspect worth mentioning is that she was unable to draw her learners into a discussion. To facilitate discussion it might be useful for her to frame questions before a lesson, including ones that require higher cognitive skills. The learners need to be taught how to answer questions that require different thinking skills, by using knowledge in different ways. Seven percent of the questions dealt with remembering factual knowledge, and 3% of the questions related to remembering conceptual knowledge. No application, analytical, creative questions were posed in any of the knowledge dimensions.

One interesting aspect emerged in this lesson, which accounts for two questions noted as 'other' in Table 4.8 (above). This was the first time that a learner asked the teacher a question in the form of a request to proceed to the next animal for discussion. It appears that the learner felt they had exhausted the discussion on the hippopotamus and should proceed, probably wanting to discuss her animal. This illustrates that the learner wanted to contribute because she was prepared and wanted her voice to be heard. Learners in Grade 5 in this context do not question their teachers and this was

an honest and brave action of the child. Most learners would accept this line of questioning and become bored with the lesson.

Another example of the teacher using lower cognitive questions is observed in the second lesson at Geranium Primary, reflected in the Table 4.9 (below).

Table 4.9: Analysis of question types used in this lesson. Geranium 2/3 Grade 5/4

The Cognitive Process Dimension			N= 80 questions			
Knowledge dimension	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual knowledge	18	17	16	0	0	0
Conceptual knowledge	0	7	0	0	1	0
Procedural knowledge	0	0	0	0	0	0
Meta-cognitive knowledge	0	0	0	0	0	0
	Other question types					
Instruction	8	Instruction questions pertain to classroom management				
Clarification	4	A clarification type question, the teacher wants the learners to elaborate and explain their responses				
Confirmation	6	A confirmation type question, the teacher enquires from the learners if she or they understood what was happening in the lesson				

This was meant to be a discussion based on the previous day's lesson. The teacher asked the learners to find out if a snake had a backbone then to decide if snakes were vertebrates or invertebrates. The teacher made frequent use of factual knowledge questions during this lesson, posing 22.5% factual recall questions, 21.25% factual understanding questions and 20% factual application questions. At first the learners did not respond well, and then one learner, Kim (pseudonym), explained that snakes had bones because when they moved a crackling sound could be heard. The teacher tried to repeat what Kim had said but misinterpreted her. This scenario is illustrated in the extract below.

Kim:	I, I, think a snake has er vertebrate because er when it walks and even ….you hear it sounds like crr crr. And I got information ... (*The rest of the response was unclear in the recording).*
Teacher:	O, okay, wait did you hear what she was saying?
Children:	(*In unison*) Yes ma'am no ma'am
Teacher:	She was saying she thinks they are vertebrates because they have bones. All animals don't have bones, *ne*?
Teacher:	you were saying that?
Kim:	I said… (*Kim tries to explain herself*)
Teacher:	Sipho, listen!
Kim:	I said… (*Kim again tries to clarify herself*)
Teacher:	Okay she also says because of the movement. She says they, they have bones. Okay another one

I believe the teacher missed an opportunity to investigate and enhance this response by not giving Kim time to explain. The teacher could have challenged Kim's argument by suggesting that the sound might have originated from another source. One account for the crackling could be explained as the body moving amongst leaves or the scales of the snake slipping over each other as it moved. In this manner Kim would have to re-examine her idea that snakes have bones because of the sounds they make while moving.

Mpho said that a snake was a vertebrate because he saw it in a book. He tried to show the teacher but she did not look at the book or use it in the discussion. Once again the teacher could have used Cowie and Bell's (1996) definition of FA to explore this answer. How do learners learn? Where do they get their information from? Do they trust everything that they read? It could have been an opportunity to examine the reliability of the source.

In most instances she made use of science terminology to test for understanding of concepts, with 8.75% of 80 questions conceptual understanding ones. Only one conceptual evaluative question (1.25%) was posed, presented in the transcript:

Teacher:	Does the snake vertebrate or invertebrate? Shh, shh, aah, aah
Teacher:	Thank you. Some of you did say no and some of you did say yes. We are going to start with Mpho. Mpho?
Mpho:	Ma'am (*acknowledging his receptiveness*)
Teacher:	What did you think? *(conceptual evaluative question)*

Teacher: Are snakes vertebrates or invertebrates?

Teacher: And why did you say that?

Mpho: *(Short silence)* vertebrate, ma'am.

Teacher: Why is it a vertebrate?

Mpho: Ma'am, the snake doesn't have bones, ma'am.

Based on the previous day's request that learners find out if snakes are vertebrates or invertebrates the teacher wants to find out if this learner can classify a snake on the presence of a backbone. His answer is confusing because he does not mention "backbone" but bones. However, as the questioning progresses it seems he knows that snakes are vertebrates. He may not yet be familiar with the terminology but he understands the concept. He might have answered incorrectly at first because he was picked out from the rest of the class and had to respond individually. These are some of the dynamics that might affect learners' responses.

Table 4.10 (below) represents findings of the questions in the final lesson at Geranium Primary and confirms that the teacher there made frequent use of lower cognitive questions:

Table 4.10: Analysis of the question types used in this lesson Geranium 7/3 Grade 5/4

The Cognitive Process Dimension			N = 86 questions			
Knowledge dimension	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual knowledge	52	5	6	0	4	0
Conceptual knowledge	6	3	0	0	0	0
Procedural knowledge	5	0	0	0	0	0
Meta-cognitive knowledge	0	0	0	0	0	0
	Other question types					
Recollection from previous lesson	1	Reflecting back to previous content				
Instruction	1	Instructional questions pertain to classroom management				
Articulation	1	This question relates to pronunciation of a Science word				

Clarification	2	A clarification type question, the teacher wants the learners to elaborate and explain their responses

The previous week the learners had written a test, which consisted of four questions. The first question dealt with plants and seeds, with the learners having to match five words to five sentences. The second question comprised five true or false questions. The third question contained eleven questions which began with the following words; what, name, which and give. One 'how' and one 'why' question appeared in the third question. The fourth question comprised three multiple-choice questions. A total 05 30 marks were allocated for this test. The lesson was a revision of that test, where there was no need for the teacher to construct the questions because they were available, so she read them from the paper.

This lesson consisted of 60% factual knowledge questions, a large percentage that may have been due to the teacher giving feedback to the learners. I consider the lesson a formative activity, because the teacher made learners aware of their errors and corrected them. However, I do not think that it assisted them to improve their learning for the future. Black and Wiliam (2001) propose that questions of good quality will ensure good feedback, which should not only encompass scores and corrections but also indicate to learners their strengths and weaknesses so that they know how to improve. Support for this statement comes from research conducted by Black and Wiliam (2001), who state that the feedback on tests and homework exercises should give learners guidance on how to improve and help to work at the improvement. The teacher did not use this revision lesson for that reason.

An additional 6% were procedural questions that did not form part of the original question paper. The teacher generated these questions from a learner who said that loam soil contained humus. In this instance, the teacher reacted to the response by asking learners to explain the procedure for making compost. Two examples of these questions are given below:

Question 51: How do you make compost?
Question 52: What do you need to make compost?
Question 64: When you make compost what do you use?

In the first question she wanted them to recall the process of making compost, similar to repeating a recipe. In Questions 52 and 64 she asked for the ingredients of compost,

the ingredients for the recipe. These examples show that she simply wanted them to recall the method without working through progressively challenging questions. As one glances over the three tables from Geranium Primary it is clear that this teacher addressed procedural questions only once in the three recorded lessons. It may be that the two lessons observed previously did not lend themselves to asking such questions. Procedural questions would most likely be found in lessons pertaining to techniques procedures, methods, skills and algorithms.

During the revision of the test paper there was one question (Q 11) that I referred to as an articulation question. In this scenario the learner could not pronounce the word "dicotyledonous". The teacher tried to assist but she also pronounced the word incorrectly:

Question 9:	Teacher:	Weathering.
		Seeds with two cotyledons are called what?
Question10:	Teacher:	Seeds Lizzie
	C/Lizzie:	(*Struggles to pronounce word*) Di.. di… cot..
Question 11:	Teacher:	It is right, but who, who can pronounce it?
	Child:	Ma'am Di..co..
Question 12:	Teacher:	Di/co/tyl/den/ous, di/co/tyl/den/ous seed.
		And what does dico mean?
	Child:	Two
	Teacher:	It means two. Dico means two.
		Then.
		The seeds of plants develops in the what? …
		Come, we did write this in the morning.

This extract also shows that the learner was having difficulty with the pronunciation of the word. Through her response, the teacher illustrated that she believed correct pronunciation was important, but she herself had difficulty with it and so could not assist them. I believe pronunciation is important for learners exposed to scientific and other English words because they could copy incorrect pronunciation, which would affect their spelling of the words. However, she was successful in getting them to understand the concepts in the word. The extract further illustrates her questioning style.

A different picture was sketched at Rose Primary school. Through the questionnaire, the teacher said FA is "formal assessment which covers all the learning outcomes, marks

and the learning abilities in the class". She did not articulate any of the accepted views of FA, e.g., those of researchers Bell and Cowie (2001) or Black and Wiliam (2001). Some interesting data emerged from her lessons, the most significant being that she used FA strategies despite the not being able to explain FA.

At Rose Primary, during the first lesson, the teacher's questions were more balanced and she used a range of them in the factual and conceptual domains, as shown in the Table 4.11, (below):

Table 4.11: Analysis of question types used in this lesson. Rose 8/3 Grade 5A

The Cognitive Process Dimension N= 124 questions						
Knowledge dimension	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual knowledge	16	6	0	5	0	0
Conceptual knowledge	22	19	1	8	2	0
Procedural knowledge	0	0	0	0	0	0
Meta-cognitive knowledge	1	0	0	0	0	0
	Other question types					
Instruction	4	Instructional questions pertain to classroom management				
Clarification	5	A clarification type question, the teacher wants the learners to elaborate and explain their responses				
Validation	31	A validation or seeking consensus question. The teacher wishes to establish whether the learners are in agreement with him/her. (Mortimer & Scott, 2003)				

During the first lesson at Rose Primary (Table 4.11, above), the teacher posed 124 questions in a 30-minute period, which equates to 4 questions per minute. The teacher asked almost equal numbers of recall questions in both the factual (12.9%) and conceptual (17.7%) knowledge domains. She posed fewer understanding questions in the factual domain (4.8%) than understanding questions in the conceptual domain (15.3%).

During this lesson on habitats she posed more conceptual understanding questions, venturing into analytical questions in both the factual (4%) and conceptual (6.4%) domains. In the transcript below the teacher tried to use implicit questioning to help learners to use their answers to build the concept of a habitat on their own. From the transcript the learners gave the correct answers to her questions, but they could not link them to the concept of a habitat on their own. She therefore had to give up on her strategy and ultimately had to explain the concept to them:

Teacher:	Somebody says house (*chorus*). Some and the other one say home (chorus) … Now, I want you to look at some pictures (pause as she puts pictures on the board). I've got two pictures here… I'm not going to paste them right under because I don't want to give you a clue… Look at these two pictures …
	What do you see? …
	In the first picture I numbered them. This is number one, this is number two.
Children:	*Mumbles*
Teacher:	Let's talk about number one. What do you see Baseka?
Muzi (boy):	House
Teacher:	A house, that means that this one must come here and then the other one.
Children:	Home
Teacher:	Yes, it is a home. But, BUT, I don't want you to guess because you saw the name home? What is it that makes you think or can you tell me the difference between a house and a home?
Children:	Silence
Teacher:	Can you tell the difference between a house and a home? ...
Children:	Silence
Teacher:	What is it about a house? ...
Child:	It is the biggest (lowers his voice as he continues)
Teacher:	Big and small …
Child:	When the rain … comes the…
Teacher:	In what? In the house? When the rain?
Child:	Is coming
Teacher:	When the rain is coming the roof …
Child:	(*Recording inaudible)*
Teacher:	It will. Okay, the, the rain won't, won't get inside the … house (*chorus*) *ne*? That makes you talk of the conditions…

Teacher: You know every time when the bell, the last period of the day, the, when the bells rings, I saw somebody, I see everybody is happy… And then I don't know why is happy, er, it's happy because she wants to pack. Or what is the first change that is place you like most, where you are going after school.

Children: Home

Teacher: Do you like your home? … Why?

Teacher: What is it that makes you love your home so much?
What do you get from your home? ...

Children: (*Silence*)

Teacher: FOOD *ne*? Do you see food in, in, in here? (*referring to the picture*)

Children: Yes, ma'am

Teacher: Right, he said he likes food at his home. What else?

Children: (*Silence*)

Teacher: What to drink water from the fridge *ne*? Water

Child: (*Silence*)

Teacher: Heh, food is covered. Water is covered. What else?

Children: Clothes

Teacher: You are going to change your … clothes (*chorus*) your school clothes akere? … And then what? …

Child: Bath

Teacher: Habitats are homes for … animals (*chorus*) *ne*?
Habitat are homes for … animals (*chorus*). They love their homes also, because they are able to smile this. They call that a home because they, er. Can I give you the definition I wrote, I find it somewhere and then it says "A habitat is the place where an animal or a plant lives is its… habitat" (*chorus*) akere?

Child: Yes ma'am

This dialogue took approximately four minutes (14.50 -18.48 minutes) and many questions for the teacher to make them aware that there was a difference between a house and a home. She wanted them to realise that a habitat was a home rather than a house because it suits the animals' needs rather than just providing shelter. The length of the dialogue, the learner participation, and the unintended end result may suggest why teachers seldom use this implicit questioning. Implicit questions need to be clearly framed to facilitate the desired conclusions.

Of particular interest was that this was one of two lessons in which meta-cognitive knowledge questions were used, the other being the one dated March 10. Pintrich (2002) defines 'meta-cognitive knowledge' as relating to cognition, as well as awareness of and knowledge about one's own cognition. These types of questions are slightly more difficult to ask learners, as they them to respond to how they learn and process their thoughts. In the following illustration the teacher used meta-cognitive processes to formulate the approach she was about to use, organising her mind map to the way she will present the subject matter to her learners. She explains where they have come from in the classification and how they are to move on.

Teacher: Now we are done with the, we said we classify animals according to what they er, the two groups first, *ne*? invertebrates and the vertebrates. Then we can, from the, the, the vertebrates, er, er, invertebrates we can go further and classify them according to the food they eat. Then we have the herbivores (*chorus*), we have the carnivores (*chorus*), we have the omnivores (*chorus*).

Teacher: Now today, no, before I can tell you that today to do, learn about what, but still on animals *ne*? And then still looking at the … relationship (*chorus*) how they relate akere, *ne*?

In this instance the teacher from Rose Primary used this form of questioning to organise her thoughts and structure her approach to teaching at the beginning of a lesson. The questions she posed were not intended for the learners, and she appeared to be thinking aloud. Nevertheless, it may be interesting for future research purposes to see if this approach could assist learners adopt the skills of meta-cognitive thought processes.

I believe that the nature of the lesson determines the types of questions asked. In the lesson at Rose Primary the questions types are represented in Table 4.12 (below). Fewer questions were asked because it was a 'show and tell' lesson.

Table 4.12: Analysis of question types used in this lesson. Rose 10/3 Grade5A

The Cognitive Process Dimension			N=98 questions			
Knowledge dimension	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual	20	1	1	0	0	0

knowledge						
Conceptual knowledge	16	6	0	0	0	0
Procedural knowledge	0	0	0	0	0	0
Meta-cognitive knowledge	3	0	0	0	0	0
	Other question types					
Instruction	30	Instruction questions pertain to classroom management				
Clarification	5	A clarification type question, the teacher wants the learners to elaborate and explain their responses				
Validation	11	A validation or seeking consensus question. The teacher wishes to establish whether the learners are in agreement with him/her. (Mortimer & Scott, 2003)				
Confirmation	5	A confirmation type question, the teacher enquires from the learners if she or they understood what was happening in the lesson				

During this lesson learners had to talk about the animals they had chosen to discuss. The teacher spoke less, concentrating on 20.4% factual recall and 16% conceptual knowledge understanding questions. During this lesson she mainly managed the learners by giving instructions (Q48, Q49 and Q89) and facilitating (Q 50 and Q 88) discussions. These instructional questions accounted for 31% of the lesson, examples of which are given below:

Question 48: Do you have your homework?

Question 49: Why?

Question 89: Can you show your er, er your, your homework?

Question 50: Okay do you have any questions for Peggy?

Question 88: Can somebody explain to us? ...

This following extract was taken from the beginning of the lesson. The teacher used a few incomplete questions, to which the learners could not respond. It appeared that her learners were aware that these questions were not addressed to them but that they were accustomed to their teacher's behaviour. This scenario illustrates how the teacher made use of meta-cognitive recall questions to organise her own thinking and approach to the lesson:

Teacher: Let's continue akere. Where we left off akere. Who can tell me? …

Teacher: What is?

Teacher: What can I say?

Teacher: What were we talking about yesterday and the day before?

Teacher: Who can tell us?

Teacher: Sibu?

Sibu: We were talking about the habitats.

Teacher: We were talking about the habitats. What did we say about the habitats? (*Silence).*What did we say about habitats? (*Silence).*

What is a habitat? If it can't make sense. (*Silence)*.

Come on (*Silence*) What can we say about Peggy? Okay.

In the last lesson at Rose Primary the teacher used many application questions.

Table 4.13: Analysis of question types used in this lesson. Rose15/3 5A

The Cognitive Process Dimension						N=186 Questions
Knowledge dimension	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual knowledge	35	7	32	0	0	0
Conceptual knowledge	6	6	26	0	0	0
Procedural knowledge	0	0	0	0	0	0
Meta-cognitive knowledge	0	0	0	0	0	0
	Other question types					
Instruction	6	Instruction questions pertain to classroom management				
Clarification	4	A clarification type question, the teacher wants the learners to elaborate and explain their responses				
Validation	12	A validation or seeking consensus question. The teacher wishes to establish whether the learners are in agreement with him/her (Mortimer & Scott, 2003)				
Confirmation	3	A confirmation type question, the teacher enquires from the learners if she or they understood what was happening in the lesson				
Introduction to future lesson	3	Introduction to future lesson				

During the lesson on adaptation at Rose Primary on March 15, learners were expected to apply the features of animals to suit the environment they inhabited. Based on the content of the lesson, the teacher posed 26 (14 %) conceptual application and 32 (17%) factual application type questions. The lesson focused on teacher questions with the teacher playing the main role, thus teacher-centred. In examining the entire transcript it is evident the learners seldom explained the adaptation, but rather gave one-word answers or answered together. At times they spoke softly when asked to explain animal adaptations, which led me to believe they were unsure of their answers. The number of questions during this lesson indicates that the teacher did not interrogate the answers by allowing learners to explain themselves.

There were other types of questions used in all six lessons that did not fit neatly into Anderson/Bloom's Taxonomy. I grouped these questions into the following categories: validation, instructional, confirmation, and clarification, as discussed in Chapter 2. In a confirmation type question, teachers would ask their learners if they interpreted their responses correctly or if the learners understood what transpired during the lesson. The teacher at Geranium Primary, used 14 confirmation questions in a lesson of 107 questions. Examples from the first transcript are:

Question 71 Teacher: Did you hear that?

Question 67 Teacher: When a bee stung you, you can die *ne*?

Instructions were treated as questions, and reveals that teachers were managing their classes by converting instructions into questions. As indicated above, these rhetorical tag questions do not require an answer and the learners will normally use them to fulfil the instruction. In Question 5 (below), learners would talk louder because the teacher asked them to. Two examples from the transcript of the first lesson at Geranium illustrate this:

Question 5: Okay, listen, listen to the animal you must talk loud *ne*?

Question 19: Tell us the name of the animal and then what you …?

Question 50: You must speak louder *ne*?

Another type of question used in the lessons was the validation or consensus seeking question. The teacher wished to establish whether the learners were in agreement with her (Mortimer & Scott, 2003):

Question 103: Did you know a springbok is our national animal?

Question 60: Did you see you know the answers, huh?

In this question she is gave them information which she believed they should know. She was simply validating what she thinks they ought to know.

Clarification questions appeared in all the six lessons, but less frequently, and in this context to understand what the learners said. Wilen and Clegg (1986, citing Brophy & Good, 1985; Weil & Murphy, 1982) point out that effective teachers probe students' responses for clarification. Clarification questions have the capacity to encourage learners to support their point of view and stimulate thinking, whilst higher order questions, according to Wilen and Clegg, stimulate thinking.

Unfortunately, during the first lesson at Geranium Primary the teacher did not use clarification to its full potential. Learners were asked to give feedback about the animals they had explored. One learner said that snakebites were painful and could result in hospitalization. It could be that the teacher did not hear what the learner said and inquired by asking "what?" When the learner tried to repeat herself the teacher cut her short by asking "what about the snake?" The teacher did not listen but rather asked the rest of the class if they wanted to add anything else about the snake. It appeared that the teacher was too hurried to seek clarification. She did not listen for understanding and prevented her learners from expressing their thoughts:

Child:	Snake, it bites sore so that you can go to hospital.
Teacher:	What?
Child:	The snake
Teacher:	What about the snake?
Child:	It bites … so that you
Teacher:	Anything else on snakes? …

Having established the types of questions used in the six lessons, I then wanted to link them to the perceptions of teachers on the role of formative questions. This was investigated in order to answer the third research question below.

4.4 Analysis of data that relates to the third research question: What is the relationship, if any, between selected teachers' perceptions of questions in FA and the types of questions they use during the lesson?

This final section focuses on the last research question, which sought to determine if a relationship existed between the two teachers' perceptions of FA and the observation of their teaching practice. These two features were compared both qualitatively and quantitatively. Using the two responses from the questionnaires I tried to ascertain whether the two teachers' actions while teaching matched their knowledge of FA. Having conducted research with teachers, Torrance (1995) concluded that teacher perception influences assessment practices. Based on his work I expected there might be a connection between teacher practice and perception of FA and assumed that their beliefs would influence their action. The teacher from Rose Primary said that FA was "formal assessment which covers all the learning outcomes, marks and the learning abilities in the class, whereas the teacher from Geranium Primary said FA meant "monitoring and assisting with the learning and teaching process", adding that it "keeps the teacher in line with performance". It seemed that the teacher from Geranium defined FA more aptly and therefore would use it more effectively.

There were a number of similarities between the two teachers. In all six lessons neither used written questions, only used verbal or oral ones. They did not write questions on the board. In the revision lesson at Geranium the teacher made use of the test paper to read the questions. Another similarity between the teachers was that both posed factual and conceptual knowledge questions for the major part of each 30-minute period. In the cognitive dimension both asked learners to recall knowledge. The reason for using lower cognitive questions may be, according to Van Hess (2007, citing Wilen, 1991), that teachers use them to avoid a slow-paced lesson, to maintain attentiveness of learners and to maintain control in the class.

Analyses of the transcripts revealed that neither teacher used many evaluative questions. For instance, at Geranium Primary the teacher posed five conceptual evaluative and four factual evaluative questions over the three-day period. At Rose Primary, two conceptual evaluative questions were posed, dealing with making judgements based on the information discussed in the lesson. Neither teacher used

creative questions in any of the six lessons. Creative questions, defined by David Krathwohl (2002), pertain to generating patterns, planning, and producing a coherent product from different parts. That teachers use a limited range questions raises the question of whether they are trained to assess correctly. This concern is answered by Stiggins (2002), who claims that insufficient emphasis is placed on assessment competence during teacher training in the USA, and that few teachers are able to face assessment challenges in practice because they were not given the opportunity to do so.

Another interesting perspective on the limited range of questions is provided by Robertson, (2009), who states that lower order questions could be used to initiate a response, but of importance is what the teacher does with the answers the learners give. If learners give short answers it does not mean they do not understand concepts on a deeper level. The teacher has to extract the deeper understanding by asking effective questions that lead to answers that indicate whether they understand. In these lessons the teachers do not seem to interrogate the answers learners give. They do not follow up with questions that will help them make sense of what they know. The teacher from Geranium Primary used questions based on her perception of her learners' capabilities. It appears that her questioning style went hand in hand with her expectations of her learners. Her questionnaire revealed that she believed that her learners could easily manage short questions with one or few word answers, and said that learners found filling in missing words easy to answer.

It is evident that although she knew what FA entailed, the questions she asked were restricted by her perceived idea of their capabilities. She believed that learners found describing and defining words difficult. Both these skills are dependent on language, which serves as the vehicle to communicate thoughts, and if the learners do not have sufficient language knowledge they will be unable to organise their thought to describe and define words. Nowhere in the questionnaire did she make mention of language issues, which might impede learning, in view of only one of her learners using English at home and school

Using Robertson's (2009) contribution, and mine, it is plausible to assume that FA does not depend on the types of questions posed by the teacher but what the teacher does with the responses and how he or she uses them to explore learning thinking. This means that the teacher could use lower order questions as effectively as higher

order questions. Learner responses to lower order questions are important to scaffold learners on to higher order questions and thinking.

The analyses of transcripts reveal common characteristics which I decided to explore through themes. Four themes have been selected to highlight these commonalities: teacher centred approach; the learners dictating the methodology of the teacher; the teacher forfeiting opportunities to improve meaningful learning; the tacit approach to FA and the relationship between the type of lesson and FA. McMillan and Schumacher (1993) described 'theme analyses' as a subcategory of narrative analyses, in which themes are often used. They stated that they describe distinctive recurring qualities, characteristics, subjects of discourse or concerns. Often a theme is identified in one case or instance and then investigated in others. If such similarities appear in other cases a theme could be constructed around that idea.

4.4.1: Teacher centred approach

Both teachers used a teacher-centred approach in which the lesson revolved around teacher talk. In instances at Rose Primary, 10/3 and Geranium Primary 2/3, the teacher attempted to move the learners into a discussion, asking questions to encourage learner talk, but they were passive. When learners were called upon to contribute or give their answers they reported, but did not interact with their peers, who would listen passively and not engage with the speaker. Discourse between the learners did not materialise. I am certain that if learners spoke freely with each other the teacher would be able to explore their thinking, errors would be highlighted and they would be responding in ways that would improve their learning. This claim is supported by observations by Nakabugo and Siebörger (2001) on FA in schools in the Western Cape, from which they concluded that the more a teacher employed interactive and child-centred methods of teaching the more he or she was likely to be able to use assessment formatively, and vice versa. However, in these lessons learners rarely spoke freely and only when called upon. All the lessons ultimately ended in a question and answer session (see excerpt from Rose Primary 10/3 below).

The passivity of the learners appeared to influence the teachers' teaching approach. Unintentionally, learners dictated the teacher's methodology to a teacher-centred approach (discussed under the theme "Learners dictating the teacher approach").

Teacher:	Busi?
Busi:	This animal called cow. The cow eats grass so is the herbivores. It gives birth, so it is a mammal. Cow it lives in a bush. The colour of the cow is black and white.
Teacher:	Mmm
Children:	Thank you (*clap, clap, clap*) Very much (*clap, clap, clap*) and keep it up (*clap, clap, clap*) and shine.
Teacher:	I want to be clear about something. Let me ask. I heard Busi say the cow lives in the forest, bush akere? Where else the cow can live?
Child:	On a farm
Teacher:	On a farm *ne*? The cow is it a farm animal or a wild animal…
Child:	A farm animal.
Teacher:	It is a farm animal. If it is a farm animal that mean it lives, it can live around us akere? It can have a home outside our home and then somebody talked about kraal *ne*? The kraal … that's where now the kraal comes in, because the kraal is where we keep our cows, akere?... Who else, is ready?

4.4.2: Learners dictating the teacher approach

As discussed in Theme 1 above, the teacher used a teacher-centred approach because the learners failed to interact and discuss with the teacher and amongst themselves, as the teacher had intended. Teacher-centred teaching is not conducive to FA because the voices and thoughts of learners are silent.

An example of the learners changing the strategy of the lesson appears in the following scenario at Rose Primary. A learner, Peggy, had presented her homework report about a horse. The teacher then asked the class:

Teacher:	Okay do you have any questions for Peggy? *The learners do not respond.*
Teacher:	You don't have. But I do.
Teacher:	I didn't hear the habitat of your animal. You didn't say anything about the habitat of your animal?
Teacher:	A horse. What can you say?

Teacher: Who can help Peggy?

Here she is teaching them a skill of critical listening and asking questions. She is taking the lead in a discussion. Still there is no response from Peggy or the other learners. The teacher anticipated a discussion lesson and tried to initiate a discussion, but the learners did not take the opportunity, nor questioned their peers or interacted with each other. The teacher then changed her approach and asked questions.

At Geranium Primary, the teacher encouraged a learner to talk by starting with a discussion question, however, because she did not direct the question to a specific learner they all responded together. She then changed her approach and directed the question to Mpho, who responded with one-word answers. He and the rest of the class failed to use the opportunity for discussions. Once again, the approach of the teacher was converted into a question and answer lesson. The dialogue below is from the transcript from Geranium Primary on March 2:

Teacher:	Does snakes have bones?
Children:	Yes
Teacher:	Does snakes vertebrates or not?
Children:	Vertebrates, Invertebrates
Teacher:	Does the snake vertebrate or invertebrate? Shh, shh, aah, aah
Teacher:	Thank you. Some of you did say no and some of you did say yes. We are going to start with Mpho. Mpho?
Mpho:	Ma'am *(acknowledging the teacher)*
Teacher:	What did you think?
Teacher:	Are snakes vertebrates or invertebrates?
Teacher:	And why did you say that?
Mpho:	*(Short silence)* vertebrate, ma'am
Teacher:	Why is it a vertebrate?
Mpho:	ma'am, the snake doesn't have bones, ma'am.
Children:	Ag (*exclaiming that his answer is wrong*).

These two extracts indicate that neither teacher was able to use questioning skills to direct the discussion. It is true that they changed their approach to suit their learners but in this respect the quality of the lesson was compromised. The teachers should have used their professional knowledge and experience, which Bell and Cowie (2001) list as characteristics of FA, to encourage learners to discuss science concepts.

At times, the teachers did not seize opportunities to explore learners' thoughts, which is a strategy to understand their strengths and weakness and so improve learning. This will be discussed in the following theme.

4.4.3: Opportunities for improving learning approach

At times, opportunities were lost for discussion. As argued above, it is through learner talk that learners' thoughts can be interrogated and learning improved. An example of a lost opportunity is illustrated at Geranium Primary during the first lesson on February 28. A learner reported on her findings about the bee:

> Child: They have six legs and can't see anything and it takes lots of bees to make one drop of honey.
>
> Teacher: "Dit is interresant". Something else …?

Three discussion points emerge from the learners' response. One revolves around the characteristic of insects having six legs; one is the learner's perception that bees cannot see; and one is the communal production of a drop of honey. Despite the teacher admitting that the response was interesting she did not use the opportunity to encourage other learners to contribute to these statements but rather moved on immediately and asked other learners for their contributions about bees. This is an example of the teacher not using her professional judgement and experience to make use of an opportunity and to give feedback to the learner.

A different scenario arose at Rose Primary on March 10, when this teacher worked with learners' responses to improve learning. During the show and tell lesson, a learner gave a report of a cow. The teacher picked up on the previous lesson in which the learners had struggled to arrive at the word *kraal*. She integrated science with language. In the questionnaire, this teacher said that she integrated science with other learning areas, in this case English and Afrikaans, adding that she concentrated on spelling so that learners would familiarise the spelling with concepts. It was interesting that she claimed to share her learners' problems with the Language teacher so that the teacher would assist through language development:

> Busi: This animal called cow. The cow eats grass so is the herbivores. It gives birth, so it is a mammal. Cow it lives in a bush. The colour of the cow is black and white.

Teacher:	Mmm?
Children:	Thank you (*clap, clap, clap*) Very much (*clap, clap, clap*) and keep it up (*clap, clap, clap*) and shine.
Teacher:	I want to be clear about something. Let me ask. I heard Busi say the cow lives in the forest, bush *akere*? Where else the cow can live?
Child:	A farm.
Teacher:	On a farm *ne*? The cow is it a farm animal or a wild animal…
Child:	A farm animal.
Teacher:	It is a farm animal. If it is a farm animal that mean it lives, it can live around us *akere*? It can have a home outside our home and then somebody talked about kraal ne? The kraal … that's where now the kraal comes in, because the kraal is where we keep our cows, *akere*...

In this scenario, another feature of FA was observed. After each learner contributed the teacher encouraged the others to show their appreciation by chanting and clapping. Each learner was awarded for their contribution; the teacher and the peers valued their contribution. This strategy should encourage learner's self-worth. Wilen ad Clegg (1986) claim that effective teachers use praise in a genuine, sparing, and specific manner. Learners will believe they are appreciated if praise is genuine. Given this opportunity, they might be more willing to express their understanding or misunderstanding and praise may also encourage them to reveal their thoughts. Bell and Cowie (2001) highlight that in FA learners must trust and feel comfortable to disclose what they know. In an environment of trust, learners will be free to speak without fear and express alternative thinking.

In both lessons, a few learners remained passive. I could not determine why they were unresponsive because I did not interview them but I suspected a number of reasons. Perhaps they lacked confidence in their language ability; perhaps they did not trust the teacher with their answers; perhaps they did not have knowledge of the subject; or perhaps they were disinterested in the lesson content. If I had conducted interviews with these passive learners I doubt they would have trusted me enough to disclose their unresponsiveness.

Apart from the praise-giving described above, both the teachers and their learners failed to seize opportunities during lessons. Learners failed to ask questions or contribute to discussions and teachers failed to ask and use questions effectively. It

could be that the intended teaching approach was unfamiliar to the learners or perhaps my presence made them feel inhibited. The situation might have changed if I had visited the classes over a longer period. Possibly the learners would have been less inhibited and have given the teacher better opportunities to show their questioning skills.

4.4.4: Tacit Approach of formative assessment during the lessons

It appeared that teachers did not realise that they were assessing their learners continuously, because it is a daily routine in the class. Cowie and Bell (1999) explain that tacit assessment is interactive FA, which takes place during the interactions between teacher and learner. The teacher asks a question, the learner responds then the teacher reacts to the response. The two authors define this process as noticing, recognising and responding to learners. At times the teachers asked quality questions which would enable learners to respond in ways that would show how learners worked with the subject matter and interpretation of the questions. The teachers attempted to ask questions which explored learners' answers, but in most cases teachers could not construct effective questions that would lead to learners providing answers that indicated their knowledge or lack of it (Robertson, 2009). The following scenario illustrates this observation which took place at Rose Primary:

Teacher:	Now listen … we got different types, most of habitats. We got different types of habitats. If I may ask. Can all animals live in one habitat?...
Children:	no ma'am (*in unison*).
Teacher:	Heh?
Child:	no ma'am.
Teacher:	Don't sing. Just rise up your hand and I will … Can I take ALL animals; all groups of animals live in one habitat?
Chid:	No.
Teacher:	No, why …Can you tell us why?
Teacher:	Can somebody help Thato?
	Silence.
Teacher:	Why?

Teacher:	Yes we agree, we can't live even ourselves we cannot live in one habitat. Yes we live in one habitat because we are, our houses our homes are different *ne*? the same, they are all the houses, *akere*? but in our houses there are different.
Child:	Yes ma'am.
Teacher:	Inside our homes, now I want you to, to know why? *Silence.*
Teacher:	Can reptiles, mammals' *akere* when you talk about a group of animals we are talking about reptiles, mammals' birds' insects. Can they ALL and others live in one habitat?
Children:	No.
Teacher:	Why? *Silence.*
Teacher:	Come on, I know you know the answer. I know you know the answer, Masilela. I know you know the answer. Leslie? *Silence.*
Teacher:	Lebogo, why? *Long silence.*
Teacher:	Because of what? *Silence.*
Teacher:	Remember we talked about characterises, the reptiles has got the different characteristics of … Sibu, do you want to say something?

In this scenario, the learners chorused a short response. The teacher was not pleased with the chorusing of the answer and tried to rephrase the question. The learners could still not respond to the follow-up question and awkward silences followed, which ought to have indicated to the teacher that her learners had not understood her question. She could not articulate her questions well. One of the characteristics of FA suggests that an assessment is tacit, meaning that the poor feedback she gets from her learners should suggest to her that her line of questioning is inappropriate.

4.4.5: Relationship between the type of lesson and formative assessment

Table 4.1, at the beginning of the chapter, provided a brief summary of the schools, dates, type of lesson, and content covered. Commonalities in all these lessons were oral questions. Each lesson at both schools was 30 minutes in length. On average

there were 91 questions posed in Geranium Primary and 136 in Rose Primary. Where opportunity was given to learners to talk, the teachers asked fewer questions. Table 4.1 also shows that in the lessons in which learners had to report and discuss their homework the teacher posed fewer questions. The planned discussion lesson at Geranium Primary and the show and tell lesson at Rose Primary provided evidence of my observation. On March 2, the learners had to respond to a homework assignment finding evidence to support whether a snake was an invertebrate or vertebrate. This was intended to be a discussion lesson but turned out to be a question and answer lesson. The teacher asked 80 questions and gave them an opportunity to talk. Sixty four percent of her questions were mostly factual knowledge questions, which investigated the learners' recall (18), understanding (17), and application (16). On the conceptual level, only 9% of the questions addressed understanding and 1% evaluation. She facilitated this lesson by administering eight instructional, four clarification and six confirmation questions.

Similarly, at Rose Primary on March 10, during the show and tell lesson, the teacher asked fewer questions, 98 in total, most of which were related to recalling knowledge. Twenty questions focused on recalling factual knowledge and 16 asked learners to recall conceptual knowledge. The other questions used in the lesson mainly related to validation and instruction. She formulated 30 instructional questions to facilitate the discussions. In essence, she hardly assessed learners but facilitated the lesson.

On the other hand, when the methodology selected was mostly question and answer, the teacher asked more questions. At Rose Primary the teacher posed 124 and 186 questions in two separate lessons. In Geranium Primary the teacher posed 86 and 107 questions in two separate lessons. When the focus of the lessons was more inclined to understanding concepts the number of questions increased.

It seems that there is a relationship between the methodology of the lesson, the number of questions and the cognitive levels of the questions. Using Rose Primary Lesson 2 (show and tell) as an example, the teacher asked 98 questions. One third of the questions revolved around management of the lesson. Examples of management questions were: the teacher asked if learners had completed their homework, why they did not do their homework or if they wanted to ask questions. Factual and conceptual recall questions made up the other two-thirds of the questions. Since this was slightly

more of a learner-centred lesson, fewer questions were asked. Questions reinforced what learners said and revolved around management of the lesson.

4.5 SUMMARY

In this chapter, I analysed perceptions teachers held about FA. Almost half the teachers associated it with summative assessment, which indicates that most were not conversant with its meaning. However, one cannot conclude that if a teacher is unfamiliar with the term they would be unable to implement it. I arrived at this conclusion based on the two teachers I observed, together with the theories provided by Black and Wiliam, and Cowie and Bell.

In some instances, both teachers displayed a few or more characteristics of FA suggested by Bell and Cowie, but at other times this was not the case. Thus, one could say that the teachers used FA inconsistently. This was also evident with the teacher from Rose Primary, who did not define FA correctly but her practice matched some of the characteristics supplied by Cowie and Bell. She made use of many of them and a wider range of questions, which leads me to conclude that although she might not have been acquainted with the terminology of FA her assessment was reasonably similar to it.

In the questionnaire response, the teacher from Geranium Primary school expressed an understanding of FA that closely matched Black and Wiliam's definition. However, her lessons revealed that she used a narrower range of questions and did not follow up on her learners' responses. I would describe her teaching and assessment practices as traditional, because they teacher-centred and left little room for formative questions which would have made allowance for less rigid answers.

These results match those of Nakabugo and Siebörger's (2001) study, in that teachers can be classified into frequent formative assessors, occasional formative assessors and infrequent formative assessors. *Frequent formative assessors* use appropriate assessment strategies frequently and occasionally use inappropriate assessment strategies. *Occasional formative assessors* use appropriate assessment strategies at times and at other times used inappropriate assessment strategies. *Infrequent formative assessors* infrequently use appropriate assessment strategies. I would

describe the teacher at Rose Primary as an occasional formative assessor and the teacher at Geranium Primary as an infrequent formative assessor.

Aiming to determine what types of questions teachers used in their lessons, the results from the questionnaire indicated that they used mostly lower cognitive questions. It is not conclusive that teachers formulate these lower order questions based on their lack of confidence about the subject matter or their belief that their learners are not able to cope with higher cognition questions. However, it was apparent that teachers, particularly in these observations, did not make use of their learners' answers to interrogate what they knew.

Even though language seemed to have an influence on questioning, not many teachers commented on this aspect. It was interesting that both the teachers in this study did not mention language constraints. The teacher at Rose Primary tried to accommodate her learners by code switching but they both used rephrasing questions and repeating questions approaches. Also significant is that they were unable to articulate their questions, perhaps because they both taught in English, which is not their primary language.

Despite their attempts at FA, I believe that, overall, teachers need development and support in the implementation of it, as well as a firm foundation in their content knowledge.

CHAPTER FIVE

CONCLUSIONS AND IMPLICATIONS

5.0 INTRODUCTION

The intention of this research was to investigate the use by Natural Sciences teachers of questions as part of FA (FA) during lessons. The outcomes of the study provide a window on the use of FA in teacher practice, which is particularly relevant as it provides information for designing programmes for teacher development in the implementation of FA. Teachers who display skills for effective practice of FA could become part of the DoE's programmes for the design and modelling of strategies to assist other teachers. In this chapter I draw conclusions and make recommendations from my research and findings. However, since the study was based on only two educators' Natural Science lessons, and 33 teachers' perceptions of questions, the conclusions cannot be generalized.

5.1 TEACHERS' PERCEPTIONS OF THE ROLE OF QUESTIONS

All the participants who answered the questionnaire agreed that questions were important tools in their practice. Apart from using questions for assessment purposes they offered other interesting reasons for questioning. Teachers reported that using questions encouraged learners to solve environmental problems, resolve other problems, arouse curiosity, provoke thought, encourage learning and participation and broaden learner knowledge.

None of these teachers referred to the different categories of assessment by their correct names, viz., baseline (BA), diagnostic (DA), formative (FA) and summative assessment (SA), but rather only used the terms after initiation by the researcher. However, through their responses it was evident that they used questions for these various forms of assessment. For example, some said questions were used for testing. The statement is not specific but the word 'testing' is normally associated with the traditional summative examination of a skill or knowledge. Thus, this response was classified in the study as FA.

Another form of assessment not mentioned by the teachers was baseline assessment. The researcher in the questionnaire introduced this term, nevertheless, teachers understood what was meant by it and claimed that it could be used throughout lessons, at the beginning of lessons, at the beginning of a new section and, surprisingly, at the end of a lesson. Making use of BA at the end of a lesson raised a question: did the teacher use BA to prepare for the next lesson? If this was the case then the assessment could be regarded as FA (FA), which might mean that the teacher misunderstood what BA entailed. It was reassuring to discover that they viewed baseline assessment as a means to determine learners' prior knowledge and to determine how to pitch their lessons. Teachers differed in the way they reportedly implemented BA, some performing it orally and others in a written format.

Most teachers were unable to distinguish between summative and FA, as Black and Wiliam (1998) and Singh (1999) concluded in their respective studies. Approximately half the teachers claimed that FA was used for recording purposes. Recording is normally associated with summative assessment and learners' scores are used for progression and accountability purposes.

Some teachers spoke about continuous assessment but did not explain the term comprehensively or qualify their responses. According to Nakabugo and Sieborger (2001), it can be associated with both summative and FA, however, the teachers' answers did not convince me that they could clearly distinguish between the two. Eleven teachers gave interesting but miscellaneous understandings of FA. Considering the brief synopsis it appears that teachers' use of questions for FA was coincidental and not purposely planned. They were unaware of the teaching and learning capabilities of questioning in FA. A rider must support the latter statement, i.e., no interviews were conducted with teachers who were able to validate their written responses. Only one of the 33 teachers who completed the questionnaire could explain FA correctly, but this teacher did not complete the personal information so it was not possible to investigate his/her practice.

5.2 QUESTIONS USED BY TEACHERS

All the teachers claimed that they used straightforward or recall questions but to varying extents. Half claimed to use recall questions most of the time while the other

half claimed to use them sometimes. Recall questions appeared to be favoured because teachers wanted to assess all learners; they indicated that some learners were more able to answer these questions correctly. Selecting these questions did not ensure that all the learners were successful in answering them. Some of the reasons could be related to language barriers and socio-economic challenges.

Teachers added that questions dealing with defining concepts, provoking thought and investigation, were difficult for learners to answer. Interestingly, despite learners having trouble with these questions half the teachers claimed they sometimes used integration and application questions. A quarter of the teachers said they always used integration and application questions. Even though teachers believed they were addressing different levels of questions they did not link use of different questioning to formative purposes. They did not mention Bloom's higher categories of questions, such as analysing, evaluating and creating questions, which require advanced cognitive skills of learners.

The findings from the six lesson observations indicated that the two teachers mainly assessed factual and conceptual knowledge. They, like most of the other teachers, expected their learners to recall and understand facts and concepts. It seemed that the teacher from Rose Primary made better use of her learners' responses than the teacher from Geranium Primary. What a teacher does with learners' responses is the key to FA. Learner responses should be used as steppingstones to improve learning where the purpose of the teacher is to scaffold old knowledge/concepts to new knowledge/ concepts. Application type questions were rarely used, while analysis, evaluation and creating questions were neglected by both teachers in all the lessons.

There was evidently a parallel between their views of questions and actual practice, as discussed in the preceding discussion. Both teachers' responses in the questionnaire were consistent with their practice, both using a high percentage of recall questions and not making use of questions that made their learners analyse, evaluate or create in the factual and conceptual knowledge domains. Teachers' perceptions have an influence on their assessment practice and this was observed during the observation. Vandeyar and Killen (2007) carried out a similar study; however they first observed teachers then interviewed them. They discovered the assessment practices of three teachers to be consistent with their conceptions of assessment. Teachers asked questions they thought their learners could answer. On average, there were

approximately 114 questions per 30-minute lesson. Some of the questions were no different from the preceding question. The transcripts illustrate that the teacher made slight changes to the initial question then repeated the question. Rephrasing questions was probably used out of habit or as a strategy to get learners to respond by allowing them to think (wait time). Wilen and Clegg (1986) encourage wait time of 3-5 seconds after asking a question, which gives the respondent time to formalise their thoughts before responding. They claim that the response will likely be more appropriate and lengthy because the learner has time to think carefully. Higher cognitive questions as opposed to straightforward or recall require more time. Sometimes there were awkward long pauses between question and answer, which does not constitute think time. These long silences could be interpreted as confusion of the learners or not understanding the question. Most of the answers from the two teachers in the questionnaire matched what they did in practice.

5.3 RELATIONSHIP BETWEEN PERCEPTIONS OF TEACHERS AND QUESTIONS USED

In this section, I discuss the relationship of the practice using the themes encountered during the lessons and questioning. The themes were recorded in the previous chapter viz.:

The teacher-centred approach
Dictating the teacher approach
Opportunities for improving learning
Tacit approach of FA
The relationship between the type of lesson and FA.

It appeared that both teachers used various pedagogic skills to present different types of lessons. At Geranium Primary, the teacher used questions and answers in a homework activity, in a discussion lesson and in revision of a test, while the teacher at Rose Primary used questions and answers in discussion lessons and in a show and tell lesson. Both teachers tried to carry out interactive learner-centred lessons, probably to evaluate the learners' thinking and knowledge content. Interactive learner-centred lessons, according to Nakabugo and Siebörger (2001), offer more opportunities for FA. Learners, however, did not respond as the teachers intended and the lessons were

transformed to a teacher-centred lesson. In a subtle way, the learners derailed the teacher and dictated the teaching approach.

There were learning and teaching opportunities that arose which the teachers might have noticed but failed to react to appropriately. Feedback from learners can be subtle and nonverbal, expressed by long silences, face gestures, fidgeting or incorrect answers. Bell and Cowie (2001a) suggest that teachers use these interactive messages as part of FA. Noticing such opportunities required that the teacher be alert for learners' salient cues and responses. During the lessons, the teachers noticed that learners were not responding but they failed to use this assessment feedback economically and take control of the lesson. For example, there were long silences and the teachers tried rephrasing the questions, but this did not change the learners' behaviour. Responding to poor feedback and providing good responses is not an easy task. Apart from noticing, Cowie and Bell (1999) suggest that teachers recognise the significance of the learner responses. Teachers' knowledge of the subject matter can also assist them to probe learner responses and encourage thinking. Probing is one of the strategies of responding to learner responses which, according to Robertson (2009), interrogates learners' answers even if they are correct. He states that learners may give brief correct answers but when they are probed they cannot support their answers. FA on this level did not appear to be the case in these lessons.

Another reaction of teachers in these lessons was to ask for clarification questions, when the teachers wanted the learners to elaborate and explain their responses. They also used validation questions when the teachers sought consensus from their learners or wanted to establish whether the learners were in agreement with them (Mortimer & Scott, 2003). Instruction questions were asked which pertained to classroom management, which Wilen and Clegg (1986) describe as time-consuming and wasteful. However I argue that in some instances they are necessary because they make learners organised. Confirmation questions dealt with the teacher enquiring from the learners if they understood what was happening in the lesson. Sometimes the teacher would use questions as an introduction to a future lesson, hoping to create some form of anticipation in the learners.

Both teachers used assessment tacitly, meaning that they and their learners did not realise that assessment was taking place during the lessons (Cowie & Bell, 2001). However, it appeared that the teacher from Rose Primary interacted with the learners'

responses even though she submitted a poorer understanding of FA. The teacher at Geranium Primary gave a better description of FA but repeated her questions more and interacted less with learners' answers. It therefore appears that what these teachers said about FA did not relate to what they actually did. In the process of teaching the teacher is expected to notice, recognise, and respond to the learners' thoughts (Cowie & Bell, 1999), which is a mammoth task. Researchers cannot be too critical of teachers, especially if they are faced with contextual factors such as poor PCK, language and socio-economic problems.

5.4 IMPLICATIONS OF THE STUDY

The background of this study highlighted the problem of lack of teacher skills pertaining to FA. A need was identified to address how teachers could identify learner strengths and weakness to teach more effectively. It was envisaged that the outcome of this study would enable me as a subject specialist to encourage teachers to use FA to address this problem and in so doing improve teaching and learning. The study showed that teachers had a poor understanding of FA and even though FA is an effective and beneficial tool in teaching and learning it is not implemented ideally in Natural Sciences lessons. The consequences of not implementing FA effectively are as indicated in the following sub-sections.

5.4.1 Learning paradigm will not change for learners

Although this study did not investigate learners' ideas of how teachers should teach, learners I believe they do become accustomed to their teachers' methodology and assessment practices. This was evident in the two classes: Rose Primary and Geranium Primary. The learners were passive and relied on the teacher to direct the lesson and give approval to their responses. They did not question or challenge the teacher, which makes me believe that learners formulate an idea or paradigm of how teaching and assessment should take place. If they are not exposed to different teaching and assessment they will continue to be passive learners who are dependent on their teachers for teaching and feedback, and they will not take control of their own leaning (Hargreaves, 2005). Furthermore, learners will continue to believe that assessment and learning are separate activities and therefore will not make use of

assessment for learning. A science class should be busy and interactive, with learners communicating their thoughts with their peers. At each stage of their development, they should be challenging their ideas on science.

5.4.2 Learning paradigm will not change for teachers

Teachers from this study seem to be grappling with the paradigm of FA, particularly the Science lessons. They use their own brand of ideas around FA and apply it to their practice. Correct concepts of FA explained to them could avoid the misunderstanding of FA. One important aspect is the misalignment between understanding the link between assessment and learning. Teachers in this study used questions in their lessons without liking the action to assessment for learning. Teachers and learners did not seem to truly understand learning benefits, which could be derived from an activity. They do not integrate assessment with learning or use questioning for assessment and accountability purposes. This will influence the way they teach and the way they assess learners. Uncertainty of the FA will not benefit their learners.

5.4.3 Teaching practices will continue to be traditional

If FA implementation is unsuccessfully, teachers will continue to focus on learners meeting standards, which will translate to their teaching methodology. Particularly in the teaching of Science, teachers need to accustom learners to rationalising concepts and building on past knowledge. Learning of this nature requires learners to express their ideas, irrespective of their incorrectness fearlessly. Feedback by the teacher and their self-evaluation will allow them to understand concepts better. Misconceptions and errors viewed from the perspective of improving teaching and learning should be incorporated into teachers' views of assessment. This type of activity cannot be achieved in a traditional Science class, which is teacher-focused. Teachers will be responsible for directing the learning, evaluating learners' work and looking for ways to improve learning.

5.4.4 Learning paradigms must change to include assessment for learning and assessment of learning

This study does not intend to discredit assessment of learning, which has its place in education, because stakeholders such as government, departments of education, school administration, parents, teachers and learners themselves require feedback on a set standards or criteria. Accountability through the medium of summative and systemic assessment is determined by criteria which ensure that specified targets are reached, but these practices were and are commonly used, while assessment for learning (FA) has not received much popularity, despite it benefits.

This study shows that teachers have insufficient knowledge of FA, which has influenced their practice and learning. There is a need for teacher FA development programmes so that they can bridge the gap their understanding of the relationship between learning, teaching and assessment. However, they have to internalise the concept of FA and understand how to implement it. The implication entails getting them to change their perceptions of FA and assist them to improve their PCK in relation to FA. It is acknowledged that perceptions are not easy to alter but they could be influenced by presenting teachers with convincing positive experiences of FA. A constructivist approach to achieving this goal could be through training, peer and self-development.

The process could unfold as follows: incorporating elements PCK into FA training of teachers over an extended period. Between training sessions, teachers could practice FA, follow up with peer evaluation, feedback and self-reflection. Such a model would address contextual factors, which teachers experience on a daily basis in a non-threatening environment. The success of this training also depends on the support from the Department of Education (DoE) and facilitators to address challenges.

5.4.5 Continuous teacher support in a shared community of practice

Implementation of FA cannot be successful if teachers are left to battle with challenges alone. These challenges mentioned previously include class size; poor socio economic of their learners; and anguage problems. Demands for accountability purposes are also imposed on teachers to produce good results and to develop thinking learners. The implication of these challenges is that individual teachers are

unable to overcome these challenges on their own. FA implementation will fail if there are no support structures. Apart from the normal support from the DoE, facilitators and school management, teachers need to form communities of practice where they can share good practices to improve their practice through trial and error. This means that the teachers need to reflect the positive and negative aspects of their lessons.

The findings of this study were presented at a Southern African Association for Research in Mathematics and Science Education (SAAMSTE) conference for purposes of sharing research and to get input from other educationalists in the field of Science education. Their input has been incorporated in this study.

Appointments will be secured with the participating schools to provide them with feedback of this research, which may assist them in enriching their FA practices.

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APPENDICES

Appendix 1 Information and consent letter to principal

Research study on "Teachers' use of questioning in formative assessment in Natural Sciences lessons"

My name is Margaret Cornelius. I am a master's student at the University of the Witwatersrand's School of Education. I am also an education specialist in Natural Sciences in the Department of Education. My responsibility in the Education Department is facilitating curriculum development and support among teachers in schools in the Tshwane West District of Gauteng.

I am carrying out a study to investigate teachers' use of formative questioning during their Natural Sciences lessons. Formative assessment has a number of purposes. It provides an opportunity for learners to learn and deepen their understanding of concepts in Natural Sciences. By using formative assessment, the teacher is able to determine how well learners have understood the content of the lessons. The teacher can therefore use this information to improve teaching and assessment in the class. In addition, the teacher will be able to determine the strengths and weaknesses of the learners and design appropriate intervention strategies.

My study will involve me observing one Grade 5 class during Natural Sciences lessons. I would like to visit only one Grade 5 class, for three periods before I conduct the research. The purpose of me sitting in the class before I do the observation might assist me in achieving better results. By then the learners and the educator might be accustomed to my presence and their interactions in the class provide valuable information during the actual observation. The actual observations will take place during four subsequent visits. My observation will include compiling field notes and recording lessons with the aid of a tape recorder.

I would like to invite your school to participate in this study. Your participation means that you will allow me to observe, record and take field notes in one Grade 5 class for three thirty-minute periods.

My research will benefit your school in several ways:

- The responses from your school will contribute to an understanding of the potential of formative questioning and how it might assist the educators in improving their assessment and teaching practices.
- Your educators will gain experience in formative assessment and research, which might motivate them to do their own classroom based research. This will create reflective educators who critically analyse their teaching and are prepared to enhance their teaching and assessment.

If you agree to take part in my study, I would like to make it clear that your participation is voluntary, **no foreseeable negative consequences will result from your participation**, and all information will be treated confidentially. If you do choose to participate, you may withdraw from the study at any time, if for any reason you choose to.

I hope to publish the results of my study in academic journals and in order to protect confidentiality, names I use will be fictitious.

I will provide you with a summary of my research results on completion if you would like me to.

Thank you.

Margaret Cornelius

I agree/do not agree to let my school participate in the project and agree/do not to grant Margaret Cornelius permission to observe my Natural Sciences educator execute lessons to carry out research on questioning as a Formative Assessment strategy. I consent/do not consent to Margaret making audio recordings of observations as agreed between the educators and her.

Name ……

Designation (e.g. Principal / Deputy) ……

School ……

Tel: ……

Signature …… Date ……

Appendix 2 Information and consent letter to teachers

Research study on “Teachers’ use of questions in formative assessments in Natural Sciences lessons.”

My name is Margaret Cornelius. I am a master’s student at the University of the Witwatersrand’s School of Education. I am also an education specialist in Natural Sciences in the Department of Education. My responsibility in the Education Department is facilitating curriculum development and support among teachers in schools in the Tshwane West District of Gauteng.

I am carrying out a study to investigate how teachers the use questioning for formative assessments during lessons in the classroom. Formative assessment has a number of purposes. It provides an opportunity for learners’ to learn and deepen their understanding of concepts in Natural Sciences. Formative assessments also has benefits for the teacher, it enables the teacher to reflect and improve teaching and assessment in the class. In addition, the teacher will be able to determine the strengths and weaknesses of the learners and design appropriate intervention strategies.

I will sit in class in your Grade 5 class for three periods so that the learners will become accustomed to my presence before I do the observation in four subsequent lessons. I will observe how you use questions in whichever strand you are teaching at the time of the observation. You are not required to do additional preparation or submit any documents to the researcher. It is in the researcher best interest for you to conduct the lessons, as you would normally do.

I would like to invite you to participate in this study. Your participation means that you will allow me to observe your lessons with your Grade 5 learners. You will also allow me to take field notes and make audio recording of the lessons. My observation and finding will not be used for official district or school assessment reporting.

If you agree to take part in my study, I would like to make it clear that your participation is voluntary, **no foreseeable negative consequences will result from your participation**, and all information will be treated confidentially. If you do choose to participate, you may withdraw from the study at any time, if for any reason you choose to.

I hope to publish the results of my study in academic journals and in order to protect confidentiality, I use will be fictitious names.

I will provide you with a summary of my research results on completion if you would like me to.

Thank you.

Margaret Cornelius

Appendix 3 Information and consent letter to parents and guardians

Research study on “Teachers’ use of questioning in formative assessments in Natural Sciences lessons.”

Dear Parent/Guardian

My name is Margaret Cornelius. I am a Masters student at the University of the Witwatersrand’s School of Education. I am also an education specialist in Natural Sciences in the Department of Education. My responsibility in the Education Department is facilitating curriculum development and support among teachers in schools in the Tshwane West District of Gauteng.

I am researching how teachers question learners orally in the Natural Sciences classroom. This important activity done by the teacher is given a formal name in education, viz., FA.

Formative assessment has a number of purposes. For the learners it provides an opportunity for them to learn and deepen their understanding of concepts in Natural Sciences.

Formative assessment also has benefits for the teacher, it enables the teacher to reflect and improve teaching and assessment in the class. In addition, the teacher will be able to determine the strengths and weaknesses of the learners and design the ways of helping children reach their potential.

I will observe how teachers question learners in the Grade 5 Natural Sciences class. The observation will be audio recorded and later analysed.

I would like to use the information from the classroom observation and audio recording to provide the information I need in this study. Your child’s participation means that you will allow me to audio record their answers and possibly their questions in the class (pending your consent).

Your child’s anonymity will be ensured throughout the research by providing pseudonyms in this research and future publications.

My research may benefit future learners in the following ways:

- This research will contribute to an understanding of formative assessment.
- It could assist future researchers improve assessment and teaching practices.

Thank you.

Margaret Cornelius

Appendix 4 Research Questionnaire

Teachers' use of questions in formative assessments in Natural Sciences lessons.

Dear Teachers

I am conducting a study on questioning methods used by teachers to assess their learners' formatively during Natural Sciences lessons.

Each day you consciously or unconsciously use questioning in your class for assessment. The manner in which you use questioning in your practice might provide unique assessment information. This information is especially relevant in the South African context where classes are multicultural and multilingual.

Each participant response is unique and valuable, so I would appreciate that you answer the questionnaire truthfully. You may disclose your name if you wish to participate in the research. If you do not want to give your name you may choose to remain anonymous. Irrespective of your choice, your responses will be treated confidentially.

On completion of the research the findings will be available for all interested educational stakeholders.

Section A

1. Name (optional, only if you would consider participating in my research)

2. School Name (optional, only if you would consider participating in my research)

3 What is your highest qualification?

_____

4 What type of teacher training have you received? (e.g. / cert/ Diploma)

_____

5. What is/are the language/languages of learning and teaching (LOLT) in your school?

_____

_____

6. What are the home languages of the learners in your class?

_____

_____

7. List your Natural Sciences classes you teach and the numbers of learners in each class. e.g. Classes & Number of learners/class

Class	Example (Grade 5 A)			
Number of learners	Example (32)			

Section B (All answers should refer to Natural Sciences)

No 1	**Question**	**Always**	**Most of the time**	**Sometimes**	**Rarely**	**Never**
1a	When do you question learners to establish what they already know about a certain concept?					
1b	If you responded ALWAYS, MOST OF THE TIME OR SOMETIMES, give an example **when** and **how** you use this form of questioning.					
1c	If you responded RARELY OR NEVER, explain your response.					
No 2	**Question**	**Always**	**Most of the time**	**Sometimes**	**Rarely**	**Never**
2a	How often do you ask questions that require straight forward recalling answers?					
2b	If you responded ALWAYS, MOST OF THE TIME OR SOMETIMES Explain **when** and **why** you use this type of questioning?					
2c	If you responded RARELY OR NEVER, explain your response.					
o 3	**Question**	**Always**	**Most of the time**	**Sometimes**	**Rarely**	**Never**
3a	How often do you pose questions that require learners to integrate and apply what they were taught?					
3b	If you responded ALWAYS, MOST OF THE TIME OR SOMETIMES, explain **when** and **why** you use this type of questioning.					
3c	If you responded RARELY OR NEVER, explain your response.					

Section C (All answers should refer to Natural Sciences)

4	What is the purpose of questioning? Explain in the box below.
5	What do you understand by "formative assessment".
6	Comment on the following statement in the box below "Teachers ought to utilize different questioning strategies to encourage their learners explore their understanding of concepts".
7	Which types of questions are your learners more able to answer correctly? Explain and give examples below.
8	Which types of questions are your learners least able to answer correctly? Explain and give examples below.
9	In what ways do you assist your learners to help them respond to your questions? Explain and give examples below.
10	What negative or positive factors influence the questions you ask in your lessons?

Thank you for sharing this information with me.

Margaret Cornelius

Appendix 5 Raw data from research questionnaire

	Total number of questionnaires analysed 33	
1-4	**Demographics**	
5	**Language of Learning and teaching (LOLT)**	
	English	18
	English and Afrikaans	5
	English and Setswana	5
	Setswana	2
	English, Setswana, Sepedi	1
	English and Sepedi	1
	English, Setswana, Zulu, North Sotho	1
6	**Home Languages of learners**	
	Setswana, Sepedi, Isizulu, XiTsonga, South Sotho, Pedi, Venda, Ndebele, English, Afrikaans, Swati and other languages like Portuguese and French	
7	**Class Size**	27 min 70 max
	Section B	
1	**When do you question learners to establish what they already know about a certain concept?**	
	Always	14
	Most of the time	16
	Sometimes	3
	Rarely	0
	Never	0
2	**How often do you ask questions that require straight forward answers?**	
	Always	7
	Most of the time	15
	Sometimes	10
	Rarely	0
	Never	0
	Question unanswered	1
3	**How often do you pose questions that require learners to integrate and apply what they were taught?**	
	Always	8
	Most of the time	16
	Sometimes	8
	Rarely	0
	Never	0
	Question unanswered	1
	Section C	
4	**Purpose for questioning**	
	Testing knowledge and understanding, lead children to correct answers, diagnostic assessment, check educators method, provoke thought, encourage and participate, draw attention, assessment standards are met, grasped information, improve standard, gauge prior knowledge, increase	

	focus, interact with learners, broaden their knowledge, assessment purposes, introduce new concepts , make them curious, apply knowledge, see if teaching method is relevant, if learning outcomes are achieved, reflect on teacher presentations, strengths weakness and needs of the learners, Sort out problems, how to approach topics, keep on track, solve environmental problems	
5	**What do you understand by Formative Assessment**	
	Identify strengths and weaknesses, and shape future teaching and learning	1
	Provide room for remedial lessons and expanded opportunities	1
	Judging whether learners are progressing in the subject matter/grade	3
	Identifying learning barriers	2
	Formal assessment and recorded. Assessment for recording purposes	14
	To develop learners knowledge and understanding	1
	Continuous information gathering during learning process.(informal assessment).	5
	To see if learners understood what they were taught	1
	To inform (response vague)	2
	Applying what has been taught	1
	Unanswered	2
6	**Comment on: Teachers ought to use different questioning strategies to encourage their learners explore their understanding of concepts.**	
	Agreed	30
	Not agreed	0
	No comment	3
7	**Which types of questions are learners more able to answer correctly?**	
	Matching	5
	Choose the correct answer	3
	Multiple Choice Questions	4
	True and False	4
	Complete	1
	Fill in missing words	3
	Describe or explain	6
	Simple recall	7
	One word answers	3
	Name	4
	List	4
	Open ended questions	3
	Definitions	2
	Labelling	2
	Discussion questions	1
	Direct questions	1
	Sketches	1
	Categorising	1
	Concepts	1
	Draw and design	2
	Non thought provoking questions	1
	Questions that need reasoning ability	1
	Asking questions that lead them to answering difficult questions.	2
	Introductory questions	1

	Questions that require previous knowledge	1
8	**Which questions are learners least able to answer correctly?**	
	Thought provoking questions	4
	Descriptive questions	3
	Explaining or defining questions	7
	Apply their knowledge	1
	Comprehension questions	1
	How questions	2
	Why questions	3
	Research and investigative questions	4
	Lazy to reason	1
	Reports	1
	Summarise	1
	Analysing questions	1
	Cannot express themselves	1
	Short paragraphs (struggling in reading and writing)	1
	Insightful questions	1
	Blooms higher order questions	1
	Open ended questions	1
	Can answer all types of questions, no problems	1
	Unanswered	2
9	**In what ways do you assist learners to help them respond to your questions?**	
	Provide leads, guides or give clues	11
	Ask learners to re-explain what they need to do	1
	Intervention	1
	Teaching then testing	1
	Simplify the questions	3
	Reading to learners	2
	Rephrasing questions	5
	Use other resources e.g. internet, library	1
	Drilling important words	1
	Stimulate interest with convergent questions	1
	Using body language	2
	Explain question and/or concepts	6
	Give examples	2
	Use their home language	1
	Relating to the learners environment	1
	Unanswered	2
10	**What negative or positive factors influence the questions you ask in the class?**	
	No responses	3
	Vague responses	2
	• Family background, relations and society	
	• To check if they understand	
	Negative	
	Language of Science	1
	English introduced in Grade 4, learners still new to English	1

	LOLT differs from Home language	6
	Reading and writing skills of learners	1
	Lack of vocabulary influences the questions asked	8
	Socio economic problems, no support	1
	Accommodating certain learners	1
	Movement of teachers from LA to LA	1
	Teacher knowledge of the learning area	1
	Learners do not think or are lazy to think	1
	If the teacher is unprepared	2
	Different capabilities of learners	1
	Barriers to learning	6
	Learners distracted by other disruptive learners	2
	Lack of exposure	1
	Age of learners	1
	Limited questions to cater for all learners	1
	Only certain learners respond	1
	Positive	
	Teacher knowledge of questioning strategies, subject matter and understanding learners	2
	Provide feedback	1
	Learner participation	1
	Application type questions	1
	Resources: Availability of resources e.g., posters and books.	1
	Teacher prepared for the lesson.	1
	Making use of assessments standards helps constructing better questions	1
	Bold learners	1
	Making use of various questioning levels for different learners	4
	Aware of the transitional stage of the learners	1
	Focusing to what learners enjoy	1
	Appropriate use of LOs and Ass	
	Giving rewards or incentives	1
	Unanswered	3