A study of mathematics instructional practices in foundation phase grade three classrooms in East London.

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CHAPTER ONE
AN INTRODUCTION TO THE RESEARCH

1.1 INTRODUCTION TO THE STUDY

This study describes the instructional practices of grade three teachers in their attempt to facilitate mathematical learning. The teachersô practices are described in relation to the requirements of the revised National Curriculum Statement.

In order to demarcate the field of investigation, the researcher provides an overview of the historical background of the study and draws attention to the knowledge interest of the investigation. The problem, the research questions, the assumptions of the study, the significance of the study, the rationale and the delimitation of the study are all set out in this chapter**.** A list of the major terms used in the study is also given. In concluding the chapter and outline of the issues discussed in each of the five chapters is given.

1.2 BACKGROUND OF THE STUDY

The revised National Curriculum Statement (NCS) proposes a different approach to what most South African teachers and learners have experienced in classrooms in the past. The previous South African curriculum or ósyllabusô as it was then called, was ñEuro-centered, authoritarian, prescriptive and context-blindò Jansen, as cited in (Ramsuran & Malcolm, 2005, p.518) and emphasized content and procedural knowledge. The NCS heralded a profound shift in curriculum policy, advocating outcomes-based philosophies, learner-centered integrated classroom learning experiences of knowledge, skills, attitudes and values.

… in South Africa have been framed by an outcomes-based education (OBE) policy, ñoutcomes-based education forms the foundation of the curriculum of South Africaò (Department of Education, 2002b, p.1). One of the assumptions underlying this nationally directed educational reform process is that teachers will be both willing and able to adapt their teaching and assessment practices accordingly.

Outcome-Based Education (OBE) was adopted as the approach that would enable the implementation of the new curriculum. According to Spady (1994, p.1), ñOutcome-Based Education means clearly focusing on and organizing everything in an educational system around what is essential for all students to be able to do successfully at the end of their learning experiences. This means starting with a clear picture of what is important for the students to be able to do, then organizing the curriculum, instruction, and assessment to make sure this learning ultimately happensò The (OBE) framework defines the knowledge, competencies, attitudes and values which learners in different areas should acquire, develop and demonstrate. In the South African OBE system there are different kinds of outcomes:

- Critical and Developmental Outcomes: ñThe critical and developmental outcomes are a list of outcomes that are derived from the Constitution of South Africa and are contained in the South African Qualifications Act (1995). They describe the kind of citizen the education and training system should aim to create.ò (Department of Education, 2002a, p.11)

- Learning Area Outcomes: These are broad cross-curricular outcomes which are statements of intent giving direction and guidance to more specific outcomes. OBE fosters a more holistic approach, where integration of learning content is emphasized. In order to facilitate integration, the new curriculum is developed on g areas. Each learning area has its own specific outcomes.

- Assessment Standards are other elements which play an important role in the NCS. These refer to specific knowledge, attitudes, proficiency and competencies which should be demonstrated in the context of a particular learning area. It tells teachers how deep, how complex and how far to go with the content. It is not intended to prescribe to teachers as to what to teach, but rather to assist them. They give teachers much more detailed information as to what learners should know and be able to do in order to show achievement. They also provide teachers with levels to be reached in the process of achieving the outcome. The outcomes and assessment standards "emphasize participatory, learner-centered and activity-based education." (Department of Education, 2002a, p. 12). The NCS policy document further states that the learning outcomes and assessment standards "leave considerable room for creativity and innovation on the part of teachers interpreting what and how they teach" (Department of Education, 2002a, p.12).

An important feature of OBE is that all learners are expected to succeed Spady & Marshall, 1991). This places tremendous responsibility on the teacher to be creative and innovative in their teaching to develop means in order for all learners to be successful. According to the Department of Education, (2002a, p.12), outcomes-based education in South Africa "is intended to ensure that all learners are able to develop and achieve to their maximum ability and are equipped for lifelong learning". One way of doing this is by fostering different teaching and learning styles. (Department of Education, 2003a).

Scrutiny of the critical and developmental outcomes as well as the learning outcomes and assessment standards for mathematics in the foundation phase reveals in the past that children were introduced to mathematics as

…hey are expected to engage in the activity, thus leading to mathematics enculturationòBishop (1988, p.191)

The kind of teachers envisaged by the NCS, are ñteachers who are qualified, competent, dedicated and caringò (Department of Education, 2002, p.3). Teachers are seen as the ñkey contributors to the transformation of education in South Africaò (Department of Education 2002, p.3).

However, poor performance in mathematics in schools is a subject that educators and education department officials continue to wrestle with (Bloch, 2009). It is not only of grave concern in the Eastern Cape but in the entire country. South African learners continue to perform poorly in both international and national assessments. ñThere is no shortage of evidence showing how badly the South African education is performingò (Bloch, 2009, p.17).

Official tests implemented by the Department of Education confirm these poor results. In the first of the Foundation Phase Systemic Evaluations, carried out in 2001 on grade three learners, 51000 learners were tested. The results were released by the then Minister of Education, Kader Asmal in 2003. ñThe results showed that there was an average score of only 30% on the maths markò (Bloch,2009, p. 62).The following Foundation Phase Systemic Evaluation conducted in 2007 on 54000 grade three learners produced equally disappointing results. In her address at the first foundation phase conference on the 30th September 2008, the then Minister of Education, Naledi Pandor, highlighted the findings of the systemic evaluation survey conducted on a sample of 54000 grade 3 learners from more than 2400 schools in 2007. The average percentage score in numeracy was 35%. This average score was an improvement on the baseline score in 2001, which was 30% (Bloch, 2009). Undoubtedly, however, these scores are unacceptably low.

ns evaluating literacy, numeracy and science ability clearly show that South African children are not getting itò (Bloch, 2009, p. 17). Bloch (2009, p. 58) further reports that ñSouth African schools are among the worst performers in maths and literacyé South Africa routinely comes last on all international scoresò. According to the Trend International Mathematics and Science Study (TIMSS), originally called Third International mathematics and Science Study, which was administered to grade eight learners, in 1998-99 as well as in the 2003 school year, the South African learnersô average was significantly lower than the international average. (Mullis, Martin, Gonzalez, Gregory, Garden, OôConnor, Chrostowski & Smith, 2000).

Interestingly, in the summary of educational quality in South Africa, Taylor, Mullerand & Vinjevold, (2003, p. 41) allude to the expectations of the curriculum, ñstudies conducted in South Africa from 1998 to 2002 suggest that learnersô scores are far below what is expected at all levels of the schooling system, both in relation to other countries and in relation to the expectations of the South African curriculum.ò This view is supported by a substantial body of evidence (Fleish, 2008, Bloch, 2009, Velupillai, Harding & Engelbrecht, 2008).

Fleish (2008, p.121) points to the ñclassroom as the major source of the crisis in primary educationò. Bloch concurs; he maintains that there are ñpoor levels of content knowledge, especially in maths and the sciencesò among teachers, a well as ñnot enough maths teachers with advanced levels of agility and teaching methodologyò (Bloch, 2009, p. 83). Having said that, Bloch questions how, these teachers who lack knowledge, are expected to prepare the next generation of sophisticated, technologically savvy, cutting edge knowledge workersé They do not have the skillò (2009, p .82). According to Schollar as cited in (Fleish, 2008, p.136), ñmisinterpretation of the new curriculum, particularly teachers failure to teach children basic methods and procedures, specifically in mathematics, rmance of the overwhelming majority of childrenò Bloch (2009, p. 100) agrees, that the reasons for the problems are the ñill-preparedness for the new demands and the new curricular, their failings in the realm of detailed pedagogies and methodologies of teachingò.

Johnson & Cupitt (2004, p. 3), indicate that a ñkey factor impacting on teaching in primary school mathematics is teachersô confidence in their own understanding of mathematical concepts and problem solving processes.ò The challenge is further exacerbated ñif teachers have had no experience of a classroom focused on discourse and mathematical inquiry in their own mathematics learningé If they have had limited exposure to open-ended questions, practical approaches or reflective practice in the learning of mathematics, it is unlikely that these elements will become part of their own pedagogical repertoire.ò (Johnson & Cupitt, 2004, p. 3). Tranter, Verrall & Zevenbergen in (Johnson & Cupitt, (2004, p. 4), suggest that ñmany students do not have equal access to success in mathematics because particular classroom practices result in unequal opportunities for particular groups of students to achieve successò.

This study endeavours to investigate teacher practices in grade three classrooms in East London primary schools. This study is about the process of policy appropriation or misappropriation by agents mediating between policy and its actual practice in the classroom. In this case, the policy in question is the revised NCS policy. The mediators between policy and practice in the classroom are teachers. This study aims to ask, ñWhat is going on in the teaching of mathematics in these foundation phase classrooms?ò

EM AND QUESTIONS

The main concern is whether the teaching practices of grade three teachers are aligned to the NCS, particularly pertaining to the teaching and learning of mathematics as a learning area in the foundation phase class.

This study is interested in investigating the practices of grade three teachers to facilitate mathematical learning in their classrooms. The researcher will deliberately choose teachersô current practices, and not the learnersô outcomes, as the point of departure for this research. No attempt is made to understanding the reasons for current teacher practice. Instead, the researcher looks at teaching from the teacherøs perspective by investigating the teacherøs actions in the classroom.

1.3.1 Main Research Question

The main research question that guides this research is:
What do grade three mathematics teachers in East London schools do to facilitate mathematical learning?

1.3.1.1 Sub-questions:

1. What practices in mathematics and mathematical activity are prevalent among grade three teachers?
2. What are the practices of teaching mathematics that would best facilitate mathematics learning in grade three?
3. What teaching strategies are employed by these grade three teachers in their classrooms?

The purpose of this study is to investigate mathematics teaching and learning practices in grade three classrooms.

This study aims to investigate the relationship between existing practices of school mathematics teaching and the national curriculum requirements. The first purpose of this research is to describe current foundation phase mathematics instructional practices. It must, however, be recognized that teachersôactions only form part of the mathematics instructional practice. Behind any action is a system of decisions. This decision making reflects a teacherôs knowledge-in-practice but it cannot only be captured through observing the teacherôs practice.

In order to see how teachersô pedagogical content knowledge and the richness of their interactive decision making affects their mathematics instructional classroom practice, it is necessary to go beyond what can be observed directly. The researcher believes that a careful and respectful description of current mathematics instructional practices forms the basis for offering suggestions.

To allow for a more in-depth analysis of current teacher practice in the teaching of mathematics, the research focus is narrowed further. Instead of focusing on the intrinsic aspects of a mathematics classroom, the focus in this study is directly concerned with the teachersôfacilitation of learnersô mathematical learning. Since the approaches may vary significantly at each grade level, for this study the choice is to work with grade three mathematics teachers. Grade three was chosen, because issues prevalent in the starting of school may be less influential in this grade, while at the same time mathematical practice is still in the process of being established.

This study argues that foundation phase teachers as agents of change mediating between policy and its actual practice in the classroom, appropriate and misappropriate the NCS policy.

1.6 DELIMITATION OF THE STUDY

The study was restricted to five foundation phase grade three classrooms in East London. The participants were teachers of foundation phase level. The researcher examined teachersôinstructional practices in the teaching and learning of mathematics in the grade three classrooms.

1.7 DEFINITION OF TERMS

The following frequently used terms are defined:

Foundation Phase

According to the Department of Education, (2003b, p. 19), ñthe foundation phase is the first phase of the General Education and Training Band: (Grades R, 1, 2 and 3)ò. In this study the same definition is applied.

Instructional Practice

The researcher has used the term instructional practice extensively in this thesis and it is therefore necessary to provide the reader with some sense of understanding of this term. In this study, the term instructional practice is used to mean everything that teachers do in order to support the learners in their learning. The most important features of the lesson ï key mathematical ideas, the quality of explanations, the provision of high quality tasks, how mathematics is taught, hands on materials - are all part of instructional practice.

Outcomes-Based Education (OBE)

“Outcomes-based education forms the foundation of the curriculum of South Africaò (Department of Education, 2002b, p.1). Outcome-Based Education (OBE) was adopted as the approach that would enabled the implementation of the new C2005 curriculum as well as the present NCS.

National Curriculum Statement (NCS)

The revision of C2005 resulted in a Draft Revised National Curriculum Statement. This document was subsequently further revised. A streamlined and strengthened C2005 is now called the revised National Curriculum Statement (NCS).

Pedagogy

In attempting to develop a definition of pedagogy, the researcher refers to Simon (1987, p. 371), who stated that: ñPedagogyô is a more complex and extensive term than ôteachingö, referring to the integration in practice of particular curriculum content and design, classroom strategies and techniques, a time and space for the practice of those strategies and techniques, and evaluation purposes and methods. All of these aspects of educational practice come together in the realities of what happens in classrooms.ò

1.8 ASSUMPTIONS

This study assumes that if teachers embrace the principles and requirements of the NCS and incorporate them within their instructional program and practices, learnersô mathematical achievement will increase.

1.9 RATIONALE

It is of relevance to investigate and describe current mathematics practices for several reasons:

m which to assist teachers in seeing and using alternatives in terms of teaching materials, teaching styles and activities, content and content organization. As teachers have to take into consideration the current situation of learners, so too must teacher educators take into consideration the current situation of teachers. Thus an understanding of current practices is relevant to speculations on developing practice.

- It is a way to determine what is working and what is not working within practices, especially those which have until now not been well described.
- It is a means to develop methodology in describing practices. This is necessary for further work in describing how practices change, making it relevant in terms of determining the success of the National Curriculum Statement (NCS) and OBE. It is necessary for the planning, implementation and evaluation of actual initiatives in pre- and in- service teacher training.
- It is a way to contribute to the knowledge base as to what mathematics teachers actually do to impact student learning and understanding of important mathematical ideas and concepts

1.10 THESIS CHAPTER OVERVIEW

Chapter One: Introduction

This study describes the instructional practices of grade three teachers in their attempt to facilitate mathematical learning in relation to the requirements of the revised National Curriculum Statement. This chapter is the introduction to the study. The study is contextualized and the relevance is described in this chapter. In addition, included in this chapter is the background of the study, the research problem, research questions.

is consists of four chapters:

Chapter Two: The Literature Review

In chapter two the literature reviewed provides the theory on which the study is based. Prior and current literature pertaining to mathematics teaching and learning practices are discussed and analyzed. The literature pertaining to the foundation phase mathematics policy and the implementation thereof is reviewed.

Chapter Three: Research Methodology

Chapter three locates this research process within research paradigms. The methodology of ethnographic research is explained. A comprehensive description of the research instruments used to obtain the data are explained, and the limitations and advantages of the instruments are reflected on in relation to this study. The choice of the sample and the selection of the site are explained. Finally the process of data analysis and interpretation is described. The chapter concludes with a presentation of the ethical issues that the researcher took into consideration in the realization of the study.

Chapter Four: Data presentation and Analysis

In chapter four the data is presented, analyzed and the findings are discussed. The researcher drew on the data gathered using the instruments as explained in chapter three to describe the teachersô instruction practices.

Conclusions and Recommendations

In the final chapter the key findings of the study are described in relation to the theories discussed in the literature reviewed in chapter two. The implications of the results are then discussed and summarized. The significance of the research and the limitations are presented. Finally, the concluding chapter offers the reader further possibilities for developing, and makes recommendations for further research in this area.

1.11 SUMMARY

The purpose of this chapter was to demarcate the field of the research by locating it within the historical context, and so contextualize the problem of the study. The researcher highlighted the aims of the research, and explained key concepts central to the research process and the construction of this thesis. The implications of this research are addressed from a higher education institutional perspective, and with regard to the researcher's perspectives of teaching and learning within the context of pre-service teacher education. The implications of this research are addressed from a teacher pre--service perspective as well as with regard to the transformation of teacher practices. It is important to determine what is working and what is not working and the reasons why.

The following chapter, chapter two reviews the literature that supports this study.

CHAPTER TWO
THE LITERATURE REVIEW

2.1 INTRODUCTION

The purpose of this study was to investigate foundation phase teacher practices when teaching mathematics in grade three classrooms in East London primary schools. (Fleish, 2008, p.121) points to the ñclassroom as the major source of the crisis in primary education.ò This study is about the process of policy appropriation or misappropriation by agents mediating between policy and its actual practice in the classroom. In this case, the policy in question is the revised NCS policy. The mediators between policy and practice in the classroom are teachers. This study aims to ask ñWhat is going on in the teaching of mathematics in these foundation phase classrooms?ò

This research investigates the relationship between existing practices of foundation phase mathematics teaching and the curriculum requirements. An extensive examination of the literature relevant to the practice of teaching and learning of mathematics in the foundation phase including current literature was reviewed. The researcher commenced the review with the requirements specified by the National Curriculum Statement (NCS) as teacher practice was described in relation to the NCS.

This chapter also examines the literature in relation to the learning theories compliant with the NCS, the literature on effective teaching and learning practices as well as literature on teachersô mathematical content knowledge in shaping teacher practice in classrooms.

In reviewing the literature the researcher looked at promising changes in the NCS for the improvement of mathematics teaching practice in the critical foundation phase. Knowledge of the new curriculum (NCS) reveals ching practice. It is a necessary requirement that all South African teachers implement this curriculum in their classrooms. The practice of the foundation phase mathematics teacher in implementing the NCS serves to inform this research.

2.2 AN OVERVIEW OF THE NATIONAL CURRICULUM STATEMENT (NCS)

2.2.1 Outcomes-Based Education (OBE)

ñOutcomes-based education forms the foundation of the curriculum of South Africaò (Department of Education, 2002a, p.1). ñThe new curriculum promises to provide all South African children with quality education which will "ensure that learners gain the skills, knowledge and values that will allow them to contribute to their own success as well as to the success of their family, community and the nation as a whole" (Department of Education, 1997, p.10).

The NCS is the óstreamlinedô and óstrengthenedô curriculum that was introduced in South African schools in 1998 as Curriculum 2005 (C2005). Outcome-Based Education (OBE) was adopted as the approach that would enable the implementation of the new C2005 curriculum as well as the present NCS. The (Department of Education, 1997) made the following claims regarding OBE:

- The move towards an outcomes-based approach is due to growing concern around the effectiveness of traditional methods of teaching and training, which are content based. An outcomes-based approach to teaching and learning, however, differs quite drastically and presents a paradigm shift.

ed education and training system requires a shift from focusing on teacher input (instructional offerings or syllabuses expressed in terms of content) to focusing on the outcomes of the learning process.

- Outcomes-based learning focuses the achievement in terms of clearly defined outcomes, rather than teacher input in terms of syllabus content.

- In outcomes-based learning, a learnerõs progress is measured against agreed criteria. This implies that formal assessment will employ criterion-referencing and will be conducted in a transparent manner.

According to Spady (1994, p.1), ñOutcome-Based Education means clearly focusing on and organizing everything in an educational system around what is essential for all students to be able to do successfully at the end of their learning experiencesò The (OBE) framework defines the knowledge, competencies, attitudes and values which learners in different areas should acquire, develop and demonstrate.

In the South African OBE system there are different kinds of outcomes, namely the Critical and Developmental Outcomes as well as Learning Area Outcomes.

- Critical and Developmental Outcomes: ñThe critical and developmental outcomes are a list of outcomes that are derived from the Constitution of South Africa and are contained in the South African Qualifications Act (1995). They describe the kind of citizen the education and training system should aim to create.ò (Department of Education, 2002, p.11)

- Learning Area Outcomes: These are broad cross-curricular outcomes which are statements of intent which give direction and specific outcomes. OBE fosters a more holistic approach, where integration of learning content is emphasized. In order to facilitate integration, the new curriculum is developed on the basis of learning areas. Each learning area has its own specific outcomes.

The Assessment Standards is another element which plays an important role in the NCS. These assessment standards refer to specific knowledge, attitudes, proficiency and competencies which should be demonstrated in the context of a particular learning area. It tells teachers how deep, how complex and how far to go with the content. It is not intended to prescribe to teachers as to what to teach, but rather to assist them. The assessment standards give teachers much more detailed information as to what learners should know and be able to do in order to show achievement. They also provide teachers with levels to be reached in the process of achieving the outcome. The outcomes and assessment standards ñemphasize participatory, learner-centered and activity-based education.ò (Department of Education, 2002a, p.12). The NCS policy document further states that the learning outcomes and assessment standards ñleave considerable room for creativity and innovation on the part of teachers interpreting what and how they teachò (Department of Education, 2002a, p.12). The teacher is meant to first select the desired learning outcome and then instructional materials and assessments are then created to support the intended outcome.

A study of the critical and developmental outcomes as well as the learning outcomes and assessment standards for mathematics in the foundation phase, clearly show that the focus has shifted. ñThe rationale is that for too long South African learners have memorized content, which they are required to regurgitate in tests and examinationsò (Hattingh, Rogan, Aldous, Howie & Venter, 2005, p. 13). With the introduction of the OBE-based curriculum, children are not meant to be introduced to mathematics knowledge but as active participants in the construction of their own knowledge.

Killen (2005, p18), explains OBE as ñmakes teaching purposeful and systematic, rather than haphazard, while still allowing students to discover, to follow their interests, to take responsibility for their own learning, and to develop both personally and academically. It enables teachers to provide students with appropriate and purposeful learning experiences and opportunities so that they can develop originality, self-motivation and independence at the same time as they acquire useful knowledge and skills.ò

The NCS heralded a profound shift in curriculum policy advocating outcomes-based philosophies where process and content are emphasized in learner-centered integrated classrooms incorporating learning experiences of knowledge, skills, attitudes and values.

2.2.2 The Kind of Teacher that is Envisaged by the NCS

With the new curriculum came new teacher roles and new teacher identities. Schifter (1995), talks specifically about the õconceptions of mathematics that teachers enact in practiceö (p. 18) as they move from õan ad hoc accumulation of facts, definitions, and computation routinesö to being more attuned to õsystematic mathematical inquiry organized around investigations of big mathematical ideasö (p. 22). The literature on mathematics teacher change conveys an underlying assumption that individual teachers have an epistemological and pedagogical orientation that permeates their mathematics teaching.

Crucial, however, is that teachersô beliefs and pedagogical approaches need to move from being traditional to more reform-oriented. This is not to say that scholars convey that teacher change is simple or straightforward. For many foundation phase teachers, this requires a shift from the athematics pedagogy to a more constructivist pedagogy. The syllabus of the past emphasized content knowledge. Gregg, in (Yates 2006, p.435) states that most experienced teachers are ñproducts of mathematics-as-computation view of teaching in which mathematics was regarded as transmitted set of facts and proceduresò

For mathematics curriculum reform to be successful, Bloch (2009, p.54) quotes from a conference in South Africa on Peoples Education in 1987 during the apartheid era. ñ A post-apartheid South Africa will need post-apartheid teachers é to reflect critically on the social and cultural forces which shape their lives, and a perception of their ability to change thingsé deliberate reflection on and research of their pedagogical practice and strategies could be one of the steps toward teachers taking back power from the education authoritiesé .Peopleôs education demands people who can think and challengeò The post-apartheid new governmentôs National Department of Education developed a progressive reform curriculum including a new vision of the teacher.

In addition, the NCS envisions ñteachers who are qualified, competent, dedicated and caringò (Department of Education, 2002b, p.3). Teachers are seen as the ñkey contributors to the transformation of education in South Africaò (Department of Education, 2002b, p.3). The NCS policy documents that this includes ñbeing mediators of learning, interpreters and designers of Learning Programmes and materials, leaders, administrators and managers, scholars, researchers and lifelong learner, community members, citizens and pastors, assessors and Learning Area Phase specialistsò (Department of Education, 2002b, p.3).

It is widely recognized that the role of the teacher is central to the teaching and learning of mathematics. According to Battista, cited in (Yates, 2006), teachers hold the key to reform in mathematics education. Bloch (2009, p. 90) is in agreement with regard to the crucial impact the teacher has on m, ñthis is where the teacher faces the learner in an educational relationship. Using his or her mastery of the subject and of the curriculum, her pedagogical and methodological training and instincts, to ensure that work is covered and the educational needs of the child are appropriately met.ò Cross (2008, p.908) concurs, in the mathematics classroom ñthe teacherøs role is crucial, not as the repository of knowledge, but as the one who initiates and guides the students in ócommunityô practicesé Maximizing the effectiveness of these classrooms requires the teacher to take on the role of ófacilitator and not ótransmitter of knowledgeôò Similarly, Capel, Leask & Turner (1995, p. 214), add ñeffective teaching and learning depend on the ability of the teacher to create learning experiences that bring desired educational outcomes.ò

However, Battista, in Yates, (2006, p.435) asserts that ñlack of congruence between curriculum innovation intent and teachersø pedagogical knowledge, beliefs and practices as the most cited reason for the poor history of reform in mathematicsò Johnson & Cupitt (2004, p. 4), also argue that teacher confidence is a crucial factor in determining ways that teachers approach the teaching of mathematics. ñIf current mathematics reforms are to be effectively implemented, teachers need to consider substantial changes to their role in the mathematics classroomò. They add that the practice of teaching mathematics in primary schools goes beyond the creation of maths groups and the use of concrete materials (Johnson & Cupitt, 2004, p. 4). In order to meet the diverse needs of the learners ñteachers must create regular opportunities for sustained oral interactions in order to develop a discourse community in mathematics classrooms in which the teacher and students use discourse to support the mathematical learning of all participantsò (Johnson & Cupitt, 2004, p. 4). The primary goal of a mathematics discourse community is ñto understand and to extend oneøs own thinking as well as the thinking of others in the classroomò (Johnson & Cupitt, 2004, p. 4). Johnson & Cupitt (2004), maintain that enhanced teacher confidence will encourage teachers to problem solving activities and to explore mathematical processes instead of merely focusing on computational accuracy.

Battista and Gregg, cited in Yates(2006, p.435) contends that in ñelementary schools all teachers are required to teach mathematics, but most are ill-prepared for the task as most experienced elementary teachers have not acquired a deep understanding of mathematics.ò Graven (2002) further argues that the implementation of the new curriculum is not a mere replacing the old practice with a new practice. Teachers need to take on a complete new óway of beingô Graven identifies four new roles of mathematics teachers specifically related to their practice:

- To support learners to critically analyze the way mathematics is used socially, politically and economically to prepare them for democratic citizenship.
- To bring mathematics from outside into the classroom.
- To apprentice learners into ways of investigating mathematics, being a person who has an interest in pursuing mathematics for itôs own sake.
- To convey the practices of the broader community of mathematics teachers.

Gravin states that while these roles are a vision of change, she questions whether these roles are realizable. Research cited in Yates, (2006, p.437) claim that mathematics reform practices are not realizable because ñmost mathematics reform have been introduced by education authorities through a top down approach, which ignores teachersô beliefs and pedagogical practices and the change which will be necessary for them to be able to embrace innovationò

Statement (NCS), says that "it is intended to ensure that all learners are able to develop and achieve to their maximum ability and are equipped for lifelong learning" (Department of Education 2002a, p.12). An important feature also of OBE is that all learners are expected to succeed (Spady & Marshall, 1991). Implicit in these statements is the responsibility placed on the foundation phase teacher to be creative and innovative in their teaching and assessment practice to develop ways and means in order to create equitable instruction for all learners. In order for the foundation phase teacher to make professional judgements in the classroom as to how much learning is going on and the value of the learning, teachers' need to understand "what it is that constitutes learning" as well as "how children learn" (Capel, Leask & Turner, 1995). Capel, Leask & Turner (1995, p. 215) posit that, "if you are sure that effective learning takes place in your classroom, you need a theoretical framework to provide a context within which you develop your professional knowledge". It is evident that in order to successfully implement the NCS, the foundation phase mathematics teachers are required to broaden their mathematical knowledge and competencies.

2.3TEACHERS VIEWS ON MATHEMATICS

2.3.1 A Pluralism of Perspectives

The NCS defines mathematics as "a human activity that involves observing, representing and investigating patterns and quantitative relationships in physical and social phenomena and mathematical objects themselves.

- Mathematics is a human activity that involves observing, representing and investigating patterns and quantitative relationships in physical and social phenomena and between mathematical objects themselves. Through this process, new mathematical ideas and insights are developed.

- [illegible]s its own specialized language that involves symbols and notations for describing numerical, geometric and graphical relationships. Mathematical ideas and concepts build on one another to create a coherent structure.
- Mathematics is a product of investigation by different cultures; it is a purposeful activity in the context of social, political and economic goals and constraintsà (Department of Education, 2002a, p.4). It is not value ï free or culturally- neutral

Together, these statements reflect a broad and inclusive philosophy of mathematics in the NCS. The modern perspective of mathematics emphasizes contexts and processes rather than just product. The definition of mathematics places an emphasis on more socio-constructivist, learner centered and integrated approaches to mathematics teaching and learning. This definition also indicates a shift away from the absolutist paradigm, which views mathematics as a body of infallible objective truth. The NCS therefore presents the view that is open to fallibilism, and does not promote absolutism (Ernest, 1991).

Skovsmose (1990) explains that mathematics cannot be described through one perspective. According to Skovsmose, (1990) mathematics can best be described by a pluralism of perspectives. Skovsmose, (1990) adds that mathematics is such a rich discipline, to give mathematics full credit, it must entail a product perspective, a process perspective, and a contextual perspective.

In addition the NCS focuses on the skills that are developed through the mathematics learning area. They are the development of mathematics language, reasoning, forming of conjectures through questioning as well as experimenting. (Department of Education, 2003a, p.27)

lturation

The Learning Outcomes (LO) and Assessment Standards (AS) as laid out in the NCS are a clear indication that learners are not meant to be passive receivers of knowledge in the learning of mathematics. Rather, they are expected to engage in active practices as stipulated in the LOs and ASs. These practices according to Bishop, (1988, p.191) are counting, measuring, localizing, designing, playing, and explaining. (Bishop, 1988, p.191) claims that these six activities that lead to what he terms ñmathematics enculturationò. These activities are reflected in the (ASs) of the mathematics learning area.

While the focus in counting is on the development of number concepts, it is also addressed in all the LOs. Measuring is addressed in LO 4 in a variety of contexts. Localizing is addressed in LO3 in space and shape. Explaining, while addressed in all the LOs is also seen in relation to LO2, patterns, functions and algebra and LO5, data handling. In addition learners need experiences to use logical processes to justify, explain, and construct convincing arguments in problem solving as well as to evaluate the arguments of others. By focusing on activity, Bishop addresses the process part of ódoingô mathematics.

2.3.3 The Application of Mathematics

In the traditional curriculum, content was taught and applications based on the content drove the classroom activity. Application tasks were modeled so that the learners followed step by step. The NCS advocates ñthat learners have a large number of opportunities to solve problems appropriate to their skills and mathematical sophistication. Learners need to develop the understanding that solving problems is as important as finding the most efficient and aesthetically appealing solutionò (Department of Education, 2003a, p. 27).

s ñbeing mathematically literate enables persons to contribute to and to participate with confidence in society. Access to mathematics is therefore a human right in itselfò (Department of Education, 2002b, p.4). The development of mathematical knowledge, skills and values will enable the learner among others to: ñparticipate equitably and meaningfully in political, social, environmental and economic activities, display critical and insightful reasoning and interpretative and communicative skills when dealing with mathematical and contextual problemsò (Department of Education, 2002b, p. 5)

2.4 PERCEPTIONS OF LEARNING MATHEMATICS

The purpose of teaching should be to provide learners with the possibility to learn. Thus, the possible perspectives on teaching cannot be addressed without addressing possible perspectives on learning. An important point in this regard is found in the critical and developmental outcomes inspired by the Constitution of South Africa.

The critical outcomes envisage learners who are able to:

- Identify and solve problems and make decisions using critical and creative thinking
- Work effectively with others as a member of a team, group, organization and community
- Organize and manage themselves and their activities responsibly and effectively
- Collect, analyze, organize and critically evaluate information
- Communicate effectively using visual, symbolic and /or language skills in various modes
- Use science and technology effectively and critically, showing responsibility towards the environment and the health of others

nderstanding of the world as a set of related systems by recognizing that problem-solving contexts do not exist in isolation (Department of Education, 2002b, p.2).

The developmental outcomes envisage learners who are also able to:

- Reflect on and explore a variety of strategies to learn more effectively
- Participate as responsible citizens in the life of local, national and global communities
- Be culturally and aesthetically sensitive across a range of contexts
- Explore education and career opportunities
- Develop entrepreneurial opportunities (Department of Education, 2002b, p.2).

These outcomes together with the Learning Outcomes, that suggest content, speak to the broad transformation of the inequities of the past making mathematics more accessible to all South African children.

The NCS neither requires nor prohibits specific learning theories as to how children best learn mathematics, as long as they are consistent with the meaning and content of the key elements (Spady, 1994). The critical and developmental outcomes point towards learning theories which emphasize learner autonomy, critical reflection and social interaction. These outcomes embrace constructivist and social constructivist learning theory. Teaching practices in the foundation phase mathematics classrooms should therefore be consistent with, and demonstrate constructivist and social constructivist philosophy and pedagogy.

2.4.1 Constructivist Theory

Historically, South African education has come from traditional authoritarianism and teacher-centeredness. The traditional model for by Bodner (1986, p. 873), “was based on the assumption that knowledge can be transferred intact from the mind of the teacher to the mind of the learner. Educators therefore focused on getting knowledge into the heads of their students”. The traditional view of learning as stocking up on knowledge and of teaching, and as transferring such knowledge to the empty vessels, alias students, has been thoroughly criticized. Alternative theories of teaching and learning are believed to be the way forward.

The constructivist view requires a shift from the traditional approach of direct teaching to facilitation of learning by the teacher. In recent years there has been a shift toward learner-centeredness. “Outcomes-based programming makes all instruction purposeful for students” (Killen, nd, p. 8). In the words of Killen (nd, p. 8), “teachers become facilitators of learning instead of transmitters of knowledge”. By adopting an OBE approach for the NCS, means that teaching practices in the classroom needed to move away from the one-size-fits-all delivery system.

As a theory of learning, constructivism holds the view that the acquisition of knowledge takes place when the learner incorporates new experiences into existing mental structures and reorganizes these structures to handle more problematic experiences (Kilpatrick, Swafford & Findell, 2001). Constructivism is rooted in the psychological work of Jean Piaget. At the heart of constructivist theory is the notion that children or learners are not blank slates, but rather creators of their own learning. In constructivism, learning is viewed as a process that happens internally in the learner. Knowledge is also not passively received from others, or from authoritative sources. "Piaget argued that knowledge is constructed as the learner strives to organize his or her experiences in terms of pre-existing mental structures or schemes” (Bodner, 1986, p.873). “Piaget suggested that schemas can be changed in two ways, namely, through ‘assimilation’ and ‘accommodation’” (Van De Walle et al, 2010, p. 20).

…nmodation and assimilation can be explained simply in the following way; when a person interacts with an experience or situation or an idea, one of two things happens it can either be assimilated or accommodated. Assimilation takes place when the new experiences are incorporated into existing mental structures. Existing mental structures or schemas are what we call prior knowledge. Applying this idea to mathematics, new mathematical knowledge or new concepts ñ'fitsô with prior knowledge and the new information expands the existing networkò (Van De Walle, et al, 2010, p. 20). Accommodation takes place when these structures are reorganized to handle more general experiences. In mathematics this would mean the new concept does not ófitô with the existing network, so the brain revamps or replaces the existing schema.

Through reflective thought, people modify their existing schemas to incorporate new ideasò (Van De Walle et al, 2010, p. 20). Van de Walle et al, (2010, p. 21) aptly uses the term "reflective thought" to explain how learners should actively think about or mentally work on an idea. He says: ñReflective thought means sifting through existing ideas to find those that seem to be the most useful in giving meaning to the new idea.ò Through reflective thought, we create an integrated network of connections between ideas or ócognitive schemasô As we are exposed to more information or experience, the networks are added to or changed ï so our cognitive or mental schemas are always being modified to include new ideas. This means that in mathematics classroom practice learners must be encouraged to wrestle with new ideas, to work at fitting them into existing networks of ideas, and to challenge their own ideas and those of others.

Constructivism as a theory of ñcoming to knowò, emphasizes the importance of the individual learner in constructing and reconstructing their own understanding through a process of organizing and adapting new learningôs into existing schema (Clements & Battista 1990, p. 34). Within

…ent, understanding is a fundamental requirement for the legitimate acquisition of knowledge. Consistent with this, the NCS encourages the use of concrete apparatus to contribute to the development of understanding in mathematics. (Department of Education, 2003a, p.23)

The current theoretical guide for teaching mathematics is constructivism (Van de Walle et al, 2010). Constructivists assume that given an ñappropriate mathematical environment students will be motivated and able to construct mathematical knowledge for themselves, and such self-discovery promotes optimal understandingò (Geary, 1994, p. 262)

The NCS advocates teaching by negotiation and replaces teaching by imposition, in agreement with constructivist theory. The new curriculum encourages teachers to provide their learners with opportunities to solve problems ñappropriate to their skills and mathematical sophistication, to reason, argue and to communicate in mathematicsò is an important skill that all learners need to develop ((Department of Education, 2003a, p. 27&28). Consistent with Piagetøs theory of cognition, the NCS supports the idea that students should be active constructors of knowledge in the classroom. This ódoingô need not always be active and involve peer discussion, though it often does. Learners can also engage in constructive learning on their own, working quietly through set tasks, allowing their minds to sift through the materials they are working with, and consolidate new ideas together with existing ideas, actively exploring mathematical ideas in a conducive classroom environment.

The implications for teaching from a cognitive constructivist perspective as maintained by Cobb, Wood & Yackel, (cited in Wood, 1993, p.16) are:

- Teachers should provide students with instructional activities that will give rise to problematic situations. Childrenøs actions, which are logical to them but may be irrational from an adult perspective, as rational by the teacher. Teachers should recognize that what will seem like errors and confusions, are childrenõs expressions of their current understandings. Teachers should realize that substantive learning occurs in periods of conflict, confusion, surprise, over long periods of time and during social interaction.

The goal of teaching changes, from developing pedagogical structures to helping learners acquire mathematical knowledge to one where facilitation of learner engagement with the task becomes the focus. The constructivist teacher is one who understands that learning of mathematics must be seen as a process, emphasizing the meaningful development of concepts and generalizations, increasing the prospects real problem-solving, open enquiry and investigation and characterized mainly by challenging, questioning and guiding the learners to doing, to discovering and to applying.

2.4.2 Social Constructivist Theory

Len Vygotsky, a Russian psychologist has greatly influenced social constructivist theory. Like constructivism, social constructivist theory shares the concept of active meaning making on the past of the learner. Social constructivist theory, however, does have several unique fundamental concepts. According to Forman (as cited in Van De Walle et al (2010, p. 21)), one feature is ñthat mental processes exist between and among people in social learning settings, and that from these social settings the learner moves ideas into his or her own psychological realm;ò another feature is that ñthe way in which information is internalized depends on whether it was within a learnerõs zone of proximal development (ZPD), which is the difference between a learnerõs assisted and unassisted performance on a task.ò . Another major concept of social constructivist theory is what Forman & McPhail as cited in Van De Walle et al call ñmechanism by which individual beliefs, attitudes and goal are nd affect sociocultural practices and institutionsò (Van De Walle et al, 2010, p. 21).

Vygotsky believed that language is the principal tool used for thought development. Psychologists and teachers have now come to support this view. According to Vygotsky, language is considered to be one of the ñtoolsò of mediation, social interaction is essential for mediation. (Van De Walle et al, 2010, p. 21). According to Bodrova & Leong (1996, p. 13),

> Vygotsky believed that language plays a greater role in cognition. Language is an actual mechanism for thinking, a mental tool. Language makes thinking abstract, flexible, and independent from the immediate stimuli. Through language, memories and anticipations of the future are brought to bear on the new situation, thus influencing its outcome. When children use symbols and concepts to think, they no longer need to have the object present in order to think about it. Language allows the child to imagine, manipulate, create new ideas and share these ideas with others. Thus language has two roles; it is instrumental in the development of cognition and is also itself part of cognitive processing.

Van De Walle et al, is of the same opinion and concludes that language is developed within a social context by engaging with others, (Van De Walle et al, 2010, p. 21). Implied here is that learners could reach a higher level of cognition as a result of the teacher developing teaching strategies that encourage learners to engage in meaningful discussions. This could be with their peers or other adults or in discussions with the teacher. The NCS suggests that mathematics learning will only be effective if learners learn to communicate mathematically and to develop the capacity to use mathematics to solve unfamiliar problems. The NCS encourages collaborative work where mathematical thinking skills like ñexplaining, describing, inferring, justifying, refuting and predictingò can be developed (Department of Education, 2002b, p. 9).

onstruct of individuals in conversation. Learning mathematics with understanding involves being able to give reasons and mathematical evidence (Department of Education, 2002b). In order to do this learners need to talk in class and this means that communication and language are involved. Shared experiences shape the way individuals think. As individuals experience and assimilate more into their schema, so the individual constructs and modifies their understanding to accommodate new schema. ñLanguage is regarded as the shaper of, as well as the product of individual mindsò(Ernest, 1991, p. 5)

By providing opportunities for the learners to interact, talk, debate, reason aloud in the mathematics classrooms, learners could become more proficient in the use of mathematics language. Purposeful planning and monitoring by the teacher as well as the ability to listen to her learnersô reasoning during individual or group work will ensure that meaningful mathematical conversation takes place.

> Vygotskian theory gives teachers a central role: leading children and students to new levels of conceptual understanding by interacting and talking with themé thus, teaching comprises the activities associated with enabling the learner to participate effectively in the activities of the more expert, and learning is seen as enculturation via guided and modeled participation. (Hodson & Hodson 1998, p. 37)

The implication here again, is that foundation phase mathematics teachers need to have an understanding of the appropriate pedagogy in order for mathematics enculturation to occur. Pedagogy based on Vygotskian perspectives proposes that the ñmost effective forms of learning are likely to be inquiry-oriented, personalized and collaborative and conducted in accordance with the norms and values of the community of scientists, under the guidance of a skilled practitionerò (Hodson & Hodson, 1998, p. 38, 39).

Within cognitive tradition, knowledge is seen as constructed in the mind and learning is seen as an internal process of assimilating new information and experiences in an effort to understand it. From the socio-cultural perspective, on the other hand, knowledge is seen as constructed through the engagement in the social practices of the group. (Cross, 2008).

When considering classroom practices that maximize the opportunities for learners to construct ideas, both constructivism and social constructivist theory are considered essential to cognitive change Constructivist philosophies are espoused by the national curriculum. Teachers of mathematics in the foundation phase, therefore, need to not only articulate strong constructivist theory philosophies but to translate those philosophies into instructional practice in their classrooms. Cooper (2007, p.4) holds the view that "constructivist philosophy aligns curriculum, pedagogy and assessment when fully understood and effectively implemented".

2.5 THE TEACHERS PERCEPTIONS OF TEACHING

2.5.1What constitutes Effective Mathematics Teaching in the Foundation Phase?

Effective mathematics teaching is essentially concerned with how best to bring about the desired learning outcomes by some educational activity (Kyriacou, 1990). There is an increasing emphasis on the integration of research on teaching and learning. According to Koehler & Grouws, (1992), effective teaching is now viewed through a double lens, where the outcomes of learning are determined by the learners' actions and thinking whilst these actions and thinking are largely determined by what the teacher does or says in the classroom. The NCS points to a shift away [illegible] teacher-centeredness, from where historically we come, towards learner-centeredness and learning-centeredness.

The NCS states, ĩeffective teaching relies on an understanding of mathematics and an understanding of what learners know, what they need to know and structuring learning opportunities appropriate to the needs of the particular learners that will support and encourage their learningò (Department of Education, 2003a, p.25).For teaching practice be implemented effectively in the foundation phase as stipulated in the NCS for mathematics, Guskey is unambiguous (as cited in Guskey, 2005, p.32) Foundation phase teachers of mathematics need to be competent to:

- Translate the standards into specific classroom experiences that facilitate student learning
- Ensure that classroom assessment effectively measure learning

Bandura, cited in (Swars 2005), claims that mathematics teacher efficacy is directly related to a willingness on the part of the teacher to embrace educational reform, to be willing to try out now instructional strategies, including strategies that may be difficult to implement and involve risks such as sharing control with the children. Conversely, Chernaik, in Swars, (2005) states that teachers with a low sense of efficacy are more likely to use teacher-directed strategies of teaching. The NCS is very clear as to what effective teaching and learning of mathematics is. According to the NCS, teaching and learning of mathematics will only be effective if:

- Learners engage with worthwhile and challenging mathematical tasks, it is important that learners are able to see the value of the tasks that they are doing
- Learners are given opportunities to develop a deep and coherent conceptual understanding of mathematics. Given its hierarchical nature, it is critical that learners have an understanding of what they are doing. Performing operations by rote or following a recipe simply will not help the development of understanding and hence mathematical knowledge skills and values. One of the implications for

rstanding is that learners must have negotiate meaning, that is they must be able to discuss their understanding of concepts with each other and their teacher

- Learners are able to see the interrelatedness of the mathematics they learn. (Department of Education, 2003a, p. 25).

Effective teaching of mathematics for understanding in the foundation phase, therefore, means involving the learners in activities and tasks that call on them to reason and communicate their reasoning, rather than to reproduce memorized rules and procedures. Further, it is essential that the classroom atmosphere be non-threatening and supportive and encourage the verbalization and justification of thoughts, actions and conclusions. When learners can see how various concepts and procedures relate to each other, they remember them as parts of a connected whole, rather than as separate items.

In a study on effective teachers of numeracy, Askew, Brown, Rhodes Wiliam & Johnson (1997), found that the more effective teachers tended to demonstrate deeper understanding of the links between different numeracy concepts and could provide alternate meanings and representations. They further recommend that teachers of mathematics need to develop fuller deeper and more connected understandings of the number system.

2.5.2 Content Knowledge for Mathematics Teaching

The question that teachers should be asking is, what is the most effective way to facilitate the construction of mathematic knowledge by the learners? What does effective teaching require in terms of content understanding? (Fleisch, 2008, p.v), alleges that ñabove all else reading and mathematics achievement is determined by what teachers and children do in school classrooms.ò Fleisch (2008, p. v) explains that how nd do mathematics depends among others on, ñteachersô views of their learnersô capabilities and teachersô understanding of what the official curriculum requires of themò a view supported by Battista cited in Yates(2006).

There is substantial agreement that teacher knowledge of mathematics plays a key role in quality mathematics teaching. According to Charalambous, (2010, p. 249), ñseveral studies examining teachersô responses to calls to reform their teaching have considered teacher knowledge a major contributor to their structuring and delivering of mathematics lessons.ò Kersting, Givvin, Sotelo & Stigler (2010, p. 172) concur; ñit seems obvious that one cannot teach what one does not knowé without a doubt, the construct of teacher knowledge is far more complex than simply knowing the subject as we want students to know itò.

In addition to the specialized mathematical knowledge that is required for teaching, teachers need to have ñcommon content knowledgeò (Ball, Thames & Phelps, 2008). This refers to the ability to simply calculate an answer, recognize when a learner gives a wrong answer, to be able to use the correct terms or vocabulary, to be able to recognize when a definition is incorrect in the textbook.

Ball et al (2008, p.396) report that the analysis of teacher practice reveals ñthat the mathematical demands of teaching are substantialò. Analyzing the responses and written tasks alone requires specialized expertise. ñSkillful teaching requires being able to size up the source of a mathematical erroré .Moreover, this is work that must be done rapidly because in a classroom students cannot wait as a teacher puzzles over the problem himselfò (Ball et al, 2008, p. 396). It is also not uncommon in the foundation phase for learners to formulate nonstandard approaches, moreover, teachersô should be encouraging multiple approaches. Mathematics teachersô are required to figure out the method the learner ematically justifiable, whether the approach the learner used was a once off fluke or whether the approach will work in general.

ñResearchers have recognized that what teachers ŏknowô is one of the most important factors that influence school classrooms and learner performanceò (Fleisch, 2008, p.123). These findings were confirmed by a case study undertaken in South Africa in 1999, conducted by Taylor & Vinjevold. ñOne of the most consistent findings of a number of the Presidential Education Initiative projects pointed to teachersô low levels of conceptual knowledge, their poor grasp of their subjects and the range of errors made in the content and concepts presented in their lessonsò (cited in Fleisch 2008, p.123).

In a further study in Fleisch, (2008, p.128), that was conducted in the Cape metropolitan area, Reeves found,

> a significant positive relationship between mathematics achievement and classrooms where children were exposed to high cognitive demandsé She also found that learnersô mathematics achievement was affected not only by how well individual teachersô taught but how well children had been taught in previous years. In other words, higher-achieving learners came from schools where they had been taught the curriculum consistently across the grades. (In Fleisch, 2008, p.128)

Hill, Schilling and Ball (2004, p. 13) cite Shulman who proposed three categories of subject-matter knowledge for the teaching of mathematics. The first category he called ñcontent knowledgeò to referring to the specialized nature of the subject-matter knowledge required for teachingò. Shulman as cited in (Hill et al, 2004, p. 12), includes that teachers need to understand how this ñknowledge is generated and structured in this disciplineò Shulman in (Hill et al, 2004, p. 13). Ball et al, added that included in this category was ñunderstanding principles and structures and ng what is legitimate to do and say in the fieldò (2008, p. 391). This implies that teachers have not only to understand ñthat something is so, but they also need to understand ñwhy it is so, on what ñgrounds it can be supported, and under what circumstances can the belief in itôs justification can be weakened or deniedò (Ball et al, 2008, p. 391). In addition the teacher needs to understand why certain topics in mathematics are vital and why certain topics are not as important.

The second category of subject-matter knowledge for teaching Shulman in (Hill et al, 2004, p. 13) is called ñcurriculum knowledgeò. By curriculum knowledge Shulman meant that teachers are expected to have deep understanding of the full range of programs designed for a particular subject at a given level. ñThis involves an awareness of how topics are arranged both within a school year and over longer periods of time as well as ways of using curriculum resources, such as textbooks to organize a program for study for studentsò (Hill et al, 2004, p. 13). Shulmanôs theory of teacher knowledge includes ñgeneral pedagogical knowledgeò, by this he meant classroom management techniques and teaching strategies, knowledge of educational contexts as well as ñeducational ends, purposes and valuesò as cited in (Hill, et al, 2004).

The third category of teacher knowledge Shulman called ñpedagogical content knowledgeò in (Hill et al, 2004, p. 13). This special domain of teacher knowledge termed ñpedagogical content knowledgeò refers specifically to knowledge unique to teaching. Ball et al, (2008, p. 391) call this category the most influential of the three content related categories. Shulman, defines ñpedagogical content knowledgeò as comprising:

> The most useful domains of representation of those ideas, the most powerful analogies, illustrations, examples, explanations ï in a word, the most useful ways of representing and formulating the subject that make it comprehensible to othersé Pedagogical content

> ncludes an understanding of what makes specific topics easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessonsò (Shulman cited in Ball et al, 2008, p. 391 & 392).

Magnusson, Krajcik & Borko in (Ball et al, 2008, p. 394), define pedagogical content knowledge as ña teacherôs understanding of how to help students understand specific subject matter. It includes knowledge of how particular subject matter topics, problems, and issues can be organized, represented and adapted to the diverse interests and abilities of learners, and then presented for instruction.ò

ñTeacher subject knowledge is related to assessment procedures, since knowledge of the subject provides teachers with some focus for learningò (Jones & Moreland, 2005, p. 196). It is crucial for a teacher give the learners descriptive, constructive feedback in order to improve learning. Descriptive feedback identifies the strengths and weaknesses of student work, ñenabling students to take control of their workò (Jones & Moreland, 2005, p.196). To facilitate this, Jones & Moreland (2005, p.196), say that the teacher has to have knowledge of the ñcurriculum, the goals and how students might progressò. Jones & Moreland (2005, p.196) maintain ñeffective formative interactions are thus dependent on informed assessors who are able to interpret observations and student outcomes and consequently act upon the interpretations to enhance student learningò.

Teachersô pedagogical content knowledge has to be refined in order for them to identify key subject areas in the curriculum. Teachers will grow in confidence if they concentrate on developing their conceptual and procedural knowledge in mathematics. An additional outcome of this will be purposeful, quality formative assessments.

t there is an expectation that foundation phase teachers need a strong, specialized knowledge base of mathematics in order to teach effectively (Ma, 1999, Van de Walle, 2010). Foundation phase teachers, however, are not mathematics content 'specialists', they are 'generalists', meaning that they teach mathematics, literacy as well as life skills and so have to have a general knowledge of content and pedagogy for all the areas that they teach. In a study of primary school teachers of mathematics, Ma, (1999) found that teachers with limited subject matter knowledge are unable to promote conceptual understanding even when they want to teach for understanding.

2.5.3 The Importance of Materials for Meaning Making in the teaching and learning of Mathematics

Mathematics instruction is a complex process that attempts to make abstract concepts tangible, difficult ideas understandable and problems solvable. Research by Lesh, Post & Behr, cited in (Van De Walle et al, 2010, p.27) "found that children who have difficulty translating a concept from one representation to another also have difficulty solving problems and understanding computations". It is therefore essential that children are given many ways to think about and to test an idea. Manipulatives games visual representations are just some options a foundation phase teacher can use to meet the challenge of mathematics instruction. Scaffolding, a concept that comes from social constructivist theory (Bodrova & Leong (1996),suggests that for learning that requires more assistance, a child could use manipulatives until he becomes confident with the content, and then the scaffolds can be removed. This is especially important in the early years of schooling,

If learners in the foundation phase are to develop a rich, conceptual understanding of mathematics, then they will need to 'see' mathematics concretely first. The crucial action of constructing meaning is mental; it wever, physical actions, hands-on experience is necessary for learning, especially for children. Teachers need to provide activities which engage the mind as well as the hands. The constructivist foundation phase mathematics teacher needs to engage the learner in doing mathematics in hands-on involvement, using materials to support their learning, in participatory activities like physically counting, measuring, experimenting, while learners share, discuss and rationalize. Learners actively construct mathematical knowledge by engaging in meaningful activities using concrete manipulatives. Visual representation is also essential to encourage mathematical proficiency. Visuals like pictures, charts, numberlines, graphs and the like are needed for young learners to make connections in mathematics. Mathematics instruction is a complex process, visual representations and concrete apparatus help to make abstract concepts more tangible.

Effective teachers recognize that the foundation phase learner needs apparatus and that eventually these learners will develop an abstract understanding in the absence of apparatus and contexts. Anthony & Walshaw (2009b, p. 23), says that tools offer learners ñthinking spaces, helping them to organize their mathematical reasoning and support their sense makingé tools provide vehicles for representation, communication, reflection and argumentation.ò Manipulatives are materials designed to provide concrete, hands-on experiences that can help students make the link between math concepts and the real world. Carpenter & Lehrer, cited in Munter (2009, p. 985), suggest that tools, ñsuch as paper and pencil, manipulatives, calculators, computers and symbols, be used to represent mathematical ideas and problem situations. Connections with representational forms that have intuitive meaning for students can greatly help students give meaning to symbolic proceduresò.

Context for Meaning Making in the teaching and learning of Mathematics

The NCS is unambiguous ñthe use of contexts for learning activities, that is contexts that are relevant to the lives of the learners can also contribute to understanding and is similarly encouragedò (Department of Education, 2003a, p. 23).

ñTeaching mathematics with respect for culture is one way to honour diversity in the classroomé A study of mathematics within other cultures provides an opportunity for students to put faces on mathematical contributions instead of erroneously thinking that mathematics is a result of some mystical phenomenonò (Van De Walle et al, 2010, p. 103).

The practice of teaching mathematics in school ñis often carried out for its own sake, unrelated to any real or particular context and almost always involves recording using written symbolsò (Mutemeri & Mugweni, 2005, p.50). In addition to this, school mathematics is often about following set procedures with the emphasis on producing the right answer. From a constructivist point of view, children learn mathematics more easily if it is ñmeaningful in their life and culture, if it emerges from their experiences and part or their social lifeò (Mutemeri & Mugweni, 2005, p. 50). This also means involves contextualizing the tasks that the teacher sets. According to Barnes, in (Mutemeri & Mugweni, 2005, p. 51), it is ñonly when mathematics school learning has gone beyond meaningful rote can we take it that a child has made some kind of relationship between what he knows already and what instruction has been presentedò.

Skovsmose (2005, p.5) speaks of ñbringing the studentsô cultural, background (cultural context, the socio-political context, and the family traditions) into the classroom as a resource for contextualization seems relevant for bringing meaning to mathematics classroomé Mathematics is dö. We learn in relation to what else we know, what we believe, our prejudices and our fears.

Interestingly, Skovsmose (2005, p.8) does not stop at the background to establish meaning in mathematics, but adds ñeach students foreground is a principal resource for meaning productionò Learnersô therefore need to see that meaning is produced. Wittgenstein, cited in (Skovsmose 2005, p.8), suggests an interpretation ñin terms of useö. While background refers to experience, foreground refers to expectations.

The implication here is that teachers need to use the hopes and aspirations of their learners to generate the conception of mathematics as relevant. This is especially relevant as teachers are in the best possible position to answer questions regarding real opportunities, from the learnerøs perspective, that can be created for learners if they go to school and opportunities within mathematics education. Schools and teachers can ñdetermine the foregrounds of the majority of students around the globe. It determines the disposition of groups of people, and as a consequence it structures motives for learning and for meaning productionò (Skovsmose, 2005, p. 8). If learners do not see the reason to engage in learning mathematics, teachers cannot expect meaningful participation. What teachers can expect from these learners is what Skovsmose terms ñlearning resistanceö. The challenge therefore, according to Skovsmose (2005, p. 9) is ñto look for each studentøs foreground and to try and relate learning activities to thisö.

2.5.5 Assessment for Learning

The educational reforms in South Africa are framed by an outcomes-based education (OBE) policy. One of the assumptions underlying this nationally directed educational reform process is that teachers will be both willing and able to adapt their teaching and assessment practices accordingly.

eart of an integral component of teaching and learning in mathematics. It supports teaching and learning by providing both the teacher and the learner with insights on what the learner knows and still needs to understand or is ready to learnò (Department of Education, 2003a, p. 27). Teachers need to be familiar with the different types and different roles of assessment stipulated in the NCS. The four types of assessment according to the NCS are listed as baseline assessment, formative assessment, diagnostic assessment and summative assessment. (Department of Education, 2003a). As important as it is to have a wide repertoire of teaching strategies, Burns believes that teachers also need to use a wide repertoire of assessment strategies; ñthe insights we gain by making assessment a regular part of instruction enable us to meet the needs of students who are eager for more challenges and to provide intervention for those who are strugglingò (Burns, 2005, p. 31).

Fleich quotes that Howieôs analysis of the South African results in a TIMSS study:

> Howie also believes that the poor and inappropriate application of assessment by many teachers may also contribute to the poor achievement levelsé Howie suggests that many teachers simply do not set learning tasks that are sufficiently demanding cognitively and that many teachers tend to teach to the slowest or the weakest children in their class. The reason for this is self-evident: when teachersô own subject knowledge is weak, teaching to the slowest learners is a way of coping. The misinterpretation of child-centered pedagogy can be used to justify the practice.ò (Fleich, 2008, p. 130)

According to Burns (2005, p. 26), ñmathematics teachers gain a wealth of information by delving into the thinking behind studentsô answers, not just when answers are wrong but also when they are correctò. Teachers need to use ñoral and written questions in order to attempt to probe as well as to stimulate students thinkingò (Burns, 2005, p. 27). ñMerely spotting when students are in correct in relatively easy compared with understanding the ors.ò (Burns, 2005, p. 31) Understanding the reasons behind errors that are made in mathematics demands ñcareful attention and a deep knowledge of the mathematical concepts and the principles that students are learningò (Burns, 2005, p. 31).

Assessment therefore needs to be intentional and incorporated into every lesson. Burns declares that a teacherõs goal should be to ñfind outò as they teach ñwhat the students understand and how they thinkò in order to hone in on the lesson as well as to plan the sequence of learning activities. (2005, p.31). Ongoing, well designed assessments can provide the teacher with ñspecific, personalized and timely information to guide both teaching and learningò (McTighe & OõConnor, 2005, p. 11). They add ñthe best teachers recognize the importance of ongoing assessment in authentic contexts as the means to achieve maximum performanceò (McTighe & OõConnor, 2005, p. 13). Leahy, Lyon, Thompson, & William, (2005, p. 22), believe that ñin a classroom that uses assessment to support learning the divide between instruction and assessment blursò.

Consistent and ongoing feedback has been shown to be effective in improving learnersô mathematics performance and should be incorporated at all times in mathematics teaching. Feedback that learners receive from the teacher needs to be more than praise-based, or related to task completion or social and managerial aspects; it needs to be related to improving their mathematical knowledge. ñTeachers must plan effectively in order to create conversations with their learners around key issues in order to move learning forwardò (Jones & Moreland, 2005, p. 197). These conversations during observation are formative assessments could provide the teacher with ñsufficient relevant feedback so that obstacles to learning could be identified and tackledò (Jones & Moreland, 2005, p. 197). Immediate and regular feedback from the teacher helps learners as well as helps the teacher guide and tailor their instruction.

ges that ñdeveloping classroom assessments that not only address the [assessment] standards accurately, but also help identify instructional weakness and diagnose individual student learning problemsò is what teachers find challenging. Teachers need to óunpackô the assessment standards then ñidentify the various components of each [assessment] standard that students must learn then organize and arrange these components into a meaningful sequence of learning stepsò (Guskey, 2005, p. 33). Teachers then have to make sure they adapt their teaching and assessing to cater for the individual learners.

2.6 TEACHING STRATEGIES IN THE MATHEMATICS CLASSROOM

Artzt & Armour-Thomas (2002, p. 22) say that educators need to reflect on their goals for instructional practice. ñA teacher whose goal is that students engage in mathematical reasoning tends to orchestrate the classroom discourse in such a way that the burden of explanation is placed on the students.ò

> Teachers who consider themselves facilitators of student learning tend to use instructional strategies that foster communication among students and challenge students to think for themselves and engage in mathematical reasoningé . Teachers who believe that the role of all students in the classroom is to be active participants in their own learning tend to create social and intellectual climates that set the stage for discourse that can offer every student an equal opportunity to participate. Artzt & Armour-Thomas (2002, p. 22)

Although constructivist and sociocultural theory do not espouse a particular teaching practice, certain practices that encourage learners to become active participants have been associated with them. Practices like conducting investigations, problem solving, working in groups, using manipulatives to discover concepts have come to be characterized as constructive teaching. Piagetôs theory of cognition supports the idea that constructors of knowledge in the classroom. The NCS is based on an approach to teaching mathematics that focuses on ódoingô mathematics and mathematics as a science of pattern and order, in which learners actively explore mathematical ideas in a classroom environment that is conducive to learning.

Van De Walle et al, (2010) suggest teaching strategies that reflect constructivist and social constructivist theory,

- Build new knowledge from prior knowledge
- Provide opportunities to talk about mathematics

Sociocultural theory has contributed to the formulation of the metaphor of the classroom as the ócommunity of practiceô The implication is that the teacher creates an environment that is conducive to the learning of mathematics. Learning is enhanced when the learner is engaged with others working on the same ideas. A worthwhile goal is to create an environment in which the learners interact with others and the teacher.

Thinking is said to be developed by the demands of communication. Therefore organizing students in small groups to complete mathematics tasks and then to present their solutions to the class has the potential of promoting thinking. These opportunities to communicate play a decisive role in mathematics learning. The teacherõs role is to guide students toward a set of shared norms that include: cooperation to produce mutually acceptable solutions methods and interpretations, ñpersistò and consider alternatives, ñcourageò to propose ideas, ask for explanations and evidence and for mathematical solutions to be ñexplainable and justifiableò, and operate as a community of ñconsensual validatorsò (Cobb, Wood, & Yackel, (1991).

- Build in opportunities for reflective practice e structures and supports to help their learners make sense of mathematics in the light of what they know. New concepts should be interconnected into a rich web of interrelated ideas so as to mentally engage the learners. In a problem-centered learning strategy, activities are designed to emphasize communication and meaning making. Studies suggest that students benefit from using their own insights to make meaning of mathematics (Cobb, Wood, & Yackel, 1991). Teachers need to acknowledge the importance of creating contexts that facilitate individual reflection.

- Encourage multiple approaches.

By providing opportunities for learners to build connections between what they know and what they are learning, and allowing them to use their own approaches to arrive at their own solutions contributes to an improvement in conceptual understanding. Askew et al, (1997) found that mathematics classroom processes associated with low achievement, included too much emphasis on repetitive number work. Class discussion sharing these different ideas will bring to the fore a wide range of useful mathematical connections. Treat errors as opportunities for learning. When learners make errors, it could mean a misapplication of their prior knowledge in the new situation. By questioning the learners thinking, misconceptions can be addressed.

- Scaffold new content.

The concept of scaffolding comes out of social constructivist theory and is based on the idea that a task otherwise outside of a learners ZPD, can become accessible if it is carefully structured. If the concept is completely new, the learning requires more assistance, including the use of manipulatives or assistance from more knowledgeable peers the or teacher. As the learners become more comfortable with the content, the scaffolds are removed and the learner becomes more independent

Constructivist learning and social theories emphasize that each learner is unique with each learner having a different collection of prior knowledge and cultural experiences. Since new knowledge is built on old knowledge and experience, effective teaching incorporates and builds on what the learner brings to the classroom. Further, the learnerõs prior knowledge is valued. Teachers start by first eliciting the learned prior experiences and understandings for the lesson. It is the teacherõs job to provide learning experiences depending on the diverse prior experiences the learners have. In an equitable mathematics classroom, teachers must have a deep understanding of diversity, mathematical content knowledge, and diagnostic skills to assist students. Teaching for equity according to Van De Walle, Karp & Bay-Williams (2010, p. 93), ñattempts to attain equal outcomes for all students by being sensitive to individual differencesé Equity does not mean that every student should receive identical instruction; instead , it demands that reasonable and appropriate accommodations be made as needed to promote access and attainment for all studentsö. Van De Walle, Karp & Bay-Williams (2010, p. 93) include an element of significance; ñone way to teach for equity, supported by extensive research, is guaranteeing that students have a highly qualified teacher with a strong knowledge of and experience teaching mathematicsö.

Further, teachers must also demonstrate those behaviors that promote high-expectations. The NCS suggests that ñthe teacher of mathematics needs to have available, a wide repertoire of teaching strategies that he/she can use effectively to ensure successful learning by all learnersö (Department of Education, 2003a, p. 24). Strategies suggested by the NCS are:

- Problem solving and problem posing
- Investigation
- Observation

- Reading
- Group work
- Drill and practice
- Following worked examples (Department of Education, 2003a, p. 24).

In classrooms all over South Africa we see a continuum of practice ranging from a more traditional content- and rule-based approach in which teachers spoon-feed learners in the use of rules and algorithms obtain the óight answerö, towards a more participatory approach in which the process of learning is equally emphasized, where children work in groups to find innovative solutions to real-life problems. The NCS allows us to work across the continuum; ñwhat is inappropriate is to use one approach to the exclusion of all othersò (Department of Education 2003a, p.24). The NCS encourages teachers to develop new teaching strategies in order to challenge teachers to make mathematics interesting for the learners, to engage with and make to make meaning of their lived experiences.

One way of doing this is by fostering different teaching and learning styles. (Department of Education, 2003b, p.11).The NCS proposes a shift away from a content-based, exam-driven, traditional approach to teaching and learning. Instead learners are required to achieve specific learning outcomes for different phases within each subject. Learner-centered activities form an integral part of the new curriculum with the emphasis on encouraging learners to be instruments of their own learning, whether they work individually or in groups.

Problem solving as stated by the NCS (Department of Education, 2001, p.16), should be the primary goal of all mathematics instruction and an integral part of all mathematical activity. Learners should use problem-solving approaches to investigate and understand mathematical content.

…ema, Fuson, Wearne, Murray, Olivier & Human (1997, p.81), highlight the importance of problem-solving for the teaching and learning of mathematics with understanding, ñWe believe that if we want students to understand mathematics, it is more helpful to think of understanding as something that results from solving problems, rather than something we can teach directly.ò Problem solving fosters the development of mathematical knowledge through reflecting, applying and connecting previously constructed mathematical understanding**.** More importantly, it makes for an extremely interesting activity. By problem solving children are learning mathematics by doing mathematics**.** Problem solving is not meant to be taught as an isolated topic in the curriculum; mathematics is taught through problem solving. Another important advantage of a problem solving is that the diversity of learners in every classroom can be accommodated. The different learners in a class will draw on their own network of mental tools, concepts and ideas and arrive at different ideas about how they can best solve a problem. This means that there may be many ways to solve the problem. Although most problems have singular correct answers, there are often many ways to arrive there.

ñProblem solving is an important skill to be developed in all learnersé learners also need to develop the understanding that solving a problem is as important as finding the most efficient and aesthetically appealing solutionò (Department of Education, 2003a, p. 24). Developing problem solving skills in mathematics empowers children. They learn to trust their own experiences and realize that there are many acceptable ways to do mathematics. They must develop the confidence that they can understand mathematics Von Glasersfeld (1991, p. 209), has characterized this type of empowered learning during the past two decades. He has argued that children "construct their individual mathematical realities by reorganizing their personal experiences in an attempt to resolve what they find problematic". As long as children are strated by the teacher, they may look competent, but these children do not ównô the mathematics.

Polya (1971, p.6), so aptly stated in early thoughts on problem centered research in ñA teacher of mathematics has a great opportunity. If he fills his allotted time with drilling his students in routine operations he kills their interest, hampers their intellectual development, and misuses his opportunity. But if he challenges the curiosity of his students by setting them problems proportionate to their knowledge ,and helps them to solve their problems with stimulating questions, he may give them a taste for, and some means of, independent thinking.ò The implication of this viewpoint is that mathematics instruction in the foundation phase classrooms should be problem centered. The constructivist model asserts that the teacher's role is to continually present students with problematic situations designed to meet defined classroom goals. By creating goal-appropriate tasks, the teacher creates the opportunities children need to construct a body of knowledge in the most personal, significant manner. In investigating the link between the implementation of reform-oriented features of mathematics instruction to variations in learning, Stein & Lane (1996) found that the greatest learning gains occurred in classrooms where learners were consistently exposed to high-level tasks and the high-level cognitive demands were sustained throughout the lesson.

Johnson & Cupitt, (2004, p. 7) indicate that in ñmathematics classrooms where students are encouraged to explore open-ended problems and contribute to discourse around mathematical investigations there is more scope for pedagogy to be characterized by high levels of engagement, connectedness and inclusivity and for teachers to value the background knowledge students bring to the classroomò.

antly look at their practice to determine whether the lesson taught was ‘accessible to all students while still challenging to the more capable; what the students learned and still need to know; how we can improve the lesson to make it more effective; and, if necessary, what other lesson we might offer as a better alternative” (Burns, 2005, p. 26). This type of continual evaluation is needed in order to guarantee effective instructional choices and so improve our teaching practice

2.7 CONCLUSION

The focus of this chapter was to review a of range literature relating to this study. The literature reviewed highlighted the critical and central role of the teacher in the classroom. It is evident from the literature that teachers need a thorough knowledge of the NCS and how to ‘unpack’ the Learning Outcomes and Assessment Standards, have expert knowledge in the field of mathematics content and mathematics pedagogy as well as excellent management skills to support them.

The next chapter situates the research within a methodological framework and highlights the processes that have informed this research.

CHAPTER THREE
THE RESEARCH PROCESS

3.1 INTRODUCTION

The focus of this chapter is to examine the research process of this study. In order to do this it is necessary to draw the readerôs attention to the purpose of this research. The first purpose of this research is to describe current teacher practices in the teaching of mathematics in their foundation phase classrooms. The research focus is directly concerned with the teachersô facilitation of learnersô mathematical learning. This chapter demarcates the field of investigation within a methodological framework. This chapter describes the research methodology as well highlights the procedures followed in the administering the instruments used in the data gathering process. In addition the four issues of trustworthiness of the data, namely credibility, transferability, dependability and confirmability, are addressed in this chapter.Throughout the chapter, the limitations the researcher encountered in the research process are highlighted.

3.2 RESEARCH PARADIGM

This study was located within the interpretative paradigm using qualitative research techniques. A paradigm provides a conceptual framework for making sense of the social world, and in the case of this research, for guiding the approach taken in this research. This study focuses on teachersô mathematics instructional practices to facilitate learning. . Working in this paradigm opens up the opportunity to find out how respondents understand and implement the NCS based on their teaching practice rather than theoretical knowledge. Within the research process, the beliefs a researcher holds will be reflected in the way the research is designed, data collected and analyzed, and how the research results are ce of a research paradigm is that it guides the researcherõs actions. (Cohen, Manion & Morrison, 2000)

The positivist paradigm of social research which strives to discover ñuniversal laws which explain and govern the reality that is being observedò Burrell & Morgan cited in (Cohen et al, 2000, p. 7), is informed mainly by realism, idealism, and critical realism. According to Cohen et al (2000, p. 7), ñpositivism may be characterized by its claim that science provides us with the clearest possible ideal of knowledgeò The interpretivist paradigm of social research underpinned by heuristic and phenomenological ideologies, ñstrives to understand and describe human natureò (Cohen et al, 2000, p. 23). In this paradigm, knowledge is subjective and ideographic because what counts as truth is context dependent (Cohen et al, 2000).

3.2.1 Interpretative Paradigm

The central concern of the interpretative paradigm according to Cohen et al, (2000, p. 22) is ñto understand the subjective world of human experienceò They further add that ñthe interpretative paradigms strive to understand and interpret the world in terms of its actors. (Cohen et al, 2000, p. 28). Terre Blanche, Kelly & Durrheim (2006, p. 274.) affirm that ñthe interpretative paradigm involves taking peopleõs subjective experiences seriously as the essence of what is real to them, making sense of peopleõs experiences by interacting with them and listening carefully to what they tell us, and making use of qualitative techniques to collect and analyze information.ò The interpretive paradigm views social science as influenced by interactions and behaviours. Interpretive research focuses on social action, the interactions and negotiations through which people define appropriate behaviour.

her tends to rely upon the "participants' views of the situation being studied" (Creswell, 2003, p. 8) and recognizes the impact of the research on their own background and experiences. The interpretivist attempts to understand how meaning is constructed and negotiated through interaction. Understanding always includes a subjective facet in the sense that one interprets a context or interaction from a position of pre-understanding or prior knowledge.

Working in this paradigm opened up the opportunity to find out how respondents understood and implemented the NCS based on their teaching practice rather than theoretical knowledge.

3.3 RESEARCH APPROACH

The study adopted a qualitative research approach. Qualitative research was chosen as it was more suited to provide the researcher with the responses to the questions in this study. Qualitative research, broadly defined, means "any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification" (Strauss & Corbin, 1990). Mouton (2001, p.161) describes qualitative research as involving the use of ñpredominantly qualitative research methods to describe and evaluate the performance of programmes in their natural settings, focusing on the process of implementation rather than on quantifiable outcomesò In Mertens, (2005, p.229), qualitative research is described as ña set of interpretative, material practices that make the world visibleò Qualitative researchers believe that "multiple ways of interpreting experiences are available to each of us through interacting with others, and that it is the meaning of our experiences that constitutes reality. Reality, consequently, is 'socially constructed'" (Bogdan & Biklen, 1992, p 42).

Qualitative research involves an óinterpretive, naturalistic approachôin its subject matter by studying things in their natural settings attempting to

...t phenomenon in terms of the meanings people bring to the using a variety of materials ï case study, personal experience, introspective, life story, interviews, observational, historical, interactive and visual texts that describe routine and problematic moments and meanings in individualsô lives (Denzin & Lincoln, 2000). The word quality usually relates to value and is associated with research with small numbers of people, but more rich information is collected.

The main purpose of qualitative research has been to use and create a number of non-quantitative research methods to describe the rich, interpersonal, social and cultural contexts of education. Qualitative research, according to Bogdan & Biklen (1992) has five key features:
(a) The data source is the natural setting with the researcher being the key data collection instrument;
(b) It attempts primarily to describe and then to analyse;
(c) It is concerned with both the process and the outcome
(d) Data is analysed inductively and
(e) It is concerned with the meaning of things.

Therefore qualitative research methods are suitable for this study that was concerned with investigating how the grade three teachersôinterpretation of the NCS is demonstrated in their teaching practices in mathematics in their foundation phase classrooms. In this regard, the experiences sought in this study occurred in the natural setting of foundation phase classrooms. Such depth in description can only be achieved by ñgetting close to the phenomenon under studyò (Patton, 2002, p.43)

3.4 ETHNOGRAPHIC RESEARCH DESIGN

A research design outlines how the research is conducted beginning to end (Mouton, 2001, p.55). That is, it is a programme to guide the researcher in the collection, analysis and interpretation of observable research management.ôIn addition, the research design also relates directly to the testing of hypothesesôin that it outlines the procedures to be undertaken to obtain evidence to answer the research questions (Leedy & Ormrod 2001). In the context of this study the question facing the researcher with reference to the research design is: The aim of this study was to to address the relationship between existing practices of school mathematics teaching and the curriculum requirements.

Leedy & Ormrod (2001) describe research design as a complete strategy for attack on a central problem by providing the overall structure that the researcher follows, the data he collects and the data analysis that follows. The aim of this study was to to address the relationship between existing practices of school mathematics teaching and the curriculum requirements. To achieve that the researcher chose an ethnographic research design for this study, as its qualitative methods provided sufficient flexibility for describing, interpreting, exploring and explaining the process as well as the products of teaching and learning.

Wolcott, (cited in Thomas, 2003, p. 36) explains that, ñparticular individuals, customs, institutions, or events are of anthropological interest as they relate to a generalized description of the life- way of a socially interacting groupò. The societies on which the researcher focused were the grade three foundation phase classrooms.

In recent years ethnographic research has been acknowledged as an alternative research strategy in education. ñEthnographies are based on observational work in particular settings.ò (Silverman, 2010, p. 49). According to Wolcott, (1997, p.156), ñethnography means, literally, óa picture of the way of lifeô of some identifiable group of people. Ethnography was best suited for this research as ñethnography is good for asking, óWhat is going on here? How does it happen? What does it

, 2006, p. 282) The ethnographer therefore develops a keen appreciation of context in educational research.

The ethnographer ôlearnsô about, ôrecordsô and ôportraysô the culture of this group. Important to this portrayal is that, the study of human behaviour is always in terms of cultural context. What is culture? ñCulture is an abstract concept that ethnographers infer from peopleôs talk, behaviour and toolsò Barofsky, as cited in (Anderson-Levitt, 2006, p. 280). Consistent with Anderson-Levitt adds ñ we generally define culture as learning that people do as members of human groups, not learning done completely on oneôs own without the intervention of other peopleé culture as meaning making includes values, attitudes and feelings, knowing how to actò (Anderson-Levitt, 2006, p. 280, 281). Ethnography provides several techniques to enter into the lives of other cultures and learn from them how they live their lives, how they define themselves and how they make meaning.

An ethnographic study permitted the observation of daily mathematics teaching in foundation phase classrooms, the collection of data on classroom life, and interviews which further informed the data that was collected. The ethnographic research design enabled the researcher to observe the five participantsô practices by becoming immersed in the activities of the classrooms and sharing in the conditions in their classrooms. This enabled the researcher to gain an insight into the culture that otherwise may have been difficult. The researcher also dialogued with the participants through semi-structured pre and post interviews to ñreveal the nuances of meaning from their perspectivesò (Wolcott, 1997, p.158). Throughout the fieldwork the researcher was a ñcareful observer, interviewer, and listenerò (Leedy & Ormrod, 2001, p.151)

ESEARCH TECHNIQUES

According to Wolcott (1997, p.158), the ethnographer, ñwill never rely solely on a single observation, a single instrument, a single approachò but rather on ñobtaining information in many ways rather than relying solely on oneò. He adds that the ethnographer, ñin information gathering, uses multiple sources of data and employs multiple techniques for finding outò (Wolcott, 1997, p.158). The researcher used multi-faceted data collection in order to obtain a clear picture to emerge of the complexities that characterize teacher practice within the classroom setting.

- direct observation
- in-depth pre and post interviews
- Participant post lesson questionnaire schedule
- Samples of the teacherôs planned activities

The researcher drew on ten completed classroom observation field notes, audio and video taped lessons as well as five pre and five post interviews. Conducting observations physically provided the researcher with multiple impressions of the respondents. The researcher was able to don ñthe analytical lens of a cultural anthropologist and entering the chosen group [the classrooms] for an extended period of time to study how the group functionsò (Thomas, 2003, p. 36).ò Eisenhart (1988, p. 105), maintains that ñparticipant observation is a kind of schizophrenic activity in which, on the one hand, the researcher tries to learn to be a member of the group by becoming part of it and, on the other hand, tries to look at the scene as an outsider n order to gain a perspective not ordinarily held by someone who is a participant only.ò

The lessons were videotaped while observations were recorded in the form of field notes. The interviews were tape-recorded with the consent of each respondent. The interviews followed a semi structured and unstructured format involving a series of questions. Participants were required to complete a post lesson questionnaire.

supplement, clarify, or validate the data gained from the observations. During the interviews the researcher engaged in systemic noting that included holistic recording of events, behaviours and resources in the classroom.

The first part of the observation schedule collected general information regarding class size, setting, desk arrangement, date and time. The observations were audio taped then transcribed. The object here was to gain a picture of how participants lived what they believed, hence to enrich findings.

The researcher used two tape recorders, one tape-recorder for monitoring the teacherôs conversations and the other tape-recorder was put on a table to monitor all studentsô conversations within the range of the tape recorder. The tape recording transcripts enabled the researcher to reconstruct the lessons observed. This provided factual information, leaving interpretation until the researcher had a follow up discussion with the participant. This discussion, was an interview, which was also tape recorded. The researcher recognized that the limitation of an audio recorder provides no visual account of events and does not record silent activities or events; the researcher therefore video recorded the lesson as well.

The researcher was conscious of the fact that the recordings and note taking could inhibit, interfere and impact in some ways on the participants and the context. Further, the researcher was aware that there are several problems with the introduction of a tape recorder into the classroom while observing as well as interviewing. The presence of a tape-recorder could cause the participants to become nervous, ôconstrain the respondentô or cause them to act unnaturally. Cassette tapes could introduce a slight ôhissingô sound that can drown softly spoken words and sometimes valuable data.

d also required a great deal from the researcher who tried to be unobtrusive in order to identify the "big picture" while observing considerable amounts of fast moving and complex behaviour (Everton & Green, 1985). However, the qualitative nature of observations enabled the researcher to discover the complex interactions in the lessons observed.

Before each participant teacher began teaching their lesson, a pre-instructional schedule was given to each one of them to complete.
The schedule included:

- the title of the lesson
- the intended mathematical learning outcomes
- the assessment standards for the mathematics lesson
- intentions to achieve these assessment standards
- how this lesson related to the previous mathematics lesson
- ideas or concepts that the learners may find difficult

There was a post instruction questionnaire schedule that the teachers were then asked to complete. This schedule included the following aspects:

- were the outcomes of the lesson achieved?
- what did you think was good about your lesson?
- what was not good about your lesson?

The five teachers were each interviewed following each observation. Interviews, according to Tuckman as cited in Cohen et al, (2000, p.268), provides "access to what is 'inside a person's head', it makes it possible to measure what a person knows, what a person likes or dislikes or what a person thinks". "The research interview has been defined as a two-person conversation initiated by the interviewer for the specific purpose of obtaining research relevant information… on content specified by the research objectives… or explanation" (Cohen et al, 2000, p.269).The

the interview was conducted 'carefully' and 'sensitively' The researcher made certain that the teachers felt secure and comfortable to talk freely. Written informed consent was gained prior to all the interviews. All the teachers were guaranteed anonymity and confidentiality. The interviews were tape – recorded with the consent of the respondent teachers.

3.5.1 Observation

Participant observation is an integral part of ethnographic research. Observation of classroom teaching has been fruitfully used for over two decades to explore the territory of mathematics teaching practice. The researcher, however, did not have the opportunity to be an active participant in the classrooms but rather a 'privileged observer' with occasional chances to speak to the learners and the teacher. Consistent with Wolcott's (1997) description of a privileged observer, the researcher sat in an unobtrusive spot in the classroom and observed the lessons. The researcher had minimal interaction with the teacher or the learners. Prolonged observations allowed the researcher to confirm that the recorded lessons were consistent with the participant teacher's typical teaching practice.

While the learners were engaged with activities, the researcher walked around the room to observe the learners at work as well as to unobtrusively observe teacher-learner interactions. The researcher made copious notes in each lesson observation in order to capture "the wide variety of ways in which people act and interact" (Leedy & Ormrod, 2001, p. 195).

The researcher was mindful of the point made by Leedy & Ormrod (2001, p. 158), that "the primary advantage of conducting observations is flexibility" meaning that the researcher could easily "shift focus as new major disadvantage is that by her very presence, the researcher may alter what people say and do and how significant events unfold” Leedy & Ormrod, 2001, p. 158). Conducting observations physically provided the researcher with multiple impressions of the respondents. The researcher was able to don “the analytical lens of a cultural anthropologist and entering the chosen group [the classrooms] for an extended period of time to study how the group functions” (Thomas, 2003, p. 36). The researcher was careful not confuse the actual observation with the interpretation of them, because interpretations of what were seen and heard changed over the course of the study (Leedy & Ormrod, 2001).

Observations were unstructured; the researcher attempted to record detailed descriptions of the context as well as the actions of the participants. It was important for the researcher to ensure that field notes and detailed descriptions of what actually happened were accurate rather than interpretative comments Field notes can be subjective so it was necessary for the researcher to additional research tools. Denzin cited in (Thomas, 2003, p. 37) cautioned researchers not to expect ethnography to portray the “objective truth”. He says that even though the researcher claims to have “simply recorded” their observations, “their account is inevitably a rendition filtered through their particular mental magnifying glass, resulting in different versions of the same event as seen by different investigators” (Thomas, 2003, p.37).

Face to face interaction moves rapidly. Communication is not just about words, but about linguistic behaviour, gestures and movement as well as the context that gives it meaning; the researcher, therefore, relied on a video recorder as well as an audio recorder to capture and document the happenings in the classroom so as not to miss out on crucial material and thereby maximizing the accuracy of the report. Verbal and non-verbal behaviour could later be studied.

Observation as a Method in Ethnographic Research

- The researcher was able to provide a picture of a óealï lifeôsetting and produce rich, exciting results.
- Observation allowed the researcher not only to tell what was going on, but also to see who was involved. It allowed the researcher to observe and understand the processes as they happened.
- It allowed the researcher to be involved where and when things happened.
- It allowed the researcher to clarify processes and examine causality and therefore suggest why things happened in a particular setting.
- It gave the researcher access to often obscured phenomena, like non-verbal cues.
- Observation allowed the researcher to examine actual teachersô practices compared to what the teachers said about their teaching practices.

3.5.1.2 Disadvantages of Observation as a Method in Ethnographic Research

- Observation as a method is time consuming and labour- intensive. Observation is prolonged and repetitive. Lessons have to be observed more than once.
- The researcher was aware that the results could end up being subjective depending on her personal biases.
- The researcher had to develop the crucial technique of recording observations in writing,
- The researcher was aware that observation results produced could be over-impressionistic, carelessly produced or idiosyncratic.
- The researcher was aware that observation could affect the respondentôs behaviour, and may differ during the researcherôs presence and absence.

aper and pencil recording could lead to material being missed resulting only a partial or selective view. The researcher, therefore, opted to also use a video and audio recorder to ensure more accurate records.

Ethnographic research requires "direct observation", it requires the researcher to be immersed in the field situation. While the researcher has listed the many disadvantages of observation as a method of collecting data, the researcher chose to enter the field in order to gain an intimate insight into instructional practices in the grade three foundation phase mathematics classroom so as to understand how the teacher's interpretations of the NCS policy translates into actual instructional practices rather than opinions of what is happening in the classrooms. Silverman (2006, p.85) speaks of the "importance of using the eyes as well as the ears when doing observational work" as this is a crucial source of data. Denzin and Lincoln (2000) say that staying close to the data is the most powerful means of telling the story. The researcher was convinced that the participant's needed to be observed in their context in order to access directly what was happening in the classroom.

As stated earlier in the study prolonged observations allowed the researcher to confirm that the recorded lessons were consistent with the participant teacher's typical teaching practice. For reasons of trustworthiness, however, the researcher chose to counteract the challenges listed in the disadvantages of observation by providing thick descriptive data using multiple methods of data collection.

3.5.2 Interviews

"Listening is probably the most important activity of an ethnographer during field work. By listening and asking open-ended questions is how the ethnographic researcher understands the participants. Because asking is are listed as a method of equal importance as participant observation.ö (Anderson-Levitt, 2006, p. 280, 288). The interviews allowed the researcher to access the thoughts of the participants.

These in-depth ethnographic interviews were unstructured and conducted with each teacher. This according to Kerlinger as cited in (Cohen et al, 2000, p. 273) means that ñalthough the research purposes governs the questions asked, their content, sequence and wording are entirely in the hands of the interviewer.ò Patton (2002) described unstructured interviews as a natural extension of participant observation, because they occur as part of participant observation fieldwork and rely entirely on the spontaneous generation of questions in the natural flow of an interaction and narration. Patton (2002), adds that while the interview is unstructured, the interview cannot be started without detailed knowledge and preparation. In an unstructured interview, interviewers have to be good at questioning, probing and adjusting the flow of the conversation, they have to be adept at asking the appropriate type of questions while keeping the conversation focussed.

In the case of this research, the interviews were unstructured because the interviews were based purely on the classroom observations. The intention of an unstructured interview is to expose the researcher to óunanticipated themesô and to help her develop a better understanding of the participantøs social reality from the participantøs perspective. The questions were used to clarify points that emerged from the observation in order for the researcher to develop a more complete picture. The interview was also a means to gain access into the teachers' impressions, beliefs, assumptions as well as for justification of observed events.

The teachers were asked to clarify issues that the researcher was unsure of as well as questions to elicit the participant teacherøs interpretation.

… asked spontaneously as an extension of what the participant had answered. This allowed for the accumulation of more detailed data. The questions arose in response to the observation, in order for the researcher to develop a better understanding of what was observed and to explain issues of concern. The researcher undertook to probe as much as possible in order try to understand the participants and their actions.

According to Zhang & Wildemuth, cited in (Cohen et al, 2000, p.275) ñin an ideal unstructured interview, the interviewer follows the intervieweesô narration and generates questions spontaneously based on his or her reflection on the narrationò. Interview questions were generated by observing the lessons. These interviews allow the researcher ñto probe so that she may go into more depth, or to clear up any misunderstandingé they enable the interviewer to test the limits of the respondents knowledgeé they allow the interviewer to make a truer assessment of what the respondent really believesò (Cohen et al, 2000, p.275).

In-depth ethnographic interviews were conducted with each teacher after each lesson. The questions arose in response to the observation, in order for the researcher to develop a better understanding of what was observed and to clarify issues of concern. Taking on the role of observer allows the researcher to ask informal and unstructured questions as they arise. These questions were asked in the context of the classroom and sometimes, while the teacher and learners were involved in the lesson. The researcher asked interview questions in a relaxed and non-threatening manner that allowed the teachers the freedom to talk and elaborate on their teaching practice. Full cooperation from the teachers was as a result of the relationship that the researcher had developed over time with the teachers.

d during the informal discussions that arose after lessons. Some questions arose spontaneously from the lesson and were focused on the teaching practice and educational content being addressed, the processes used, the rationale behind some of the teachersô actions, and so forth. The researcher was able to shift to interviewing in order to clarify observational data, and so relate the interview data back to the observational data. At all times the researcher was mindful of the focus of the study. Conducting such interviews, represented the participants in a way that was seen to be fair and true.

The combination of observation and interviews also allowed the researcher to ñexplore voices and experiencesò Byrne in (Silverman, 2006, p.114) thereby to understand the meanings teachers held of everyday mathematics perspectives and teaching perspectives. The interviews were a rich source of data which provided the researcher with access as to how the teacherõs accounted for their actions in the classroom.

The researcher chose to record all the teacher interviews. This was carried out with the permission of all the participants. The interviews were later transcribed. The researcher was therefore able to examine the transcripts of the individual interviews thoroughly.

3.5.2.1 Advantages of Interviews as a Method in Ethnographic Research

Patton (2002, p. 343) maintains that the merit of an unstructured interview lies in its óconversational natureô, which allows researcher to be ñhighly responsive to individual differences and situational changesò. ñEthnographers use interviews to enhance insight into a ótotal situationô The interview is the personal record of an event by the individual experiencing it, told from that personõs point of viewò (Powney & Watts, 1987, p. 23).

- “Ethnographers avoid the automatic imposition of a researcher’s theories on the people being studied”, (Powney & Watts, 1987, p.13) they first find out how these people define the world through interviews.
- The researcher was able to take the descriptions, beliefs, attitudes and events of the different situations and understand them through a discussion of the participant’s motives and perspectives.

3.5.2.2 Disadvantages of Interviews as a Method in Ethnographic Research

More of a challenge than a disadvantage is, analyzing the data from unstructured interviews. Because the questions are dependant on individual interview contexts across various sessions, different questions generate different responses. The effort to systematically analyze the data to find patterns could prove tedious. (Patton, 2002)

“Because it involves a complex speech unit, ethnographic interviewing requires practice to acquire the necessary skills.” Spradley as cited in (Powney & Watts, 1987, p.15)

- Language pervades all stages of the ethnographic research, language can however, block understanding between the researcher and the participants. This is especially true if they do not share a common vocabulary and meanings. There is the possibility that some elements of the interviews were not properly understood by the participants or the responses not properly comprehended by the researcher. (Two participants were not English first language speakers.)

…s aware that participants were not always willing to share all that needed to be explored.

Similarly, Patton, (2002, p. 343), alleges that the characteristic of unstructured interviews requires researchers to have a "rich set of skills," the researcher should be able to listen carefully during the conversation and "be able to adjust the interview direction in response to the individual interview context, the researcher has to be able to: generate rapid insights and formulate questions quickly and smoothly."

3.5.2.3 Method of Recording the Interviews

Conventional note taking is difficult at the speed of normal conversation. Full note taking would also have been an intrusion on the researcher's concentration resulting in a collection of only a small amount of data. Bearing in mind that with the taking of field notes the researcher may unintentionally miss important gestures, facial expressions, meaningful pauses, ambience, the researcher also opted to utilize a video and audio recorder.

The researcher chose to use an audio recorder to record all the interviews. This was done with the permission of all the participants. The interviews were later transcribed. The purpose of this recording was interpretive in order to inform the reader of this thesis and of the process of the research engagement. The researcher assured the participants that video and audio data were purely for analysis in the study. The researcher assured the teachers that the video images would not be shown in any publication of the research. Audio and video recordings of the lesson enhanced the observation field notes taken by the researcher. The video recorded lessons allowed the researcher to evaluate the mathematics in instruction. It was intended to support the observation field notes in capturing on record the range of teacher practice with mathematical ials, and learnerõs responses to the lessons. The researcher anticipated that the recording equipment would foster reliability of the reporting.

3.5.3 Artifacts

During the classroom observations, the researcher examined, and occasionally collected artifacts. These artifacts took the form of samples of activities set by the teacher, samples of lesson preparation and the activity worksheets for the observed lessons. The researcher observed the learnerõs engagement with the tasks set by the teacher. The researcher noted whether the task required the learners to think deeply; was the activity stimulating and challenging? Was the work routine, simplistic and how much of teacher support was needed and how enthusiastic were the learners to perform the tasks?

3.6 THE RESEARCH SITE

The researcher chose five foundation phase grade three teachersô from different schools in the East London area to participate in the research. The schools chosen were an assortment of the schools in the area. This was done in order to understand foundation phase teacher practice from different perspectives. Access was first gained from the Eastern Cape Education Department as this was a requirement for carrying out research in the schools. The researcher then gained access to the respective grade three classrooms through the respective principals of the schools. The teachers were asked to volunteer to be part of the study. The teachersô anonymity was ensured and written permission was obtained from all the teachers before embarking on this research. The researcher spent time in each of the grade three classrooms becoming familiar with the teacher and the learners in order to ñestablish a rapport and to gain their trustò (Leedy & Ormrod, 2001, p.151).

LING

A sample refers to the group of individuals, selected from a larger population by means of a sampling procedure to generate the data for the research. (Cohen et al, 2000) Five consenting teachers from East London primary schools were purposefully selected to participate in this study. They were all grade three foundation phase teachers with between five and thirty five years teaching experience. The participating teachers were chosen purposefully in an effort to include the diverse schools in the East London area. Their formal qualifications ranged from Junior Primary teaching Diplomas to a Bachelor of Education degree. The researcher focused on foundation phase classrooms grade three teachers as the source to reveal what teacherøs in East London schools do to facilitate mathematical learning.

The sample of ñkey informantsò was purposefully selected as ñthey provided the information and insights relevant to the research questionò (Leedy, & Ormrod, 2001, p. 151). The small sample size is determined by the ethnographic research design. ñIn purposive sampling, researchers handpick the cases to be included in the sample on the basis of their judgment of the typicalityò (Cohen, et al 2000, p.103).The sample was therefore not representative of the wider population. ñWhilst it may satisfy the researcherøs needs to take this type of sample, it does not pretend to represent the wider population; it is deliberately and unashamedly selective and biasedò (Cohen et al 2000, p.104)

The researcher was introduced to the participant teachers a few weeks before the commencement of the study. This gave the researcher the opportunity to explain the study to the participant teachers, to answer their questions, to allay their concerns and to obtain the participants consent. The researcher used the opportunity to arrange pre-observation visits to the classroom.

As articulated by Cohen, et al, (2000, p.147), data analysis ñinvolves organizing, accounting for and explaining the data in terms of the participantõs definitions of the situation, noting patterns, themes, categories and regularities.ò In ethnographic research, the researcher commences data analysis during the data collection process. The researcher did this so as not to have the added problem of data overload as well as to select ñsignificant features for future focusò (Cohen, et al, 2000, p.147). The researcher brought order, structure and meaning to the ôthickõ narrative data, by searching for general statements about the relationships among the categories of data in order to ñthick interpretationò possible. The category generalization phase of the data phase was the most difficult and complex process.

The process used in category generalization involved noting regularities in the setting and of the participants chosen for the study. The analysis became more complete when the critical categories of (a) teacherõs mathematical practices and (b) teacherõs teaching perceptions were defined.

The analytic procedures used were to: organize the data; generate categories, themes and patterns; test the emerging hypotheses against the data; and search for alternative explanations of the data which led to report writing.

Each of the phases of the data analysis mentioned went through the data reduction process as the thick data was interpreted. The researcher paid careful attention to how the data was reduced throughout the research endeavour. In some instances there was a direct transfer of data onto pre-developed data recording memos. The researcher interacted with the data and first as suggested by Hammersley and Atkinson ñreading and rene thoroughly familiar with them, noting also any interesting patterns, any surprising or unexpected features, any apparent inconsistencies or contradictionsò(Cohen, et al, 2000, p.149).

Analytical devices of pen, scissors and index cards were used to gather together emergent broad categories. (Wolcott, 1999, p. 32, 33) supported the idea that data needs to be sorted into very basic or broad categories sufficiently comprehensive to sort all the data, in order to ask ñwhat is going on hereò

The researcher then looked for matching interview responses to observed behavior as well as relationships and linkages between different situations and participants. This helped the researcher to streamline the data management and thus ensure reliability of the research method.

As the categories of meaning emerged, the researcher searched to identify the salient, grounded categories of meaning that the participants held with regard to:

- Mathematical practices prevalent among the grade three teachers
- Teaching practices with regard to facilitating learning
- The teaching strategies employed by the grade three teachers.

The next step was to make ñspeculative inferences.òThis is an important stage according to Cohen, et al, (2000, p.149), as ñit moves the research from description to inferenceòThe researcher was required to put forward possible key elements, explanations and their probable causes.

3.9 LIMITATIONS OF THIS ETHNOGRAPHIC STUDY

The key limitations of this ethnographic study were:

- Ethnography takes time.

to quantify because of the reliance more on description

- Respondents may have been nervous to answer truthfully.
- The researcher was aware that the video and audio recordings may have intimidated the participant teachers as well as the learners and caused them to act unnaturally.
- The investigation was confined to five grade three teachers in the East London area.
- An awareness of the potential pitfalls and limitations of the research techniques led to attempts on the part of the researcher to reduce them or at least to minimize their effects in this research.

While the quality of the data in ethnographic research is dependent on the researcher developing a rapport with the participants, the dilemma is - how close is too close. ñThe closer the researcherõs relationship with the participants, the more likely the researcher will see, hear, and feel inconspicuous but significant features of an event and will have the background knowledge required for deriving an insightful interpretation of what the features meané too close an emotional identification [with the participants] can damage the objectivity é so the report may reflect what they wish the world were like rather than what the world really is likeò (Thomas, 2003, p.78).Wolcott cited in Thomas proposed,

> [The researcher] ordinarily an outsider to the group being studied ï tries hard to know more about the cultural system he or she is studying than any individual who is a natural participant in it, at once advantaged by the outsiderõs broad and analytical perspective but, by reason of the same detachment, unlikely ever totally to comprehend the insiderõs point of view. The [investigator] walks a fine line. With too much distance and perspective, one is labeled aloof, remote, insensitive, superficial: with too much familiarity, empathy, and identification, one is suspect of having ñgone nativeò (Thomas, 2003, p.78).

ESS, CREDIBILITY, TRANSFERABILITY, DEPENDABILITY, CONFIRMABILITY

With regard to ensuring rigour in qualitative enquiry, Spiers, (2002, p.2) asserts that ñwithout rigour, research is worthless, becomes fiction, and loses itõs utilityö Central to assessing the rigour or quality of the qualitative research are the criteria of reliability and validity. A number of frameworks have been put forward in the qualitative research literature; however, a widely adopted set of criteria have been proposed by Lincoln & Guba (1985). Rather than criteria of internal validity, external validity, reliability and objectivity which are typically used to establish trustworthiness within a qualitative research paradigm, they originally proposed that research using qualitative methods, as in this study, consider the criteria of credibility, transferability, dependability, and confirmability.

3.10.1Trustworthiness

The aim of trustworthiness in qualitative research is to support the argument that the research findings are ñworth paying attention toö (Lincoln & Guba, 1985, p.290). Regarding trustworthiness, according to Lincoln & Guba (1985, p.290), the basic issue is simple: How can an inquirer persuade his or her audience that the findings of an inquiry are worth paying attention to, or worth taking account of? What arguments can be mounted, what criteria invoked, what questions asked that would be persuasive on this issue?

Using the criteria outlined by Lincoln & Guba (1985) and Potter (1996), the following discussion will establish the trustworthiness of the study by auditing the events and influences on the research processes and the researcherõs reactions to them. Koch (1994) notes that although the reader may not share the interpretation presented by the researcher they should be able to follow the way in which it was derived. This is a result of the fact to the analysis our own preconceptions that influence the dialogue between the researcher and the text or the reader and the interpretation. The researcher's own prejudices and preconceptions are discussed further.

3.10.1.1 Credibility

Credibility, according to Lincoln & Guba (1985, p.296), is an evaluation of whether the research findings represent a "credible" interpretation of the findings. Lincoln & Guba (1985) suggest a number of techniques in order to ensure more credible finding and interpretations: activities in the field that increase the probability of high credibility, peer debriefing, negative case analysis, referential adequacy and member checks. Three of these techniques were adopted during the study to address credibility: activities in the field, peer debriefing, and member checks.

Activities in the field

With regard to activities in the field that increase the probability of high credibility, Lincoln & Guba (1985) suggest three techniques: prolonged engagement as well as persistent observation. The researcher ensured that substantial amount of time was spent in the participant's classrooms in order to build trust and establish a rapport with the participant teachers and their learners. The prolonged observations also allowed the researcher to confirm that the recorded lessons were consistent with the participant teacher's typical teaching practice.

Peer Debriefing

Peer debriefing involves exposing the work to a disinterested peer in order to illuminate aspects of the research that might otherwise remain implicit. Lincoln & Guba (1985) argue that that this should not be undertaken by e researcher such as members of the research committee. In the case of this study, peer debriefing was an ongoing process through engaging in discussions with a peer who had no contractual interest in the situation. The researcher was mindful of the suggestion made by Guba and Lincoln, (1989, p.237), that the disinterested peer should pose "searching questions in order to help the evaluator his or her own posture and values and their role in the inquiry". The researcher regularly discussed the study with a peer, whose role was consistent with that defined by Lincoln & Guba (1985), who posed questions regarding the research throughout the research process.

In addition my supervisor read my entire work as it progressed and provided written feedback. This feedback provided the researcher with the opportunity to reflect on the honesty and accuracy of the study. This aspect of trustworthiness is consistent with Potter's (1996) criterion of readers' evaluations, in which readers are able to make their own evaluations and suggest alternative interpretations

Member checking

The researcher engaged in informal as well as in formal member checks. The participants were in certain instances asked to clarify what was said in an interview informally as well as to verify that what was written down after the interview were transcribed was what was intended to be communicated. This practice allowed the researcher to correct errors as well allowed the participant to offer additional information

3.10.1.2 Transferability

Lincoln & Guba (1985, p. 316) argue that it is not the responsibility of the researcher to "provide an index of transferability". Rather, the responsibility of the researcher lies with providing sufficient contextual data or "thick reader can make a judgement of transferability. Guba and Lincoln, (1989, p.241) advise that ñthe major technique for establishing transferability is thick descriptionò. The researcher has attempted to provide careful and extensive descriptions of the participants and their contexts and as complete a data as possible in order to facilitate transferability on the part of others who wish to apply the study to their own situations.

3.10.1.3 Dependability

Dependability is concerned ñwith the stability of the data over timeò Guba and Lincoln (1989, p.242). One way a study can be shown to be dependable according to Lincoln & Guba (1985) is through an audit. In this study the readerõs evaluation is made possible as a result of the presentation of direct transcripts alongside interpretations made by the researcher.

3.10.1.4 Confirmability

Confirmability, according to Guba and Lincoln (1989, p.243), is concerned with assuring that the data, interpretations and outcomes of inquiries are rooted in contexts and persons apart from the evaluator and are not simply fragments of the evaluators imaginationò. Lincoln & Guba (1985), suggest that confirmability can be achieved as part of the audit to determine dependability. This process is also supported by keeping a reflexive journal. The researcher kept a journal throughout the process of this study. The researcher made notes of observation, questions, issues to explore matters to return to and so forth. The journal contained personal notes to the researcher as methodological issues for exploration. As a result of this process the data can be tracked to their sources.

3.11 ETHICAL CONSIDERATIONS

The first issue of informed consent creates a dilemma for ethnographic researchers; the issue is one of overt or covert research. ñOn the one hand there is a powerful argument for informed consent, however, the more participants know about the research the less naturally they may behaveò (Cohen, et al, 2000, p.142). The researcher however considered her responsibility not only to her participants and their vulnerable learners, but also her undertaking with the Department of Education of the Eastern Cape which obligated her to gain informed consent. ñThe scientist has the right to research for the truth, but not at the expense of the rights of other individuals in societyò (Mouton, 2001, p. 239).

In consequence of this the following ethical issues were addressed:

- The researcher provided the five teachers with a copy of the research proposal. This was done to clarify their participation in an ethnographic research that would study teachersô mathematics instructional practices, and that the research would result in the researcherõs masterõs dissertation.
- The teachers were not coerced into participating in the study. The researcher made it clear to each of the teachers that they had the right to refuse to participate in the research at any point during the process or not to complete any item should they not feel comfortable with answering it.
- The teachersô anonymity was ensured and written permission was obtained from all the teachers before embarking on this research.
- All participants were guaranteed confidentiality with the assurance from the researcher that the participantsô real names, the names of the schools or other identifying characteristics would be withheld in all the research.

a privileged observer, the researcher needed to continuously acknowledge her subjectivity throughout the study.

- Explicit authorization was obtained from the teachers before interviews were tape recorded and verbatim transcripts made.
- The teachers, who were interviewed, were guaranteed confidentiality.

3.12 CONCLUSION

In this chapter the researcher outlined the process and procedures used to carry out the research. This included the selection of research instruments used to collect the data i.e. observations and interviews, selection of respondents, permission to observe mathematics teaching practice, as well as permission to conduct the interviews. This chapter also addressed four issues of trustworthiness and includes the limitations of the study. The quality of any research is important; the researcher therefore alluded to the way in which the integrity of this research was ensured.

In the next chapter the data will be presented and analyzed.

CHAPTER FOUR

THE ANALYSIS AND INTERPRETATION OF THE RESEARCH FINDINGS

4.1 INTRODUCTION

In this chapter the researcher presents the findings of the research. The focus here is to present, analyze and interpret the research data that was gathered in this study. The purpose of gathering the data was to investigate mathematics teaching and learning practices in grade three classrooms.

The researcher was aware of the responsibility not only to her participants and their vulnerable learners, but also her undertaking with the Department of Education of the Eastern Cape which obligated her to ensure confidentiality of the participants. For the purpose of this study the researcher will refer to each of the participant teachers and their schools by the first five letters of the alphabet. By this the researcher means Teacher A is from School A.

As indicated in chapter three, the data for this study was generated through mathematics lesson observations, video and audio recordings of lessons, semi-structured and unstructured interviews, pre and post lesson questionnaires and artifacts in the form of samples of the teachersô planned activities.

4.2 THE ANALYSIS OF THE DATA

The analysis of the data was completely qualitative. In analyzing the data the researcher focused on dimensions of effective mathematics practice, the instructional processes, the instructional tasks, the social organizing of learning created by the teacher as well as the teacherõs decisions and actions as proposed by the NCS. This method of accumulating data tion, which proved the basis to an understanding of foundation phase mathematics teacher practice in five East London primary schools.

The researcher analytic procedures used were to bring order, structure and meaning to the thick narrative data, to search for emerging themes, patterns, recurring general statements and regularities in the setting and the participants chosen for the study and to generate categories. The analysis of the data required disciplined examination while paying careful attention to the purpose of the research. The researcher carefully considered verbal and non verbal data and applied data reduction strategies to the data.

In analyzing the data the researcher focused on dimensions of effective mathematics practice, the instructional processes, the instructional tasks, the social organizing of learning created by the teacher as well as the teacher's decisions and actions as proposed by the NCS. The thick description proved to be the basis to understanding foundation phase mathematics teacher practice in five East London primary schools.

4.2.1 Coding Of Data

Data analysis proceeded in stages, during data collection and after data collection. Categories were identified that reflected key features of lessons observed. These categories included planning, content, teaching strategies, cognitive level of content, teacher-learner engagement, connections of prior knowledge, resources, learner tasks, teacher support and classroom environment. For observation of instructional practices, the researcher wrote a summary description of actions and lesson features pertinent to each category. Using the summary descriptions, the researcher organized the results of the teacher observations. Comparisons were then made to look for distinctive common features.

he observations according to an instructional format, the teacher's role, the teacher's focus, learner's behaviour and expectation of learner's cognition. The codes were clarified by defining each of them

The researcher drew on the work of Shulman (cited in Ball et al 2008) who also developed codes for interviews. Concepts were identified and organized into categories (eg. knowledge of the curriculum, principles of OBE, active learning, importance of continuous learning, teacher's role, learners' role, assessment for learning, equity, context, content).

4.2.2 Coding the Teaching Practice

<u>Table 4.1: Category description of actions and pertinent lesson features</u>

Lesson Planning	The teacher plans and is well organized for her lessons everyday. Learners have enough materials for the activities. The teacher is mindful of what students have learned in previous grades as well as what skills they need to acquire at this grade level. (Hill et al 2004)
Engaging Content	Teacher's knowledge of the mathematics entailed in the lesson as revealed by its enactment. The teacher provides lessons, activities and tasks that arouse the curiosity and anticipation of the learners, reviews content in a meaningful way, employs many teaching strategies, creates authentic products, uses current events as a context for learning, uses hands-on strategies, and builds excitement when introducing new material. Included is the recording of the mathematical work of the lesson and delivery of the mathematical tasks students rking on. (Department of Education, 2002)
Multiple Representations of Tasks	To teach a single concept, the teacher uses many different methods to deliver the lesson content. (Artzt and Armour-Thomas, 2002)
Learning by Doing	Learners are given opportunities for hands on learning. (Geary 1994)
Scaffolding	The teacher models and assists learners when they are struggling to learn new material. (Hodson and Hodson 1998)
Encourages Risk Taking	The teacher encourages the learners to take chances and try new things. The learners get the message that when they try new things the teacher and classmates will support their efforts. (Van Der Walle, 2010)
Encourages Independence	The teacher communicates to learners that there are many things they can do on their own, without the teacher's assistance. Learners know that they are to do as much as they can before asking for help. (Department of Education, 2002)

	…ners are given many opportunities to use materials to assist them in … learning eg. suitablity of the lesson materials. (Mutemeri and Mugweni,2005)
Monitoring	The teacher constantly assesses learnersô engagement, understanding, and behaviour during the course of the day. The teacher constantly monitors the entire class, even while she is working one-on ï one with a learner. (Jones and Moreland, 2005)
Positive Feedback	The teacher takes advantage of many opportunities to give constructive feedback to learners. Her feedback is immediate and specific to learnerøs accomplishments. The teacher uses these opportunities to encourage and gently push the learners to think more deeply. (Jones and Moreland, 2005))
Stimulates Cognitive Thought	The teacher provides activities and lessons that promote deep processing and higher order thinking skills. The meaning and use of mathematical language, meaning making using mathematical language about ways of reasoning, and about mathematical practices. (Van Der Walle et al, 2010)
Stimulates Creative Thought	In planning lessons, the teacher allows learners to be creative and think in novel ways. (Van Der Walle et al, 2010)
Strategy Instruction	The teacher uses explicit strategy instruction. Learners are taught many skills and strategies by the teacher modeling and thinking out loud about her process and plan of attacking a problem or question. (Van Der Walle et al, 2010)
Positive Classroom Management	The teacher uses classroom management techniques that are positive, constructive, and encouraging towards her learners. When she needs to correct a learnerøs behaviour, she does so quickly and privately, getting the learnerôback on task as soon as possible and with as little disruption as possible. Van Der Walle, 2010)
Learner Engagement	About 80% of the learners pay close attention for the entire time the observers are present. (Van Der Walle, 2010)
Teacher Encouragement of learner understanding and reflection	The teacher monitors learners understanding of the material. She probes for answers, allows time for learners to think before answering, provides ñwait timeò and encourages them to self correct their wrong answers. (Cobb,Wood and Yackel,1991)
Self Regulation	The teacher provides ways for learners to monitor their learning and make the transition independently to some activities after they are finished their set tasks(Van Der Walle, 2010)

(adapted from Dolezal, Welsh, Pressley and Vincent, 2003, p. 258-262)

Categories were developed, then merged, collapsed and some were discarded. The coding underwent refinement as a result of what was encountered during the fieldwork.

DATA

4.3.1 Demographics

The research was conducted in East London and involved five schools. For the study one teacher from each of the five schools consented to be a participant. The schools chosen for the study encompassed the full range of socio economic levels found in central East London.

The study comprised five urban schools. Of the five schools one was extremely well resourced, two were moderately resourced and two schools were considered historically disadvantaged. In an effort to further represent the diversity of the schools in the East London area, the researcher chose three English medium schools, one Afrikaans medium and one Xhosa medium school. The researcher focused on foundation phase classrooms grade three teachers as the source to reveal what teachers in East London schools do to facilitate mathematical learning.

4.3.2 Demographic Characteristics of Participants

The demographic characteristics of the participants are presented in Table 4.2.

characteristics of participants

Participant	Gender	Teaching Qualification	Number of years teaching	Number of years teaching foundation phase	Number of years teaching grade 3	Class Size
Teacher A	female	Diploma in Education (Foundation Phase)	5	5	5	28
Teacher B	female	Diploma in Education + 2nd Year B.Ed (Intermediate Phase)	10	5	5	46
Teacher C	female	Diploma in Education (Senior Phase) + B.A degree	18	5	6	42
Teacher D	female	Diploma in Education (Intermediate Phase) + H.DE	25	6	6	35
Teacher E	female	Diploma in Education (Foundation Phase)	35	35	6	22

Table 4.2 illustrates the profiles of the teachers who participated in the study.

All five teachers were female and hold teacher qualifications. They were all grade three foundation phase teachers with between five and thirty-five years teaching experience. Their formal qualifications range from Junior Primary teaching Diplomas to a Bachelor of Arts degree.

Table 4.2 indicates that only two of the participants were trained to teach foundation phase, two of the teachers were trained to teach in the intermediate phase and one was a senior phase trained teacher. Teacher B and Teacher C are now teaching foundation as they needed to relocate and found that the only posts available in the area they required were foundation phase posts which they accepted. Teacher C was trained to teach Biology. Teacher D was an intermediate phase teacher who taught languages and library for nineteen years. Six years ago when a grade three post became available at the school she requested it.

The majority of the teachers in this cohort were not trained foundation phase teachers. This means that these teachers lacked the training in dology. According to Ball, Thames, Phelps &, (2008, p 391), not only is teaching elementary mathematics extremely challenging, but "making instructional learning that support student learning requires teachers who understand content beyond knowing what procedures to use, when to use them and why they work". In addition Van De Walle et al, (2010) adds that teachers need to understand how knowledge is constructed and thereby have a sense of how children learn.

Table 4.2 also indicates a significant variation in class size. Teacher B and C had considerably larger classes. The learner to teacher ratio was much higher compared to the class of Teacher A or Teacher E. Teacher B and Teacher C found it difficult to walk around in their classes because of the congestion of desks. The researcher also observed the challenges of teachers attempting to supervise work in the large classes. It was not possible for the teacher to give all the learners the attention they needed. The long wait between tasks as well as the time waiting for assistance from the teacher gave the learners ample opportunity to misbehave. Teaching time was also wasted in an attempt to control the class. Every few minutes the teacher had to draw the learners attention back and to warn them to behave. It was observed also that certain learners especially in the large classes were not noticed; especially since whole class, chalk and talk method of instruction was used. Teaching practices however, were identical in the large and small classes.

4.3.3Teacher Profiles

Teacher A

Teacher A is in her forties. She teaches in a well established school in a middle to low income area of East London. The school is over one hundred years old. The school is also well resourced. She has a class enrolment of twenty eight. Her learners' home languages are English and luent in English as they have been at the school from grade R.

Teacher A has been teaching for five years, but previously was a teacher aid for ten years. During her time as a teacher aid she was accepted as a student to study toward a teacher's diploma. As a result of time spent as a teacher's aid, she was granted recognition of prior knowledge and promoted to the second year of study. She is sensitive about the circumstances that fast tracked her teacher qualifications and makes reference to all the effort she puts into her teaching. While Teacher A has a recognized teacher's qualification, the gaps are evident in her practice. One such gap was her inability to design instruction for the specific needs of her learners.

Teacher B

Teacher B is in her late thirties. She has a recognized teacher's diploma and is presently in her second year of studying toward a Bachelor of Education degree. She was trained to teach in the intermediate phase. The post in the foundation phase at this school was open when she wanted to relocate from the rural area. She applied and was accepted. She has been teaching for ten years, five of them at this school in the grade three. Her home language is Xhosa although her language of instruction is English.

School B is situated in an area of East London with low cost housing. The learners at this school come from low-income families. Unemployment is very prevalent in this area. The majority of the learners at this school are dependent on the school feeding scheme for a meal. The researcher was curious about the restlessness that seemed almost to seize the learners in the class about half an hour before break. According to Teacher B, from the lunch servers walking toward the grade one classes, they become completely distracted.

Teacher C

Teacher C is in her late thirties. She has been teaching for eighteen years. She is senior primary trained with specialization in Biology. She was redeployed from a rural high school and was sent by the Education Department to School C. Teacher C has been teaching grade three at this school for the past six years. Teacher C has a teacher's diploma and a Bachelor of Arts degree.

This school is in a township. It is a neat and well maintained school. The learners come from low-income families, where there is a high rate of unemployment. There are many volunteer parents who work in the school gardens to grow vegetables in order to supplement the food for the learners, supplied by the Education Department. Parents also come in to cook for those children who are fed by the school feeding scheme. The children are all Xhosa speaking. English is introduced as a subject in grade three. Xhosa is the language of explanation in the English lessons.

Teacher D

Teacher D is in her early fifties. School D is situated in an affluent area of East London. It is a well established school with a very proud history. The school is over a hundred years old. The school is very well resourced with interactive whiteboards in every class as well as computer programs for mathematics and literacy among other latest resources.

Learners at this school come from the around the vicinity of the school as well as other nearby suburbs. The socio-economic background of the learners at this school is upper middle class. Teacher D has a multicultural [illegible] language ranged from English, Xhosa, and a few Afrikaans speaking learners. The learners in the class are very proficient in speaking the language of teaching, which is English, as almost all the learners have been at the school from grade R.

Teacher D has been teaching for twenty five years. She has a teacher's diploma as well as a higher education diploma. She was trained as an intermediate phase teacher and taught in the intermediate phase for nineteen years. When the vacancy for a grade three teacher in the foundation phase at the school became available, Teacher D requested the opportunity to take up the position to teach grade three. Teacher D has therefore been teaching grade three for the past six years. While Teacher D has had no formal training in foundation phase teaching, her school has been very proactive with regard to teacher development. Teacher D has therefore been on two courses a year for the past six years arranged and paid for by the school. Courses range from curriculum issues, different OBE matters, mathematics and literacy teaching, and so forth.

Teacher E

Teacher E is in her late fifties. She has been teaching for thirty five years. She has trained in foundation phase teaching and has taught in the foundation phase all her life. Teacher E has a very calm demeanor. The medium of instruction at this school is Afrikaans. The school is a preparatory school. The school population is made up of grade R, grade one, grade two and grade three. Teacher E is Afrikaans speaking. The learners speak mainly Afrikaans and Xhosa at home. The learners in Teacher E's class were all fluent in Afrikaans.

School E is situated in the city centre. It is a comparatively well resourced school. This is one of a small number of Afrikaans medium schools in East London. The learners at this school come from all the surrounding areas of range of socio economic backgrounds. School E has a small compliment of indigent children who are fed by the school on a daily basis.

4.4 DISCUSSION OF RESEARCH FINDINGS

In this section the data is presented per research question.

4.4.1 *Research Question 1*:

<u>What practices in mathematics and mathematical activity appear to be prevalent among these grade three teachers?</u>

The data generated from participant observational techniques involving intensive descriptions of lessons as well as in-depth interviews provided the researcher with an insight into each participant teacher's practice of mathematics teaching aimed at answering the question

Teacher A

The learners were seated in rows facing the chalkboard. Teacher A stood in front of the class while she taught. Teacher A was very authoritative. If the children disobeyed an instruction they were threatened with a demerit and detention.

Teacher A had an assortment of posters on the walls for the core learning areas including mathematics. She had a wide range of resources that were very neatly packed away in perfectly marked containers. The class was beautiful with bright posters on the walls, colourful draped curtains, coordinated tablecloths and everything in perfect place. While Teacher A's walls were adorned with posters, the learners did not use the charts as reference material during lessons. She did not refer to the charts in her

...ncourage her learners to do so. There was no display of the learners' work in this class. Learners were not allowed to touch anything unless the teacher gave permission; this included not being allowed to use the counters. The researcher did not see the learners use any resources in all the time spent observing in Teacher A's class. A common practice observed among the learners was the use of the markings on their rulers to count.

One of the lessons observed in Teacher A's class was a lesson on capacity. She had a wide range of standard and non standard receptacles, measuring jugs of different shapes and sizes, an array of measuring spoons as well as the equipment to measure. In addition, the equipment to measure and make an instant pudding was set out on the table. Teacher A did all the talking, the measuring, pouring and the colouring of the water to show different levels and then proceeded to make the instant pudding entirely on her own. This presentation went on at length, with a minimum of learner talk interrupting its flow.

When the learners were asked questions that required a 'yes' or 'no' answer or to point out a jug or a spoon to show or to call out a measure, often Teacher A asked a question and answered it herself. As in the following example:

> *Teacher: Now we are going to do ordering. Who knows what it means when we order numbers? If I say 30, 60, 7, 4 and say order from the smallest to the biggest. Which number will you use first?*
> *Learners: the smallest number 4.*
> *Teacher: to the biggest, which is 60. Now let's look at the different containers.*

For most of this lesson the learners displayed passive attention. The learners were not asked questions that encouraged deeper thinking. Questions that involved, giving a reason or 'why' or 'how' were not asked. The lesson concluded with the measuring and making of instant pudding.

s meant to be the consolidation of the concept. Teacher A demonstrated with one packet of instant pudding. The learners pointed out the appropriate measuring cup or spoon as Teacher A read the recipe. Once all the ingredients were added to the bowl. The learners were given a chance to hold the electric beater. The mathematical content that was presented was very superficial. Learner participation in the mathematics lessons in this class was minimal. It would be reasonable to suggest that very little learning took place in this lesson.

It was evident that Teacher A lacked the understanding of how to organize the lesson content and pace her teaching in order to help her learners to understand it. Teacher A seemed to be often guilty of óinformation overload.ô An example of this was when she introduced ócapacityô, there was too much of mathematical content in the first lesson.

The lack of participation, the length of time that the learners had to sit passively and watch caused some of the learners to become restless and distracted. Teacher A was very rigid in her approach to teaching. There was a lack of learner engagement in the lesson or teacher-learner communication. In previous mathematics lessons observed in this class, Teacher A relied on demonstrating algorithms on the board then setting them tasks to mimic the procedure.

Teacher B

Teacher Bös classroom looked pleasant and attractive. The display of mathematics charts on the wall included multiplication tables, months of the year, number frieze and shapes among others. This was the largest of all the classes in this research. The learners were seated in rows facing the chalkboard. The class was very cramped. Teacher B stood in front of the class while she taught. She did most of the talking while the learners watched and answered questions.

cularly concerned by the instructional practice in Teacher Bös classroom. In one observed lesson on shapes, Teacher B attempted to integrate the life skills lesson on õhomesö Her attempt at making explicit links was very weak. Her way of creating a link between the two lessons did not have a õgoodness of fitö The learners were asked:

Teacher: "What shape is a house?"

Answers like, ña rectangleö, ña squareö were forthcoming. None of these answers were accepted. Teacher B shifted to another question, without any explanation, and asked;

Teacher: "What shape is a shack?"

The researcher found the teacherös questioning lacked focus. It was confusing for the learners as well, especially since the teacher proceeded to the next question without some sort of resolution.

In explaining the properties of a triangle, circle, square and rectangle, Teacher B made many mathematical errors. Teacher B asked the class:

Teacher B: What can you say about a triangle?
Learner: It has two sides that are the same.

Teacher B accepts this answer as correct. She asks another child to draw a triangle on the board.

Teacher B: Who can draw a triangle?

Teacher B continued in this same vein as she questioned the learners about the shapes on their worksheet. The shapes were a triangle, rectangle, square and a semi-circle. The teacher did not question the learners about the different types of triangles, the properties of the different triangles or even to find the shape in the environment. The researcher noted that even though there was a chart depicting shapes on the wall, the teacher did not refer to it at all. The poster on the walls, were serving an aesthetic rather than for an instructional purpose.

on time was spent having the learners draw shapes on the board. First a child was told to draw the shape on the board without a ruler while another learner was given a ruler to draw the shape on the board. This was done painstakingly by the learner. Teacher B would then come to the board and measure the sides of the shape. A second and a third was then called to the board to correct the drawing.

It was evident to the researcher that Teacher B lacked mathematical knowledge of 2 dimensional shapes. The task of repeatedly drawing the shapes on the board was mathematically unchallenging and did not foster mathematical thinking and reasoning, in addition little or no learning occurred.

Teacher B did not draw the learnersôattention to the properties of the 2D shapes as she did not explicitly understand them herself. The representations that the children drew on the board were mathematically misleading, but Teacher B failed to draw the learnersôattention to them. The learners in were made to believe that all three sides of a triangle were equal.

To illustrate a mathematically misleading example: A learner is asked to draw a triangle on the board.

> *Teacher: Is that right?*
> *Learner: No only two sides are the same.*
> *Teacher: Come and draw the triangle for me.*
> *Learner:* (takes a ruler and draws a triangle with all equal sides)
> *Teacher: (*Takes the ruler and measures the sides) *It's all the same. Is this a triangle class?*
> *Learners: (*chorus) *Yes!*

The learners were set a task to complete in their class work books. The task was much too easy for a grade three level. The learners were shapes of their worksheet into their books, then cut and paste the shapes into their books. Not only did this activity fail to excite the learners but the learning for that mathematics lesson was to trace and cut; no thinking was required for this activity. Based on the evidence in this classroom, the implication of low mathematical teacherôs knowledge was reflected in mathematical errors and poor mathematical choices in the classroom.

Learners became noisy while Teacher B tried to assist learners with the uninspiring activity of tracing the shapes. Even though the task that the learners had to complete was very simple, learners constantly raised their hands to ask for help. Teacher B monitored her studentsô work without actively interacting with them. She was either not talking or her communication was non-mathematical. She walked around the class encouraged the learnersô to work faster or she complimented them on their neat work

It was evident to the researcher that the learners in this class were unable to work independently. Almost all the learners who asked for help, wanted to know how to place the shapes to fit on the page the teacher always responded by showing the learner how to best fit the shapes on the page. At no time did the teacher ask the learner to suggest their own way. The learners in this class were never observed doing any form of collaborative work.

The teacher did try to bring order to the class but she resorted to threatening the learners to persuade them to follow instructions by admonishing them:

Teacher: Finish your work or you will not go out at lunch time!

The teacher was often negative and punitive and used threats to persuade the learners to complete their work.

Teacher C had a large class of 42 learners. With the limited space available in the class Teacher C seated her learners in groups that formed three rows so as to make maximum use of the space, as well as to allow for group and pair work. Teacher C had a small assortment of posters, including mathematics posters displayed on the wall.

It was evident from the observations in Teacher Cөs class that the learnersô context was important to Teacher C. She placed emphasis on the learnersô real life experiences and drew on them often as a way of introduction. In one of her lessons she used the cutting of brown bread to share for working with fractions; in another lesson she engaged the learners in the class to collect containers from home for the teaching of capacity.

Teacher C taught mathematics to the whole class while the learners were seated at their tables. She made use of resources in her teaching. For the lesson on capacity, the learners brought a range of different sized bottles, a measuring jug and a set of measuring spoons from home. Teacher C also made use of the chalkboard.

Teacher C exhibited whole class teaching and attempted to engage her learners. eg. Teacher C points to all the containers laid out on a table and tells her learners that they have a shop in their class and the learners must decide on a name for the shop. The learners name the shop:

> *Learner: The name of the shop will be Thandabantu*
> *Teacher: you can also look the weight from the bottom of the bottle and you will see that they are different. When a person goes to the shop to buy something he needs to know what he wants.*

Teacher C calls two learners to the front of the class and gives each of them a shopping list to buy at the shop. One list merely lists the items, re explicit, and lists the quantities of the items required. The learners are questioned as to the difference in the shopping list and why details like quantity must be included. This was the introduction of the lesson.

Teacher C than makes an abrupt shift from this part of the lesson and moves into the teaching of capacity:
Teacher C picks up a measuring cup and tells the class:

> *Teacher: The cup size is 250 ml*
> *Teacher: We can add two 250ml, if we add 250ml plus 250ml how many ml are we going to get hands up? I have told you how you add numbers you leave zero you just add other numbers*

Teacher C proceeds to ask different learners to come to the front to point out the different measures that the containers hold. She writes on the board:
Teacher C writes this information on the board. The learners read it then repeat it a few times.

> *Teacher says: Which means 1 cup = 250ml*
> *2 cups = 500ml*
> *3 cups =750ml*
> *4 cups = 1lt*

The teacher made no attempt to question their prior knowledge, or to create a link to show logical progression from the introduction of the lesson to the rest of the lesson.

> *Teacher: Which size follows after a liter?*
> *Learners: Its 1,5 lt*
> *Teacher: 1litre is made by 500ml+500ml*

Teacher C had different measuring receptacles but there was no measuring, that is the amount of liquid the containers held, or experimenting and discovery that a liter bottle may come in different same amount of liquid. The teacher told the learners a fact and she then wrote it on the board. The learners read what was written and were expected to commit the facts to memory.

To conclude, the learners were set a task. The task was intended to reinforce the concept. The learners in this class were divided into 5 groups, who had to choose 10 different bottles and arrange them according to sizes.

> *Teacher: Groups are going to cut these words and paste them next to the right measures are according to their sequence.*

This activity of simply matching cutting the cards and matching it to the size of the bottle was too simplistic. The lesson as well as the task did not encourage thinking, nor did it create any excitement.

Teacher D

This was a bright, very inviting class. Teacher D had her learners work displayed on the walls. The bulletin board, walls and the outside passage were covered with the learnersô artwork. Posters and charts were displayed on the walls. Mathematics resources were visible to the researcher. In addition to posters and books, containers of unifix cubes, counters, clocks, shapes, measuring equipment were visible. It was very learner friendly; the desks were arranged in groups of four to promote cooperation and collaboration.

Teacher D had large mat in the class on which the learners sat for mat work and group work. Teacher D started her lessons with whole class revision of oral mathematics, set work for the whole class then proceeded to teach the learners in ability groups on the mat.

… mathematics lesson with oral mat work. She commenced with simple calculations and proceeded to increase difficulty. The learners knew that when it was mat work time they needed to take their black markers, their tile and their cloth with them. If the problem had to be worked out, the teacher gave them some ‘wait time’ to work it out. When she called ‘time’, the learners held up their tiles to show the teacher. Teacher D in turn, quickly perused the answers then went on to the next problem. A mathematics program was also used for some oral examples.

It was evident to the researcher that the more difficult the problems the more reluctant the learners were to hold up their boards. However, she said:

Teacher D: Come on guys some of you are too slow!

Several of the examples were challenging and needed the learners to concentrate.

An example of a simple question:

Teacher: Counting backwards in 2s starting on 271
Learners: 271, 269, 267, 265, 263, 261, 259, 257, 255, 253, 251, 249, 247

A more challenging example:

Teacher: Starting on 457 add 3 add 40 double the number take away 5 take away 95 and half the number.
Learners: 450
Teacher: Give me the sum and the answer
Learners: 457+3=460+40=500 double the number= 1000 – 5=995 – 95=900 half the number = 450
The learners answered in chorus.

The learners were sent to their desks after the oral mat work and handed a worksheet. Teacher D had strong classroom management techniques. As she started to explain the class task she said:

Teacher D: Put your finger on the first instruction.

read the entire worksheet to the class. All the learners were expected to do the same work in their work books.

Teacher: You have 15 minutes and Maths books must be handed in.

The teacher then pointed to a small pile of worksheets on a table. Those were extra activities for the ñbright sparksò as the teacher called the faster learners. The researcher noticed two boys harassing Teacher D on the mat as she was busy teaching a group. They were unsure about how to work out a problem. Teacher D replied ñwork it out.ò

Teacher Dõs class divided her learners into three mathematics groups. The learners were not in fixed groups. The learners took their tiles, cloth and black marker to the mat. Teacher D posed problems to the learners in the groups and allowed them time to work them out on their tiles. Teacher D checked the answers that the learners had written on the tile then went on to the next problem. Concessions were made for those children who were unsure of how to use the unifix cubes to work out the sum. When learnerõs answers were wrong, Teacher D had them redo the problem, she did not ask the learner questions to help clear up any misunderstanding or to get the others in the group to try to explain the error. Burns (2005) emphasizes the importance of understanding the reasons behind errors made in mathematics.

It was evident that although the learners in Teacher Dõs class were grouped, the work that they were involved in was teacher directed. The learners were not asked to explain or share with the rest of the group how they arrived at their answer. When a learner got an answer right, the teacher did not choose to engage the class in a discussion of what the learner did or why it made sense. The right answer or the product was emphasized but process was perceived as inconsequential.

s the source of knowledge. A closer look at the mathematics within the lessons suggested that only certain kinds of mathematics was being done in this class, like practicing procedures, routine problems and drill. Teacher D taught the procedure to be followed when faced with division sums; the learners followed the set procedure of their teacher. They were not encouraged to find other ways of working out the problem. Teacher D was more concerned about the right answer.

Teacher E

Teacher E had an inviting class with learnersô work displayed on the walls. The mathematics resources of Teachers Dôs classrooms were visible to the researcher. In addition to posters and books, containers of counters, clocks, shapes, measuring equipment were visible. This was the smallest class of all in the study. Teacher E was a very organized teacher. Teacher E had a large mat in the class on which the learners sat for group work. Teacher E started their lessons with whole class revision of oral mathematics at their desks. The learners wrote their answers on a tile and held it up for the teacher to see.

> *Teacher: I see you have all done well, give yourselves a round of applause.*
> *Teacher: Some of you are keeping up well but, I see some that are struggling.*

The teacher, however, made no attempt to take a closer look at how the learners were working out the problems or to randomly ask a learner to explain their method of working out the problem or to find out what the learners found problematic.

On completion of the oral work, Teacher E set work for the whole class then proceeded to teach the learners in ability groups on the mat. The in advance by the teacher and pasted in the learnersö work books. The task was about shapes. All the learners were expected to do the same task. Teacher E set additional tasks for the early finishers.

Teacher Eøs attempt to differentiate instruction was clear evidence that she did not understand the concept of differentiated instruction. Although Teacher E taught three groups, she taught exactly the same content, in the same way and at the same pace. It was evident from the observations that the slower learners did not grasp some of the concepts taught in the lesson. The learnersô blank expressions and their inability to answer questions posed by the teacher showed their lack of understanding. Teacher E merely proceeded to give the learners the answer. The teacher made use of wooden 3D shapes. The content was presented in a very monotonous manner. An example of this: (Teacherøs comment in brackets)

<u>Group 1:</u>
Learner 1: I have a rectangular prism (rectangular, very good)
Learner 2: I have a pyramid (and you?)
Learner 3: I have a cylinder (and you?)
Learner 4: I have a square.
Learner 5: I have circle
Learner 6: I have a pyramid (and you?)
Learner 7: I have a cylinder
Learner 8: I have a rectangular shape
Learner 9: I have a square

The lesson went on in exactly the same way with all three groups. The learners were then asked whether the shape that they each had in their hand could roll or slide. The researcher thought looked like the teacherøs attempt to conceptualize the lesson on shapes, when she showed the learners a ñweetbixö.

Teacher: What is this?

Learners: It's weetbix.

rectangular prism.

Teacher then shows the learners an orange and says:

> *Teacher: Firstly let's look at the orange. Good I'm going to cut it. I have cut it in the middle. So what is it now? Think of division, what is this?*
>
> *Learners: It's a half*
>
> *Teacher: And this? (indicates half of the orange) put*
>
> *The half back again that you get (indicates the whole*
>
> *orange).*
>
> *So I'm going to cut out the halves again then get?*
>
> *Learners: four slices.*
>
> *Teacher: It's all part of four divisions. So it's a (quarter)*

The linking of the 3D shape to something that the learners were familiar with, (the weetbix being a rectangle prism) was a clear way of connecting the mathematics to real life experiences. The researcher expected the same when the teacher produced the orange, however, the teacher abruptly shifted into a discussion on fractions without making any link. As abruptly as Teacher E introduced the topic of fractions, she ended it and sent the learners back to the desks.

The following day the researcher expected to see some form of reviewing of the previous dayøs lesson especially since there were a few learners in the last group who had been left very confused. The confusion was evident to the researcher when the learners looked blankly at the teacher when she asked what an edge and what a side in a 3D shape was. Teacher E, however, gave them the answer and proceeded to the next aspect of shapes. Prolonged observation confirmed that this practice was consistent with typical teaching in Teacher Eøs classroom. Teacher E nect to the learnersôprior knowledge or to make connections between topics.

The observations in five classroom provided evidence of the different ways in which the teachers and the learners interact. The focus of the lessons in all the classes was to demonstrate, provide practice and to check on the learners progress. None of the teachers encouraged the learners to explore different methods for solving problems or to probe for underlying meanings. The learners in all the classes run the risk of forgetting the proceduresc since they lack conceptual un derstanding

4.4.2 Research Question 2:

What are the practices of teaching mathematics that would best facilitate mathematics learning in grade three?

The researcher drew on the data obtained from the interviews, the pre and post questionnaire schedules in order to address research question 2. In-depth, recorded and transcribed interviews allowed the researcher to develop a better understanding of the meanings teachers held about the practices of teaching mathematics that facilitate mathematics learning.

All the participant teachers described their own prior learning in mathematics as memorization. One participant teacher said,

> *I learned rules in maths, If we got the right answers, I got a good mark, and it was not important to know what it meant or could I use it that was not important.*

When asked about their prior conceptual learning, interviewees typical responses were okay, not very strong, or I wasn't very sure even what that meant. The dilemma is that these two teachers equated being taught conceptually as mathematics lessons in which they taught using to recall their perceptions of mathematics teaching, the participants described intending initially to teach as they had been taught. One of the teacherôs, responded in the interview:

> *Well I really didn't have any experience with the conceptual methods so I just assumed to teach the way I was taught as a child and at college but to use apparatus and always teach in groups*

The teachersô responses confirm that they all came from traditional mathematics background of direct instruction of content. All the teachers admitted to limited exposure of open ended questions, active learning or mathematics communication.

Two teachers (Teacher A and Teacher E) were foundation phase trained, of the other three teachers, two were intermediate phase trained (Teacher B and Teacher D) and one teacher trained as a senior phase teacher (Teacher C). They were in agreement that they generally based their practice on their own previous classroom learning experiences in traditional settings. Where they have come from, mathematics teaching and learning comprised of rules, procedures, algorithms, and equations; they in turn, present these routines to their learners. The classroom observations and videos confirmed lecture methods, low-level recall questions, and teacher demonstrations as the dominant instructional practices.

Teacher A and Teacher C teachers revealed that they did not study mathematics as a subject after what was then called standard seven. The researcher was keen to find out how equipped they felt to teach mathematics in their classes, even though both teachers said that they felt very confident. Observations of their mathematical teaching practice and their responses in the interviews verified that there were substantial gaps that affected their instructional practices.

observed by the researcher were uninteresting. The researcher was perturbed by the uninspiring instructional practices in all the grade three classes. Based on the observations of lessons the researcher asked to look at all the teachersôlesson plans. The planning for instruction was very sketchy. Their lesson plans were made up of words that did not translate into action in their teaching. Teacher Bôs planning is an example of this:

Planned Assessment
Activity 1-formal assessment
Observation- Learner can work with designs
Oral and practical-Designs
Recording- House has a colourful appeal

The lesson plans were very revealing. It was clear to the researcher that the teachers were not skilled at planning. Their poor content knowledge made it difficult for them to decide on relevant content and how to teach it. The teachers needed to have an understanding of how children learn in order to make instructional decisions, (Van der Walle et al, 2010) and (Anthony, and Walshaw, 2009b).

Commenting on how she plans her lessons, Teacher B said that she consults the new Department of Education lesson plan documents and follows them. It was evident to the researcher that her planning was poor and incomplete and meaningless. The lesson plan documents made available to teachers by the provincial education departments are intended to be adapted by the teachers to suit the needs of the class. The lessons are designed towards meeting learning outcomes and assessment standards for mathematics. Teacher B demonstrated no initiative towards making the lesson authentic by interconnecting her learnersôcontext.

The researcher was curious as to how the individual teachers used their freedom and creativity to plan mathematics lessons for their diverse learners. Three of the five teachers said that they relied on the lesson al Education Department, while the other two teachers said that in their schools they planned as a grade. The evidence reveals that, while the Provincial Education Department lesson plans were intended as a guide to assist the teachers, teachers have become dependent on them either as a result of their lack of confidence in what to teach and how to plan for teaching or are unconcerned about the learners in their care.

There was a mismatch between lesson that Teacher B taught and the planning presented to the researcher. Her lesson failed to correspond with what she taught. In addition, the planning said very little about mathematics. The only indication that the planning had something to do with mathematics were the following two points:

> *Skills: Identifying 2D shapes and 3D shaped creating homes from shapes*
> *Knowledge: 2D shapes and 3D objects shapes of homes*

Teacher C also did not adapt the lesson plans.

From the teacherõs response in an interview, the researcher realized that it was also a common practice in many schools not only to plan as a grade, but in the case of one of the participant teachers, lesson planning for the core learning areas at her school were planned and executed in a uniform way in all the classes. According to Teacher D, the content, pacing, tasks as well as their assessing were all uniform. The reasoning behind this was that with the demands made on them, sharing for the teaching of a particular concept lightened the workload. Clearly, this was in direct contradiction to the philosophy of OBE based NCS, that of being learner-centered. In chapter two, the researcher put forward the expectation of the NCS that teachers ñknow and structure learning opportunities appropriate to the needs of the learnerò (Department of Education, 2003, p.25). The implication is that each teacher is responsible for translating the LOs and matics learning area into specific classroom experiences that are worthwhile and challenging to the learner.

The researcher studied all the lesson plans for the lessons observed. The teachersôgrasp of mathematical knowledge for teaching was lacking. The teachers were unable to translate the assessment standards into engaging content that arouse the learnersô curiosity (Kyriacou, 1990). In the interview all the teachers responded that they were pleased that their lessons were successful and they had achieved their outcomes. To the question ñwhat are the indications that you have or have not achieved your outcomes?ò The common responses were:

The children enjoyed the lesson.
The children were able to answer the worksheet.
They answered the questions.

The emphasis was on general participation rather than on what the learners learned in terms of developing mathematical understanding and skill.

Responses were elicited from the teachers regarding their understanding of what the NCS termed ñeffective teachingò in mathematics:

> *Teacher A: I think to be effective firstly, effective teaching is coming to school and being able to listen, listen to the children, to their needs, their wants and to base your lessons on that*
>
> *Teacher B: Yes, maths needs to be done daily. Maths I say is a jealous area, if you don't do it for a day you will forget*
>
> *Teacher C: we must let the learners go and found out for themselves that you spoon feed them rather than learner centered*

g well planned, knowing what to teach, hatever resources available, and taking into account what you've got in your class

Teacher E: Effective is you must be able to put yourself in the situation of the child and know what they are capable of. You should encourage them so they can be eager to learn. That is what I can see in my children

The range of vague responses from the teachers reveals the uncertainty prevalent among participating foundation phase teachers with regard to what effective teaching looks like The NCS is unambiguous with regard to what effective mathematics instruction is (Department of Education , 2003, p.25).

The same could be said for the teachers interpretation of active learning. Clearly, the curriculum is being misinterpreted and misunderstood,

The teachersô lessons pointed to a lack of understanding of the NCS. Regarding their limited understanding of the basis principles of OBE and how their understanding of the principles of OBE translates into the implementation of NCS, the teachers were uncertain. The three teachers replied in a similar vein. The teachers attributed the blame to the two inadequate training sessions on the NCS from the Education Department. According to Teacher C, one of the training sessions was an introduction to the curriculum policy documents. Not much attention was given to questioning their understanding of the document. This has resulted in undirected lessons, with simplistic and shallow content in all the lessons observed. The researcher found the teachersô knowledge of the NCS superficial and this often resulted in misinterpretation.

The other two teachers said that their schools enlisted the services of private professional curriculum experts to assist them come to terms with the requirements of NCS. However, their teaching practice did not reflect this.

of classroom practice, the researcher raised the issue of how the teachers cater for diversity in their classrooms. From the responses, it would appear that teachers are unsure as to how to support the diverse learners in their classrooms. When the research addressed this issue, all the participant teachers immediately commented on the slower learner; the teachers did not consider diversity ranging from the gifted learner or the learner from problematic socioeconomic circumstances to the learner with physical and mental challenges. The responses show that that the teachersôhave not grasped one of the basic tenets of OBE ï the equity principle.

Responses were:

> *Teacher A: Repetition and just explain again do a little bit of extra work with them and patience (lots of patience)*
>
> *Teacher C: We don't have a problem in maths, that's not our problem. But if I have a problem, I ask them to stay behind.*

The challenge for foundation phase teachers is to ensure that their mathematics instructional practices facilitate mathematics learning and help their learners develop mathematically (Van de Walle, 2010) High quality mathematics instruction focuses on teacherõs knowledge of important content as well as coherent connections among lessons designed to achieve important mathematical goals, teachers attention to how children learn, the use of different teaching strategies, the learning context , the learners engagement in mathematical tasks (Kyriacou, 1990).

3

What teaching strategies are employed by these grade three teachers in their classrooms?

The analysis of the data obtained from the classroom observations, as well as the video and audio recorded lessons were used to respond to question 3

The NCS suggests that "the teacher of mathematics needs to have available, a wide repertoire of teaching strategies that he/she can use effectively to ensure successful learning by all learners" (DoE, 2003a, p24) The researcher read the lesson transcripts and viewed the video recordings repeatedly for each of the observed lessons in order to describe the teaching strategies used by the participant teachers in their grade three classrooms. The classroom observations revealed a consistent picture of teacher practice in the foundation phase mathematics classroom. Traditional teaching strategies are prevalent in the classrooms. There was no discernible difference in the in the teaching practice especially of Teacher A and Teacher B from the teaching practices of the past. In all the classes, procedural understanding was valued above conceptual understanding.

Based on the researcher's observations of the teachers' practice of teaching mathematics in the classrooms, the researcher questioned each teacher's understanding of 'teaching strategies' and the strategies they use in their mathematics teaching.

> *Teacher B: I have a different style of teaching. I can say it depends on approach, what you want to do because in teaching all the outcomes must come first*
>
> *Teacher C: It's about researching I do question and answer method or telling method*

should be flexible and not ... the book especially when the children don't understand.

The teachersôresponses were vague, and generally lacked understanding. The only teacher who was familiar with teaching strategies was Teacher D. She did, however, admit that while her experience has taught her that using different strategies to teach mathematics makes for more exciting lesson and improved learning, it does takes time and effort to think and to plan. She added that teachers, often ŝslip into a comfort zoneò and teaching becomes routine, the same way using the same methods.

From the teachersôinability to explain or to provide examples of strategies that they use in their mathematics instruction or in the opportunities they provide for their learners to demonstrate their learning was an indication that the teachersô current practice was very limited. The researcherŝ observations in the classes confirmed this.

The teachers were in agreement that learners needed to be active. Comments like:

The learner must be involved in the lessons.

To do, to get involved.

What was disturbing was that none of them could elaborate on how they needed to get the learners involved. Active learning in mathematics was interpreted purely as working with counters and providing counters to perform mathematics operation and teaching the learners in groups. These responses were limited and inadequate. By insisting that learners follow the teachers approach to solving problems, indicated the teacherŝ limited understanding of the principles of OBE. It was common practice to see the teachers prescribe methods in all the classes observed. An example of a response of a teacher in an interview:

we were doing shapes, but I didn't draw the shapes on the board, they were doing the drawing That is an example of active learning.

Attempts to probe for more clarity resulted in accounts of the demands of copious assessments from the Education Department, and large classes, disruptive learners, lack of resources and lack of space, as some the reasons for their methods of teaching.

The observed mathematics lessons were uninteresting; the content in all the lessons was presented in most instances in a chalk and talk monotonous manner. In order for learners in foundation phase to develop ‘rich’ conceptual understanding, they need to ‘see’ mathematics. They need physical, hands-on and minds-on experience of estimating, measuring, discovering and explaining in the lessons on capacity. The learners need to feel, handle, roll the different shapes and articulate their findings to each other and to the teacher in Teacher B’s and Teacher E’s lessons. Instead of Teacher D spelling out the steps to work out the problem, the children need to be encouraged to think of ways that make sense to the learner and be encouraged to come up with different ways to solve the problems, or to discuss, argue or suggest alternative methods (Ernest, 1991), talks of using language as the “shaper” of individual minds. Learners need to feel safe to take risks without fear and volunteer their ideas using non-standard approaches. Likewise, teachers, need to use the learners’ responses, whether correct or incorrect to understand how the learners think. (Burns 2005).

The only observable resource that Teacher B always used was worksheets. The colourful wall chart was meant to be a teaching and learning resource. Teacher B made no reference to the visual representation of shapes on the wall. All the teachers in the study resorted to filling out worksheets for reinforcement of learning. The activities were cognitively demanding and filling in the answer type activities instead of using many and varied activities to reinforce a concept.

Teaching for equity encourages teachers to be sensitive to the learner's individual differences and to ensure in their mathematics teaching, the teaching strategies, learner activities or tasks are adjusted to "celebrate classroom diversity" (Van Der Walle et al, 2010). However, despite the emphasis on participative learning in the new curriculum, teacher-centered pedagogies of direct instruction, and the lecture method and question-and-answer techniques, were the predominant teaching styles used the classrooms

Teacher D had the benefit of modern technology to use as a resource in her mathematics teaching. The interactive whiteboard is an exciting tool if used correctly. The researcher witnessed Teacher D use a computer program to test oral mathematics. Teacher D explained in the interview, that she was "a bit of a techno-phobe" she was therefore not making maximum use of all technology that was on offer at her school.

Teacher C involved her learners in the collection of empty containers from home for her lesson on capacity. The children were familiar with the containers and their use. As an introduction, Teacher C set up a 'shop', which she involved the learners in naming. The resources used by the teacher were appropriate for the content that was taught and was relevant to the context of the learners. This practice is in agreement with the NCS who advise that "it is important that learners see the value of the tasks that they are doing" (Department of Education, 2003a, p. 24). Skovsmose (2005), also talked of bringing the "the students cultural context into the classroom as a resource." More importantly this resource could have been used as a tool to link the mathematics to home experiences with the intention of engaging the learners in mathematics meaning making.

sroom interaction

Level	Teacher	Learner
1	Presents content in a well organized, correct and well sequenced manner, based on a well designed lesson plan. Provides resources. Engages learners with questions	Learners stay engaged. Respond and initiate questions
2	Presents content in a well organized, correct and well sequenced manner, based on a well designed lesson plan. Provides adequate resources Engages learners with questions that encourage deep thinking	Engages in meaningful group work. Offers contributions to lessons
3	Presents content in a well organized, correct and well sequenced manner, based on a well designed lesson plan. Provides relevant resources. Uses teaching strategies that engage the learners. Probes learnerǿs prior knowledge Learning activities are structured along the lines of good practice. (Knowledge is constructed, is relevant and is based on applying knowledge in problem solving. Assessment for learning practice.	Engages in meaningful group work. Makes own contribution based on concepts learned from engaging in activities. Active discussions pertaining to learning among group members as well as with teacher
4	Presents content in a well organized, correct and well sequenced manner, based on a well designed lesson plan. Provides relevant resources Learning activities are structured along the lines of good practice. (Knowledge is constructed, is relevant and is based on applying knowledge in problem solving. Facilitates learners as they undertake investigations. Assessment for learning practice	Learners take responsibility for their own learning. Active engagement in learning. Constantly questions own, peer and teachers thinking.

(adapted from Rogan, cited in Velupillai et al, 2008, p.69)

Table 4.3 indicates the levels of classroom interactions observed in the mathematics lessons in the foundation phase classes. The level descriptors are an indication of the quality of the classroom interaction, with level 1 being interaction where the teacher initiates a question and the learner responds to level 4, where teacher and learners engage in discussions; learners are encouraged to reason and explain their actions, procedures or answers.

Interaction observed in four of the five classrooms, ie. Teacher A, Teacher B, Teacher C and Teacher E fell into level 1. Teacher D, however, fell into pted to engage her learners to think deeper, her group activities, However were predominately procedural not meaningful to the learners. There was no evidence of level 3 or level 4 activities in the observed classrooms

4.5 THE INTERPRETATION OF THE FINDINGS

This research study sought to investigate teacher practices in the teaching of mathematics in grade three foundation phase classrooms. In analyzing the data the researcher focused on dimensions of effective mathematics practice, the instructional processes, the instructional tasks, the social organizing of learning created by the teacher as well as the teacherôs decisions and actions as proposed by the NCS. The interpretation of the findings are documented under the following sub-headings:

- The teachersô views of mathematics
- The teachersô perceptions of teaching

4.5.1 The teachers' views of mathematics

In chapter two the researcher argued that the NCS calls for a pluralistic view of mathematics. This means that in mathematics instructional practice teachers need to focus not on just a singular perspective that is the product. Teachers need to focus on context, the processes and the products.

With reference to the definition of mathematics in the NCS policy documents as quoted in chapter two, NCS advocates a further description of the view of mathematics. The researcher refers to the (LO) and the (AS) specified for the mathematics learning area requiring the identification of the context, specific processes and specific end products. The identification of these provided the researcher with benchmarks against which the participantsô views of mathematics were measured.

ng is of particular significance, but in conjunction with the processes involved in the formulation of mathematics ideas. The implication is that the NCS is based on a falliblistic view of mathematics and is further conveyed in the definition of mathematics as a ôhuman activityö This is a complete contradiction of the absolutist view of mathematics. The definition points to activities that arise from te human need to question, reason, to logically find solutions. The solutions include the mathematical products arrived at, the way concepts are developed and multiple procedures to the most efficient procedures are developed.

Clearly, the instructional practice observed in all the participantsô mathematics classrooms indicates an absolutist view of mathematics. Within the absolutist view the teacher is the transmitter of knowledge that the learner needs to learn and master. Rules and procedures are taught in a decontextualized way. The teachers made no reference to how those rules or procedures learnt in the mathematics class could be useful in daily life.

One such example of a lesson observed on capacity:

Teacher: I'm going to write some of the units on the board
and you are going to put these units together
until you get to 450ml.
1 cup = 250ml, half a cup = 125ml, 50ml.
Learners: 250ml + 50ml + 50ml + 50ml + 50ml
Teacher: 50ml + 50ml + 50ml + 50ml = 200ml + 250ml
= 450ml

In this example, it was also clear that while the response from the learners was correct, the teacher only accepted her own version of the answer.

Evidence of another strand of what is termed empirical absolutism was observed in Teacher Dôs class. Two features of this approach were evident, the passing reference to real life experience and emphasis placed on practical work. Learner participation is encouraged, there was a lot

...is class compared to the others, however, there is still a step-by- step build up to the rule or algorithm

> *Teacher: I want Luke, Nicholas, Lisakhanya, Sky Soso, Kuhle, Tamsen, Adriaan, Olwethu to come to the mat with your white boards. Read the 3 word sums and all I want is the open number sentences.*
> *Teacher: Nicholas read number one for us.*
> *Learner: Mrs Sparks wanted to share 459 beans out evenly between Emily, Sky and Taylor. How many will each girl get?*
> *Teacher: so what's your open number sentence?*
> *Learner: 459 ÷ 3*

The third strand of the absolutist view is identified as the connected absolutist view. This strand was not evident in any of the classes. In this type of lesson, the real life experiences of the learner are taken as the starting point. Teachers ensure that learners engage in sense making in an interactive environment. There is also a shift away from procedural knowledge to conceptual knowledge. While all these are features of the fabbilistic view, the teacher is still regarded as the authority regarding right from wrong, making it an absolutist view (Ernest, 1991).

4.5.2 Perceptions of Teaching

Based on the definition of mathematics according to the NCS in chapter two, the expectation is that the foundation phase teacher will strive to create a learning environment that will foster conceptual understanding of mathematics and that will provide every learner in the class with an equal opportunity to actively participate in learning. (Department of Education, 2002a) The teacher's perception of the role therefore can be identified from the type of instructional practices she designs for her learners. The researcher argues that the instructional practices ought to be compatible with the definition of mathematics, namely, conducting investigations, problem solving and engaging in mathematical discussions in collaborative and individual settings. (Artzt & Armour-Thomas, 2002).

zed teachersô perceptions of teaching according to the type of activities that they encouraged as well as the type of representations used in their instructional practices. The analysis of the components served as a benchmark to measure the participantsô views of teaching.

The NCS has identified instructional practices that are characteristic of effective mathematic teaching practices. Moreover, the NCS makes it clear that opportunities should be created that challenge the learner to learn. The teacherøs role is to have a wide repertoire of teaching strategies that will engage the learners in mathematical discourse, while they explore and investigate both collaboratively and individually. Important also is that at all times the teacher knows her learners, that is, their different abilities, interests, barriers etc. and that instructional practices make connections with their real world. The NCS, suggests that to promote the development skills, learners need to work out problems where the approach for solving it was not so obvious, that required them to reason, reflect and to arrive at multiple possibilities (Department of Education, 2003), (Van de Walle, 2010).

In summarizing, the teachersô perceptions of teaching, were contrary to the expectations of the NCS; the participant teachers were rigid in their planning. Their perceptions were predominately that of transmission. Teaching was based on procedures that need to be learnt, practiced and followed. This was evident in the teaching practices of all the teachers. The teachers focused on learning to do as opposed to learning to think. None of the teachers took into consideration the current understanding of the learners, or their different abilities. While Teacher D allowed the slower learners to use unifix cubes to work out the sum, they were allowed purely for the learner to arrive at the right answer.
An example observed in Teacher Døs class is as follows:

a word sum on the board.
is the key word?

Learners: Share
Teacher: So what is the maths symbol for share?
Learners: Divide
Teacher: How many children are going?
Teacher: So what is your number sentence?

A further indication of the teachersô ability to make mathematics comprehensible to the learners is to provide structures to help learners make sense of mathematics, by building on what they know and by providing opportunities for reflective practice, like using deep questioning techniques or problem solving strategies, including the use of language for the developing of cognition and cognitive processiong (Van de Walle 2010, Bodrova & Long,1996). However, the teachers observed made very little use of the learnersô prior knowledge or checked learners understanding through questioning in order to circumvent erroneous conceptions. All the participant teachers were observed asking shallow, lower order questions that required little elaboration or thinking on the part of the learners.

Example:

> *Teacher: We can add two 250ml, if we add 250ml plus 250 ml how many ml are we going to get hands up? I have told you how you add numbers you leave zero you just add other numbers*

Learners need to be able to connect new concepts to what has been learned already. Unfortunately, because the teachers did not make connections to prior learning and prior experiences, it appeared that students were memorizing concepts, rules, and procedures. The teachers did not encourage the learners to represent their understanding in different or multiple ways to that show the kind of connection they made. This was yet another avenue that the teachers neglected to use to facilitate discussions with the learners.

al view of mathematics value practical hands-on activities, embodying the mathematical ideas that learners must discover. While the teachers in the study all talked about hands-on activities, not much attention was given to the selection of activities that would stimulate the development of cognition. All the teachers in the study displayed empirical perceptions although their lack of emphasis on conceptual understanding distinguished them more in the weaker range(Walshaw, 2009b, Munter, 2009). Although all the teachers set many procedural practice tasks, only Teacher D offered the learners manipulatives to assist with calculations. The other teachers were not to keen to use counters. Teacher A was especially emphatic that the learners are old enough to count without the use of ôcrutchesô

More emphasis needed to be placed on contextual problems as emphasized by Skovsmose (2005), as well as the use of concrete materials not only as a point of departure or as an introduction, but as a practice of teaching to ensure conceptual understanding through active participation but to develop interest and stimulation in mathematics. According to (Killen, 2005), a significance of constructing mathematical knowledge is to make use of it in everyday life.

In this study, the teachersôpedagogical styles were primarily whole class instruction that focused on acquiring facts and procedures; little emphasis was put on conceptual understanding of ideas. However, it did appear that classroom management was a key issue with Teacher B and Teacher C, because of the large numbers of learners in each class and dictated the mathematics instruction provided. These teachers were so concerned about classroom management that they did not consider using hands on manipulatives. The effective use of hands-on manipulatives can also promote positive classroom behaviors.

views of teaching are more skilful in eliciting the individual images that learners have about mathematical ideas and how to build on these ideas. Crucial also is that teachers find out what the learners understand, pay careful attention to evidence of understanding how the learners think, what they are having problems with and what kinds of instructional strategies are working, ñmathematics teachers gain a wealth of information by delving into the thinking behind studentsô answers, not just when answers are wrong but also when they are correctö (Burns, 2005, P.26), all of which would dictate how the work should be paced. These are crucial for the planning and assessment of mathematics. The participant teachers paid very little attention to observing and listening to their learners in order to use the knowledge gained to support their mathematics development.

When learners are involved in mathematics activities, teachers need to engage individuals or groups of learners in mathematical discussions regarding their explorations. This practice fosters the development of mathematical communication. Teacher D very infrequently posed questions that helped students arrive at some closure, Teacher E, Teacher B and Cös discussions were more to do with management. Completion of the activity, neatness of the work, and behaviour issues were the teacher-learner discussions. Invaluable opportunities for teaching and learning were therefore wasted. The NCS makes it clear that assessment is an integral component of teaching and learning in mathematics and that assessment is meant to support learning. (Department of Education, 2003a).The researcher saw minimal evidence of this view among the participant teachers

Teachers not only need to have sound mathematics content knowledge and curriculum knowledge but also pedagogical content knowledge (Hill et al, 2004, Ball et al, 2008). The NCS is explicit that teachers need to be ñcompetent.ö Bloch (2009) talks about the importance teacherös mastery of urriculum to meet the educational needs of the child. That means that all teachers need to be able unpack the LOõs and ASõs, arrange them in order to teach in a meaningful way and have the ability and understanding to cater for the individual learner (Guskey, 2005). Based on the evidence, the researcher concurs with Bloch, that the participant teachers lacked the ñcore abilities to teachò (Bloch, 2009, p.102).

4.6 SUMMARY OF FINDINGS

This study has found that:

- The lessons observed exhibited features of traditional mathematics teaching practice.
- Mathematical content that was presented in all the classrooms was very superficial and not challenging
- Deep pedagogical content knowledge and mathematical understanding that was needed for teaching was not evident in their teaching
- Content was taught in isolation. None of the teachers encouraged the learners to make connections with other lessons or to the learnersô context.
- When the learners spoke, it was generally confined to the learners chorusing answers or a learner giving a one word answer to the teacher
- The teachers did not check for understanding or allow the learners wait time to think about the answer or even to probe so that the learners could self correct the answer.
- The learners were questioned and the right answer was sought.
- The teachers lack what Hill et al (2004, p. 13), call ñcurriculum knowledge,ò this means that all teachers need to have the expertise to know how learning is arranged in the curriculum, what competency levels learners need to achieve in the year as well as

to follow. This is especially important in mathematics because mathematics is conceptually cumulative in nature.

- The teachers, lack of content knowledge was further highlighted by their failure to use the many opportunities to provide the learners with immediate and specific feedback to improve their learning
- Assessments in the participant grade three classes took the form of weekly tests written on worksheets, oral and tests of bonds and multiplication tables. In all cases marks were the most important factor.
- All the teachers besides Teacher D used a ôone size fits all strategyö meaning that the teachers teacher the whole class without making allowances for differences in abilities or learning styles.
- Clearly, the participant teachers, do not value diversity.

4.7 CONCLUSION

The evidence from this study suggests that mathematics teaching practice in the participant teachers classes demonstrated that they are enacting the curriculum very differently from the way the curriculum developers intended.

In the final chapter the findings of the study are described in relation to the theories discussed in the literature review. The implications of the results are also discussed, as well as the weaknesses of the research and suggestions for further research.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

In this concluding chapter the researcher will the summarize findings of the of teacher practices that appear to be prevalent among foundation phase teachers in East London primary schools in their effort to facilitate mathematical learning. The main concern of this research study was to investigate the alignment of mathematics teaching practices of grade three teachers with the progressive pedagogy implied in the new curriculum NCS. In addition, this study aimed to take to make recommendations to teacher educators to consider developing practice that is relevant. Furthermore, the implications of the evidence of teachers mathematic practices in the foundation phase are discussed. This chapter concludes with recommendations and outlines the limitations of the study.

A description of effective mathematics teaching is outlined according to the NCS. The changes in content as well as recommended teaching styles represent a significant departure from traditional mathematics teaching of the past. The NCS is based on theories of active learning. Experiences that teachers provide in their foundation phase mathematics classrooms should be designed to maximize learning by engaging the learners physically and cognitively. Alternative approaches are recommended, with emphasis placed on the development of conceptual understanding.

5.2 SUMMARY

In this section, several important issues about quality teaching in foundation phase mathematics classrooms are raised. The evidence from this study of mathematics instructional practices in the grade three foundation phase classrooms indicates that the participant teachers have hematics teaching and learning called for by the NCS. Teachers in the foundation phase were mandated to implement the NCS from 4. Six years on and the benefits of the OBE based curriculum are hard to find.

In investigating teachersô instructional practices in the teaching and learning of mathematics in grade three classrooms, the researcher focused on dimensions of effective mathematics practice, their instructional processes, the instructional tasks, the social organizing of learning created by the teacher as well as the teachersô decisions and actions as proposed by the NCS. The thick description proved to be the basis to understand foundation phase mathematics teacher practice in five East London primary schools.

For many teachers, including the cohort, the deep paradigm shift in pedagogy from their earlier behavourist-influenced traditional training of executing the curriculum by specifying objectives and measuring observable behavour, to this new curriculum, with teaching practices that encourage learners to become active participants, explore open-ended problems, where pedagogy is characterized by high levels of engagement are practices, is proving to be a challenge.

Research has suggested that teacherôs educational views and experiences are a filter for their instructional and curricular decisions; these can either promote or impede change (Prawat, 1992).

When compared to the prescriptive curriculum where the teacher was a passive recipient of professional knowledge, the model of instructional practice proposed by the NCS is a progressive one. Research confirms that the teaching practices advocated in the NCS results in more effective mathematics teaching and learning (Clements and Battist a, 1990, Munter, 2009) defined in chapter two by the NCS, is a pivotal one, Bloch (2009, p.90), refers to the classroom as the ñfirst level that impactsò on educational outcomes. ñThis is where the teacher faces the learner in an educational relationship, using his or her mastery of the subject and the curriculum, her pedagogical and methodological training and instincts, to ensure that work is covered and the educational needs of the child are appropriately metò. The evidence, as stated by Bloch (2009), affirms that teachers are central to making a difference to the present.. Teaching mathematics in the foundation phase is extremely challenging. Teachers need to have deep understanding of the mathematics they are to teach as well as to how to engage their learners in that content.

The evidence of this study raises pertinent issues regarding the quality of foundation phase mathematics instructional practices. A teacherøs deep understanding of the mathematics curriculum is significant to their ability to implement the curriculum. Shulman, (as cited in Kersting et al 2010), suggests that the kind of knowledge teachers need for effective teaching goes beyond the mathematics teachersô learned in school. More important is ñpedagogical content knowledgeò, which is knowledge unique to teaching. It is a term that describes the specialized mathematics knowledge that teachers need and is a fundamental prerequisite for learner achievement.

To make sense of a new concept, learners need to be able to connect it to their existing knowledge (Anthony 7 Walshaw, 2009). Teachers need to value the background knowledge that learners bring to the classroom and to use this knowledge to provide learners with to opportunity to build connections between what they know and what they are learning. When mathematics learners learn is meaningful to their context, they find that they can use it as a tool to solve significant problems in their everyday life, they begin to view it as interesting (Mutemeri & Mugweni, 2005, Skovsmose, 2005, Anthony & Walshaw, 2009), emphasize just how connections between mathematical ideas are to conceptual understanding.

The curriculum is explicit, it is the responsibility of the teacher, as the facilitator and planner of learning, to create meaningful learning experiences for all the learners (Department of Education, 2002). Teachers therefore cannot assume that all learners will learn equally well from one teaching strategy or in a certain period of time. The foundation phase teacher is therefore obliged to be flexible in their teaching and innovative in developing teaching strategies.

For the foundation phase learner, manipulatives or ótoolsô, are helpful for ñcommunicating ideas and thinking that are otherwise difficult to describeò (Anthony & Walshaw, 2009b, p.23). According to Mc Clain, ñtoolsò are a critical resource for the teacher as a means of support to meet their mathematical agenda. This support ñmanifests itself in the form of instructional tasks and tools available for solving the tasksò (McClain, 2002, p.219). McClain, however, advises that it is not the tool in isolation ñit is how the learners use the tool and the meaning that they come to have as a result that are importantò (McClain. 2002, p.219). It is only when teachersô understand their learnersô ways of reasoning, can they develop instruction that supports their learners development. (McClain, 2002)

In chapter two, the researcher argued that the NCS highlights the need for teachers to focus on ways of developing the learnersô ability to communicate mathematically in their quest to become mathematically literate (Department of Education, 2002a). One practical way in the foundation phase is for the teacher to revoice and redescribe the explanations and solutions of the learners in a way that guides the learner to justify and explain their solutions. ñRevoicing involves repeating, rephrasing or expanding on student talkò (Anthony & Walshaw, 2009b, p.19). Supporting the learnersô ability to make sense of mathematics by rticulating their explanations or justifying their solutions in the foundation phase, not only helps learners make links between mathematics language and their understanding, but they also become less preoccupied with finding solutions and more involved with the thinking that leads to the answers (Anthony & Walshaw, 2009b). Creating a mathematics learning environment in which the social nature of the classroom facilitates conceptual conjecture and justification is therefore essential.

Mathematical communication in the form of discussion, conjectures, arguing, the use appropriate mathematics vocabulary to reason, was totally absent in the grade three classrooms. One word answers, prompted answers, chorus answers are not what counts as mathematics communication. Specialized mathematical vocabulary need, to be modeled and explained so that learners make sense of the underlying meanings. In addition learners must be encouraged to use the correct vocabulary in mathematics discussions. More importantly, in order for foundation phase teachers to make the development of reasoning and justification part of the repertoire of teaching strategies, they also need to understand the need for mathematical reasoning.

In chapter two the researcher alluded to the significance of assessment on teaching and learning. According to the Department of Education, (2003a, p.27), ñassessment is at the heart of and integral component of teaching and learning of mathematicsö. The emphasis on tests in the observed classes confirms the need for the teachers to change the way they think about assessment. Norm-referenced assessment ignores individual differences in the learners. Assessment should be referenced to predetermined assessment standards and learners be given multiple opportunities to demonstrate their competence. The interviews uncovered the teachersô lack of understanding regarding assessment *for* learning as opposed to assessment *of* learning. The participant teachers still use ed tests with emphasis on marks rather than gaining valuable insight into learner thinking and reasoning.

A principle of OBE, according to Killen (2005), is that assessment should always have the goal of improving learning. Burns, (2005) emphasizes that teachers gain ñinsightsò through regular assessment. Questioning, observing learners while they work, engaging learners in ñgenuine conversationsò about mathematics, means that teachers take their learnersôideas seriously in their attempt to understand and support learner understanding. Clearly, there is a need for teachers to become conversant with OBE assessment practices as set out in the NCS and to develop a wide range of assessment strategies.

Immediate and helpful feedback is important. Focusing on the mark does not tell the learner why something is right or wrong. Self and peer evaluation is also a skill that was not observed; however, it is encouraged by the NCS as learners develop greater self awareness. Collis (1992, p. 36), declares very eloquently, that ñcurriculum designed on the finest principles with the very best intentions makes no change to what goes on in the classroom if assessment procedures remain the same.ò

Effective mathematics teachers need to go beyond superficial practices of implementing some aspects of the NCS in their mathematics instruction such as practices like providing manipulatives for the learners to use, providing activities and offering opportunities for pair and group work. These are superficial changes and while necessary, they are by no means sufficient to build sophisticated mathematical understanding. It is relatively easy for teachers to adopt the surface characteristics of teaching recommended by the NCS but much harder to implement the recommended core features in their everyday mathematics instructional practice.

5.3.1 Recommendations to Teacher Educators for Developing Programs for Practice

One of the purposes of this research alluded to in chapter one was a basis for offering suggestions to practicing teachers as well as to enhance the researcher's own professional development in teacher education. This study has implications for teacher education programmes in South Africa. Based on the evidence in this study, the onus rests on the teacher educators and other lecturers within higher education institutions to ensure that teacher education prepares students in initial teaching for education in the democratic South Africa by developing curricula in line with the stated competencies that articulate learning outcomes as espoused in the Norms and Standards for Educators.

In order to be able to implement the NCS the way it is intended, requires that the teachers must have a thorough understanding of the curriculum. This study has found to the contrary. Teachers cannot implement what they do not know. In addition, in order to implement the NCS the way it was intended requires the teacher to be skilled in pedagogy and knowledgeable in the subject matter. The NCS (2002) has identified the teacher as the "key contributor to transformation." Bloch (2009, p.89 0, concurs and says that "the role of the teacher is central" to making a difference.

On the basis of the findings in this research, gaps in foundation phase mathematics teacher preparation have been revealed. There is substantial agreement that teacher knowledge of mathematics plays a key role in quality mathematics teaching.The critical issue is the need for a better preparation program for prospective foundation phase mathematics teachers. The researcher proposes that areas of knowledge in matics pedagogy be identified for prospective teachers as an outcome of their study.

The researcher recommends that the learning theory of teaching developmentally and the knowledge necessary for learners to learn with understanding be a requisite for prospective foundation phase mathematics teachers. Shulman (in Hill et al 2004) proposed three categories of subject-matter knowledge that are essential for quality mathematics teaching: content knowledge, curriculum knowledge and pedagogical content knowledge.

Foundation phase teachers are not mathematics content specialists, but generalists ie. foundation phase teachers have to have a general knowledge of content and pedagogy for all the core areas that they teach. Nevertheless, the literature, (Charalambous, 2010, Ball et al, 2008)) makes it clear that there is an expectation that foundation phase teachers need a strong, specialized knowledge base of mathematics in order to teach effectively.

5.3.2 Recommendations for Practicing Teachers

The Norms and Standards for Educators highlights the idea of being a ólifelong learnerôas one of the Seven Roles for Educators. The implication is that there is an expectancy that all teachers develop a culture of ongoing learning. Teacher learning is widely acknowledged as critical to educational reforms (Collopy, 2003, p.287).

Teacher competence has been called into question. Teacher competence relates to teacherõs having the content knowledge and the ability to use this knowledge pedagogically to ensure that the curriculum is thoroughly covered at grade level (Fleish, 2008). Sound professional development, that includes a focus on understanding how children learn mathematics, order thinking, developing questioning and communicating skills will all impact on learner achievement. Studies have found that there is a strong relationship between teacher knowledge of mathematics and learner achievement (Fleish, 2008)

An added recommendation is that teachers "take seriously the issue of their own empowerment" (Bloch, 2009). One way to do this is the formation of workgroups made up of class teachers. This would be for teachers to focus on the areas of the curriculum that they find challenging. Taylor (2004, p. 219) refers to this as "collegial interaction" as a feature of schools wanting to implement and sustain extensive reform. He sees this collegiality as the "existence of high levels of collaboration among teachers, the product of teachers working together on a common project toward a common goal" (Taylor, 2004, p. 220). Curriculum specialists could be invited to these meetings to offer their expertise and respond to the teachers concerns. The researcher recommends that curriculum specialists make classroom visits to support and advise teachers on their mathematics teaching practice.

5.3.3 Recommendations for Curricula Support

The Organisation for Economic Cooperation and Development cited in Bloch argued that "gaps exist in all countries between policy aspirations and their full implementation. In the case of South Africa, in the context of the compressed time-span… and the fact that major educational reform is a long term, rather than a 'quick fix'" (2009, p.171). Vandeyar & Killen state that "it is naïve" for the Department of Education's to expect "teachers perceptions to change, simply because policy mandated it" (Vandeyar & Killen, 2007, p.111).

Training, development and support from the Department of Education for the NCS have been insufficient. The poor training of teachers and the illmands of the new curriculum has resulted in a significant number of teachers who have not changed their teaching practices. A recommendation is that teacher development needs to become a priority. It is vital, that programs be developed to retrain foundation phase teachers in-service. Teacher in-service practices need to be aligned with curriculum reform knowledge and progressive mathematics pedagogy so as to how to facilitate mathematics learning.

Schifter & Fosnot, (cited in Collopy), add that in ñmathematics teachers are asked to enact approaches that often differ greatly from their own experiences of mathematics instruction, and that requires a deeper knowledge of mathematics than many teachers haveò(2003, p. 288).

Moreover, there is a need for Department of Education to develop mathematics teacher resources, like, textbooks, and teacherõs guides with practical advice for teachers as to how to implement effective teaching practices. These resources must be designed to assist teachers with what and how best to teach. Coupled with the teacher resources, there needs to be accompanying learner resources that are problem-based.

Collopy, (2003, p.288), suggests crucial elements to effective professional development for teachers:

- First, support for teacher learning is more effective when it is linked closely to teacherõs classroom context.
- Second, because learning develops in iterative cycles over extended periods, effective support is ongoing and long term.
- Third, teachers need new opportunities to build new beliefs and knowledge about teaching, learning and subject matter.

for Future Research

The researcher chose grade three for the purpose of this study because issues prevalent in starting school are less influential in this grade. However, a recommendation for future research is that mathematics instructional practice be studied holistically across the foundation phase in order to shed additional light on aspects of mathematics instruction practices that appear to be influenced by curricular context, as well as those that appear more resistant to change.

In terms of initial teacher education, a recommendation for future research could be to investigate how teacher education might prepare teachers of mathematics in order to increase their confidence in teaching mathematics.

5.4 LIMITATIONS

The researcher experienced one key limitation in undertaking this study. This study was a qualitative study that focused on five foundation phase grade three teachersộ the sample was too small and therefore cannot be generalized.

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APPENDICES

APPENDIX A

Letter granting permission to conduct research in the East London Schools

h. your research will be limited to those schools or institutions for which approval has been granted;

i. you present the Department with a copy of your final paper/report/dissertation/thesis free of charge in hard copy and electronic format. This must be accompanied by a separate synopsis (maximum 2 – 3 typed pages) of the most important findings and recommendations if it does not already contain a synopsis. This must also be in an electronic format.

j. you are requested to provide the above to the Director: The Strategic Planning Policy Research and Secretarial Services upon completion of your research.

k. you comply to all the requirements as completed in the Research Policy duly completed by you.

l. you comply with your ethical undertaking (commitment form).

m. You submit on a six monthly basis, from the date of permission of the research, concise reports to the Director: Strategic Planning Policy Research and Secretariat Services.

3. The Department wishes you well in your undertaking. You are most welcome to contact the Director, Dr. Annetia Heckroodt on 043 702 7430 or mobile number 083 271 0715 should you need any assistance.

Mr. R Swartz

ACTING HEAD: EDUCATION

APPENDIX B

Letter requesting permission to access schools

20 July 2009

Dear Principal and staff

I am a lecturer as well as a registered part time student at the University of Fort Hare (East London), studying for a Masters in Education degree.

I am writing to request permission to conduct research in one grade 3 class at é é é é é é é é é é é ..I would be grateful if you would grant me access to observe mathematics lessons in one grade three class. I would then need to interview the teacher of that particular class.

The aim of my study is to investigate mathematics teaching and learning practices in grade 3 classrooms. Should you allow me the opportunity to use your school as a research site, data will be collected by observation, video and audio recording, as well as interviews.

The school, teacher and learners are assured of complete anonymity at all times. On completion of the final report, the participant teacher will be invited to proofread the draft to ensure that the details are accurately recorded and reported.

Should you have any concerns or questions regarding this request, please feel free to contact me on 0837804645, or 043 7354645

Many thanks

Yours sincerely

é é é é é é é é é é é é ..

B.Williams (Mrs)

APPENDIX C

Letter granting permission to access school

Consent Form

Ms Beverley Williams is hereby given consent to use a Grade 3 class of é é é é é é é é é é é .. as the research site for the thesis that she is required to write for the completion of her Masterõs Degree.

It is understood that the data will be collected from recorded video and audio lessons as well as observations and pre and post interviews which will be audio recorded. The information from these will then be used in the final report. Further, I have received the assurance that the school, teachers and learners will remain anonymous in the report.

Principalõs signatureé é é é é é é é é é é é é .

Dateé é

Teacherõs signatureé é é é é é é é é é é é é é

Date: é

APPENDIX D:

Pre-instruction schedule

e- Instructional Schedule

Date: é é é é é é é é é é é é ..

Time: é é é é é é é é é é é é é

Title of the Lesson: é .

Learning Outcomes:

é é
é é
é é
é é

Assessment Standards

é é
é é
é é
é é
é é
é é

Intentions to achieve these assessment standards

é é
é é
é é
é é
é é
é é

How does this lesson relate to the previous mathematics lesson?

é é
é é
é é
é é

learners may find difficult:

é é
é é
é é
é é
é é
é é
é é
é é

APPENDIX E:

Post-instruction schedule

t – Instructional Schedule

Date: é é é é é é é é é é é é ..

Time: é é é é é é é é é é é é é

Were the outcomes of the lesson achieved?

é é

Why do you think so?

é é
é é
é é
é é
é é
é é

What do you think was good about your mathematics lesson?

é é
é é
é é
é é
é é
é é
é é
é é
é é

What do you think was not good about your mathematics lesson?

é é
é é
é é
é é
é é

APPENDIX F:

Observation schedule

Observation Schedule

Date: é é é é é é é é é é é .. Timeé é é é é é é é é é é é é

No in classé é é é é é é é é é .

Desk arrangement

é é
é é
é é
é é
é é

Resources:é é
é é ..é é
é é
é é
é é
é é
é é

Setting:é é
é é
é é
é é
é é
é é
é é
é é

APPENDIX G:

Examples of ethnographic questions

view

While the questions the researcher asks the teachers in the post interview will arise in response to the observed lessons, the researcher will base the questions in the unstructured interview on:

I) How the teacher facilitates mathematic learning
II) The teacherõs content knowledge
III) The teacherõs decision making

Questions

Typical questions used in the Interview

Questions regarding teacher preparation

- How well do you think your training a teacher prepared you for the classroom?
- Can you recall what the major focus of teacher preparation was when you studied to become a teacher?
- Has your teaching style changed from the time you qualified as a teacher? If it has how has it?
- What is your general teaching philosophy?

Questions about teaching grade 3

- Do you have specific goals in teaching grade three?
- What do you enjoy the most about teaching grade 3?
- What learning area do you enjoy teaching the most ? Why? Least ï why?
- How do you motivate your learners? Examples
- How do you feel this present class doing compared to your previous grade three classes?
- What kind of activities do your learners most enjoy? Least enjoy?
- What was the general competency of this class at the beginning of this year?
- How do you characterize your behaviour management techniques?

- ...he NCS has had an impact on the way you manage your learners? How so?
- What techniques do you use to encourage a motivating and supportive environment?
- Do you have opportunities to collaborate with other teachers in your grade at school? Out of school, with other grade three or foundation phase teachers?
- What do you think will be your learnersô greatest strengths when they leave grade three?
- Tell me about é é ..(choose a learner in the class)
- Describe you homework structure?
- How would you describe the role and participation of your learnersô parents in motivating them? How interested are they in their childôs education
- What is the amount of time allocated to teaching mathematics per week in your class?
- Do you teach mathematics everyday?
- What is your general practice in mathematics teaching?

Questions to probe teachers understanding of concepts like learning, teacher, learner

- Why do you think mathematics learning is difficult?
- How do you think it can be made easier?
- In your opinion how does learning occur?
- What do you understand by the term as teacher as learner?
- What do you think leads to active construction of knowledge?
- How would you describe your understanding of the NCS?
- What teaching philosophy do you think informs it?
- What have your experiences been like in the implementing of the NCS?
- Has anything been problematic? If so What?

…bout mathematics teaching

- What is the general competency of this class in mathematics?
- How do you assist your learners who struggle in mathematics?
- How do you assist the above average and achieving learner?
- How does the instruction differ from your standard instruction?
- Can you explain to me how you plan your lessons for the teaching of mathematics?
- How important is your planning to your teaching?
- How do you decide on the content?
- What are some of the things that you bear in mind when planning your mathematics lessons?
- How confident do you feel to teach mathematics?
- What do you think is the most important of mathematics instruction? Why?
- Do you teach only as a class or do you teach in small groups as well? Why?
- What do you understand by the term to communicate mathematically?
- Do you think it is important to communicate mathematically? Why
- Do you encourage your learners to communicate mathematically? How?
- What percentage of your mathematics instruction on average is whole class teaching, small group teaching?
- How are your learners grouped? Why? How often? Which activities?
- How often do you asses in mathematics?
- How do you assess your learners in mathematics?
- Do you use the information from your assessments in any way? How?
- What is you opinion of the use of manipulatives in your grade three class?

ces in general?

- Do you connect mathematics to other learning areas? How?
- Do you think it is necessary to do so? Why?
- What about connecting to their existing knowledge ï how important is that? Why?
- How do you motivate your learners to make these connections?
- Do you use different strategies to teach mathematics/ Examples

Metaphors: less direct approach to be used to uncover teachers beliefs

- Learning is likeé ?
- Teaching is likeé ?
- A teacher is likeé ?
- A learner is likeé ?