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**ASSESSMENT IN MATHEMATICS CLASSROOMS IN GHANA:
A STUDY OF TEACHERS' PRACTICES**

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**Thesis submitted to the University of Sussex, United Kingdom, in partial
fulfillment of the requirements for the degree of Doctor of Education**

JUNE, 2015

DECLARATION

I hereby declare that this thesis has not been submitted, and will not be, in whole or in part to another University for the award of any other degree.

Signature.....

UNIVERSITY OF SUSSEX**EVELYN OWUSU ODURO, DOCTOR OF EDUCATION****ASSESSMENT IN MATHEMATICS CLASSROOMS IN GHANA:****A STUDY OF TEACHERS' PRACTICES****ABSTRACT**

Assessment is considered a powerful tool for improving learning outcomes and education quality. However, limited empirical research on classroom assessment exists in many developing countries including Ghana. This study explores the issues of mathematics classroom assessment in Ghana. Specifically, it investigates and analyses mathematics teachers' views and practices of assessment with specific reference to the implication for learning. Although the main focus of this study is on teachers' assessment practices, an examination of their conceptions of the nature of mathematics is undertaken to facilitate an in-depth understanding of teachers' views and practices.

The research is mainly qualitative by design and employs both interpretative and exploratory strategies. Classroom observations, semi-structured interviews and document reviews are used as instruments for data collection through a non-participant observation method. A purposive sampling method is used to select six participants: four teachers and two headteachers for the study.

This research study explores key factors affecting assessment practices in mathematics classrooms. In particular, it provides an analysis firstly of teachers' views about assessment emphasising improvement and accountability and secondly of the different types of knowledge, beliefs and attitudes of the mathematics teachers, and their relationship with practice. Attention is directed to the teacher's practical knowledge of teaching, of mathematics and how assessment comes into play. Also notable is the importance attached to the teachers' beliefs concerning the nature of mathematics.

Findings from this study show that teachers use both formal and informal assessments in mathematics classrooms although formal assessment dominates practice. Teachers' views about assessment and their conceptions of the nature of mathematics are related to their classroom practices. Beyond these two factors, this exploratory study illustrates how teachers' assessment practices are affected by a number of contextual factors which are related to institutional policies, professional development and classroom conditions.

There are implications of this research for the implementation of assessment for learning in Ghana. It is evident that in the current context, the widespread implementation of assessment for learning is ambitious and would demand well-defined and context-specific approaches to classroom practices. The introduction of these innovative assessment practices marks a significant departure from traditional practice and as such may require regular professional support and a coordinated and collaborative effort from policy makers, schools and teachers.

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LIST OF ABBREVIATIONS AND ACRONYMS

ASU	Assessment Services Unit
BECE	Basic Education Certificate Examination
CA	Continuous Assessment
CERI	Centre for Educational Research and Innovation
CS	Circuit Supervision
CRDD	Curriculum Research and Development Division
DFID	Department for International Development
DTO	District Training Officer
DTST	District Teacher Support Team
EFA	Education for All
ESP	Education Strategic Plan
EFL	English as a Foreign Language
FCUBE	Free Compulsory Universal Basic Education
FGD	Focus Group Discussion
GES	Ghana Education Service
GPRS	Ghana Poverty Reduction Strategy Paper
NEA	National Education Assessment
GNAT	Ghana National Association of Teachers
ICT	Information Communication and Technology.
ISSET	In-service Education and Training
JHS	Junior High School
JSS	Junior Secondary School
MDG	Millennium Development Goals
MDI	Measurement-driven Instruction
MOE	Ministry of Education
MSLC	Middle School Living Certificate
NESAR	National Education Sector Annual Review
NJMA	New Juaben Municipal Area
NIU	National INSET Unit
P	Pupil
PCE	Per child expenditure
PTR	Pupil-Teacher-Ratio
OECD	Office for Economic Cooperation and Development
SBA	School Based Assessment
SEA	School Education Assessment
SHS	Senior High School
SMC	School Management Committee
SHS	Senior High School
STME	Science Technology and Mathematics Education
TED	Teacher Education Division
TCoA	Teachers' Conceptions of Assessment
WAEC	West African Examinations Council
WSD	Whole School Development

CHAPTER 1: INTRODUCTION

1.1 Background

Globally, schools are experiencing increasing pressure to raise standards in pupils' learning. This has provoked an assessment-led reform which is widely considered a powerful tool in promoting higher standards of teaching and learning and a more credible means for public accountability (Black and Wiliam, 1998 a and b; Broadfoot and Black, 2004; Black, Harrison, Lee, Marshall, and Wiliam, 2010). Classroom assessment (formative assessment) is considered as a critical factor in promoting quality education and has become the pivot of various educational improvement efforts. Assessment results provide information on pupils' achievement, identify learning problems, and indicate the remedial actions that need to be taken (Gipps and Murphy, 1994; Black and Wiliam, 1998; Stiggins, 1999; Black et al, 2010). In fact, no educational effort can overlook the importance of assessment.

Over the past four decades, research on assessment has gained prominence in educational discourse and as a result, has contributed in shifting attention towards improving learning outcomes. Formative assessment has been identified as having the potential to improve learning outcomes (Black and Wiliam, 1998; Wiliam, Lee, Harrison, and Black, 2004; Carless, 2005; Wiliam, 2006; Hattie and Timperley, 2007). It is also a determining factor of educational effectiveness at both the classroom and the school level.

After the seminal review by Black and Wiliam (1998a), several empirical works have confirmed the pedagogical potential of classroom assessment to raise pupils' performance (e.g. Gipps and Murphy, 1994; Cowie and Bell, 1999; Coffey, 2003; Hattie and

Timperley, 2007; Clark, 2012). Much of the campaign on classroom assessment has been spearheaded by assessment specialists such as Gipps (1994), Stiggins, (2002), Stiggins and Chappuis (2005). Further, professional organizations, one of such being the Joint Committee on Standards for Educational Evaluation (2003) have also endorsed the use of classroom assessment to raise standards. On the other hand, summative assessment is found to be widely employed by teachers whilst they continue to use classroom assessment simply for grading and reporting purposes (McNair et al., 2003; Uchiyama, 2004).

In spite of the acknowledged effect of formative assessment on raising standard of teaching and learning, it has limited application to promote learning in mathematics classrooms (Romberg and Kaput, 1999), especially in Sub – Saharan Africa, including Ghana (Global Monitoring Report, 2013/14). Even in Cyprus, where teachers seem to have positive attitudes towards formative assessment, only a limited number of teachers are reported to have actually implemented such practices in their teaching (Creemers, Kyriakides, and Antoniou, 2013). These issues surrounding formative assessment raise questions for further research. According to Sebatane (2000), the challenges surrounding assessment in general, might be related to a lack of technical know-how about assessment and the uneven distribution of expertise for the subject.

In this regard, it is not surprising that some teachers implement formative assessment without making substantive pedagogical changes (Dixon, Hawe and Parr, 2011). Teachers need to fully understand the intended outcomes and reasons for implementing formative assessment strategies before they can do so with fidelity. Pryor and Crossouard (2008) have also pointed out teachers' different understandings of formative assessment,

equating it either with measurement or as a ‘process of co-enquiry’ (p. 2). The differences in interpretation implies that teachers need to make a conscious effort to understand the technical meaning of what formative assessment is all about and how to implement its strategies in order to achieve desirable learning outcomes.

Assessment policy changes are continual in many countries including Ghana. The 2007 education reform in Ghana strongly recommended a reduction of public examinations and excessive tests at both secondary and primary levels (Anamua Mensah, 2007). This was intended to ensure that teachers get enough time to teach for conceptual understanding. It also made room to diversify the form and use of assessment tasks with the space for including formative tasks as well as continual assessment in which grades went towards final marks rather than being based entirely on pupil performance in public examinations. Furthermore, the Education Strategic Plan (ESP 2010-2020) was to ensure a curriculum reform that would include problem solving strategies especially in mathematics.

From this perspective, classroom assessment that identifies the learning potential of pupils in mathematics departs from traditional psychometric assessment forms to more practical, integrated and constructivist approaches as suggested by researchers of assessment (e.g. Black and Wiliam, 1998; Black et al, 2010). Consistent with this, various forms of assessments, such as projects, portfolios, observations, tests and examinations were recommended by the CRDD in 2008 to assess mathematics learning in Ghana. These forms of assessments were intended to be used in all stages of pupils’ development, in line with modern global trends of assessment for learning. Though these reforms are laudable, there are concerns on implementation strategies as to how teachers actualise their assessment practices in Ghanaian schools (Akyeampong et al, 2007; NEA, 2011).

The aim of this study therefore, is to critically examine teachers' assessment practices in mathematics classrooms in Ghana and also to investigate how teachers understand and use classroom assessment to support teaching and learning. As very little research to investigate classroom assessment practices in mathematics has been conducted in Ghana, this study aims at filling this gap. Changes to existing teachers' assessment practices in mathematics will be difficult to effect unless critical examination of those practices that hinder implementation are explored to provide insights into ways in which they could be transformed. Findings of this study are therefore relevant to the implementation of assessment reforms in mathematics classrooms in Ghana. It is for this reason that I hold the view that assessment should be understood in the context in which it operates since that context (in this case mathematics) may determine the degree to which policy and practice on assessment could be successful.

1.2 Deciding on the Nature of the Study

My choice of studying assessment in mathematics classrooms reflects my professional interest in the subject. From 1989 to 1998, I was a mathematics tutor and the assessment officer at the Holy Child Teacher Training College in Takoradi, Ghana. Between 2001-2005, I was a member of the National Education Assessment Team at the Ghana Education Service (GES). I have also been involved in the training of test item writers as well as monitoring test administration in basic schools.

Another matter of interest to me is the mathematisation of modern society (Davis and Hersch, 1980; OECD, 2005; Skovsmose, 2006) which shows how mathematics influences

our lives on a daily basis. It is worth noting that mathematics is seen as pivotal in the development of technologies that are driving the world (MOE, 2008).

Ghana's Medium-Term Development Plan, captured in the Ghana Poverty Reduction Strategy Papers (GPRS I and II) and the Education Strategic Plan 20013 – 2020 (ESP) suggest the use of ICT which is full of mathematical applications as a means of reaching out to the poor in society (NDPC, 2009, MOE, 2010). The Education Strategic Plan (ESP) 2010 – 2020 recommended ICT to be part of the school curriculum. However, until now, very little has been achieved as reported by the National Education Sector Review (USAID, 2009; NESAR, 2013). Indeed, there are innovations involving the application of mathematics and technology in all spheres of life. These include commercial activities, games and home appliances that everyone needs to be familiar with in order to thrive in a globalized world.

In this context, there is increasing expectation on the development of pupils' intellectual dexterity, ability to tackle real-life challenges, applications, and problem-solving skills (MOE, 2008, MOE, 2010). Emphasis is now placed on the ability to acquire new knowledge, interpret and analyse new information effectively in the fast changing technological and globalised world (Lewin and Dunne, 2000; OECD, 2010). It is for this reason that I am of the opinion that the rapid pace of development in society due to the impact of globalization, and the new 'information age' requires that the workforce be equipped with diverse skills so as to remain competitive globally. It implies that there should be a transformation in assessment procedures which will ultimately support learning, especially in Mathematics, Science and ICT in schools and in the world of work.

In response to these current trends of events, the school curriculum has undergone reforms globally to include a focus on a range of skills and attitudes that are relevant to a fast-

moving and technologically informed society. A study by Lewin and Dunne (2000) across several African countries reveals a substantial and consistent history of curriculum reform with the aim of improving relevance and increasing cognitive demand. These reforms are often supported by international development actors and reflect the influence of globalisation (Lewin and Dunne, 2000). In Ghana, for example, recent curriculum reform that was intended to embed ICT has highlighted the pedagogic transformation demanded and challenges it presents for teachers and assessment. In effect, “the culture and practice of traditional memory-based learning is to be transformed to the kind of education that stimulates thinking and creativity which is necessary to match the challenges of the 21st Century” (MOE, 2008 p.4).

However, the Ghanaian curriculum is still characterised by a “received curriculum”, (referring to borrowed ideas) as in most African countries (Lewin and Dunne, 2000, 2010, Akyeampong et al, 2007). Durrani and Dunne (2010) identified a similar situation with the school curriculum of Pakistan. Critically for this study, the assessment practices in mathematics classrooms are found to be associated with traditions and pedagogies that focus on testing. The construction of test items have been found to essentially require recall of facts especially in Anglophone African countries (Lewin and Dunne, 2000; Agbeti, 2011).

This contrasts significantly with current learning theories which place emphasis on understanding (Bransford et al, 2007) rather than mere recall of facts. As an experienced practitioner, it is evident to me that assessment should enable pupils to demonstrate deep understanding of concepts rather than surface knowledge and recall of facts. Assessment

should also reflect where pupils are in their learning and help to indicate how they could progress further (Ecclestone, 2004). The conflict within and between teaching and assessment theories and practices poses problems in the classroom and it is this situation that provides a platform for this study. My intention was to collect primary data to understand the possibilities and barriers to innovative classroom assessment practices in Ghanaian mathematics classrooms.

1.3 Pitfalls in Assessment Practices

In spite of the highly acclaimed role that classroom assessment plays in teaching and learning, research has identified a number of problems with the quality of classroom assessment. In the UK and America for instance, problems have been found with the use of poorly focused questions, a predominance of questions that require short answers involving factual knowledge, the elicitation of responses that involve repetition rather than reflection, and a lack of procedures designed to develop higher order skills (Black and Wiliam, 1998).

In Kenya, there is evidence of similar situations where questions asked were often narrow and demanded recall of information rather than facilitating higher order thinking (Kelleghan and Greaney, 1992). Further, it was found out that there was little assessment of pupils' understanding of what had been taught before lessons were introduced (Ackers, Migoli and Nzomo, 2001). In Tanzania, teachers' questioning was found to require only the recall of facts whereby pupils responded individually or in chorus (Osaki and Agu, 2002). In a study that compared Ghanaian and Japanese classroom assessments, Hattori and Saba, (2008) found that Japanese teachers asked more higher

order thinking skills questions than their Ghanaian counterparts. In this context, it would appear important to find out what influences the assessment practices of Ghanaian teachers.

In Ghana, the school curriculum tends to follow a linear learning progression that is heavily informed by Bloom's (1969) behaviourist theory of learning (see the Ghana Mathematics Syllabus, 2013). The curriculum is designed in terms of profile dimensions¹. Teachers are expected to teach using a progression from one stage to the next, starting from the recall of basic facts to higher levels of their application, that is, synthesis and evaluation. However, reports show that basic school pupils are not asked to move beyond the recall of facts (Anamua Mensah, 2009; National Education Assessment (NEA), 2013). It remains an open question as to how strengthening the use of formative assessment might provide the impetus to encourage Bloom's higher order skills and a move beyond the content focus of the received curriculum. It is these higher order skills that lead towards learning process skills that have been highlighted as relevant to 21st century education (OECD, 2005).

Although this study seeks to identify the challenges faced by teachers in their assessment practices among their other professional concerns, it might also inform pragmatic solutions which will make classroom assessment responsive and a positive tool for improving learning in the Ghanaian context. It is the relative absence of research in this area, in the Ghanaian context that has called for this research. Specifically, little is known about what underlies the teacher's decision to employ a certain form of assessment, or

¹ Profile dimension is tied to Bloom's Taxonomy where one moves from one level to another in the ascending order.

the views that motivate their pupil questioning and feedback practices. This study attempts to fill this gap. Accordingly, and in order to get an in-depth perspective, this research aims at exploring the classroom assessment practices through a focus on four mathematics teachers and two headteachers in two basic schools in the New Juaben Municipality of Ghana. The purpose and rationale of this study are expounded in the next section.

1.4 Purpose and Rationale of the Study

This study seeks to explore teachers' classroom assessment practices in mathematics classrooms in Ghanaian basic schools. It examines their perceptions that underlie their assessment and feedback practices. Whereas considerable research on classroom assessment has been conducted in the western educational systems, the same cannot be said about the education system in developing countries. This seems to be very crucial for curriculum and assessment development, particularly in Ghana. In this context, it is clear to me that this study has wider significance for educational reform, in that, from my experience, basic education reforms need to be premised on what happens in classrooms, otherwise reforms on quality education are unlikely to be effective and may fail to achieve the desired outcomes.

Ghanaian basic schools have traditionally recorded very low achievements in mathematics education (NEA, 2010). Recent global trends show a significant exponential growth in reliance on scientific and technological innovation in national development. Yet, science and technology education still poses a great challenge for the Ghanaian education system, despite the high premium that the Government of Ghana (GoG) places

on these subjects in its policies (MOE, 2008, NESAR, 2013/14). At the tertiary education level, only 40% of pupils specialise in scientific, technological or health-related disciplines, although a policy target of 60% has long been set (NCTE, 1998). A major constraining factor in achieving the set target is the number of pupils who graduate at the senior secondary school level (grade 10-12) in basic science related subjects. Poor results at the senior secondary school level are strongly linked to low achievement levels in basic education (grades 1-9), (NESAR, 2013).

These factors among others underpin my study. Whilst all efforts at improving Ghanaian mathematics performance over the years have focused on teaching and learning, in this thesis I argue that only by redirecting the focus and paying more attention to the teacher's approach in assessing pupils' capabilities can the learning of mathematics in the country's basic schools reach the required standard. As I have already claimed there is little research into teachers' classroom assessment in mathematics classrooms in Ghana, or about how teachers enact, construct and interpret formative assessment in support of learning.

1.5 Organization of the Thesis

This thesis is organized into eight chapters. Chapters 1 and 2 concentrate mainly on the rationale and focus of the study. They also illuminate the challenges found in Ghanaian basic schools with regards to assessment in general.

Chapter 3 reviews the literature on relevant key issues which help explore mathematics classroom assessment. This chapter also includes the conceptual framework of the study. Apart from giving a critical account of the literature, it also gives a background

of my philosophical positioning in relation to the study. I have attempted to shed some light on the growing awareness of the potential assessment has to raise educational standards by promoting learning. I then explore the literature on teachers' classroom assessment bearing in mind the paradigm shift from an examination culture to an assessment culture and the implications that this has for the classroom teacher who conducts assessment.

Chapter 4 discusses my methodological orientation and choice of an interpretive qualitative research approach. The research design, procedures as well as techniques used for gathering and analysing data and ethical as well as practical issues encountered in the research process are presented.

Chapters 5, 6 and 7 provide analytical insights into the study. Chapter 5 discusses the assessment practices of teachers. Chapter 6 examines teachers' conceptions about the nature of mathematics and also examines how these conceptions influence assessment practices. Chapter 7 focuses on the policies and contextual factors that influence teachers' classroom assessment practices. The last chapter (Chapter 8) summarises the main findings of the study and draws conclusions from them. It also makes recommendations for further research.

CHAPTER 2: THE RESEARCH CONTEXT: BASIC EDUCATIONIN GHANA

2.1 Introduction

In Chapter 1, I presented the background to the study, highlighting its aim, rationale, purpose and focus as well as the significance of the study. I also illuminated the international perspectives and importance of formative assessment as well as challenges faced in its implementation. It has also provided an insight into the problems found in Ghanaian basic schools with regards to assessment. This Chapter (2) discusses the context of the study. It begins with a brief overview of the socio-political history of Ghana, followed by a discussion on the basic education system in Ghana. Subsequently, there is a discussion on the teacher deployment pattern, the basic school curriculum as well as the trends of assessment since the colonial times. The last section provides an overview of pupils' performance in mathematics at the basic school level.

2.2 A Brief History of Ghana

Popularly known as the '*black star of Africa*', Ghana prides itself as being the first country in Africa to have gained political independence from British colonial rule in 1957. The population of the country is estimated to be 24.7 million comprising 51.5% females and 48.5 % males. 38.3% of the population is under the age of 15 (GSS², 2010). Greater Accra region has the largest population of 4,010,054 followed by the Eastern region with a population of 2,633,154.

² Ghana Statistical Survey : The last census was conducted in 2010

Figure 2.1: The Map of Ghana

Source: adapted from Atlas for Basic Schools (Ngaaso et al., 2011 p. 23)

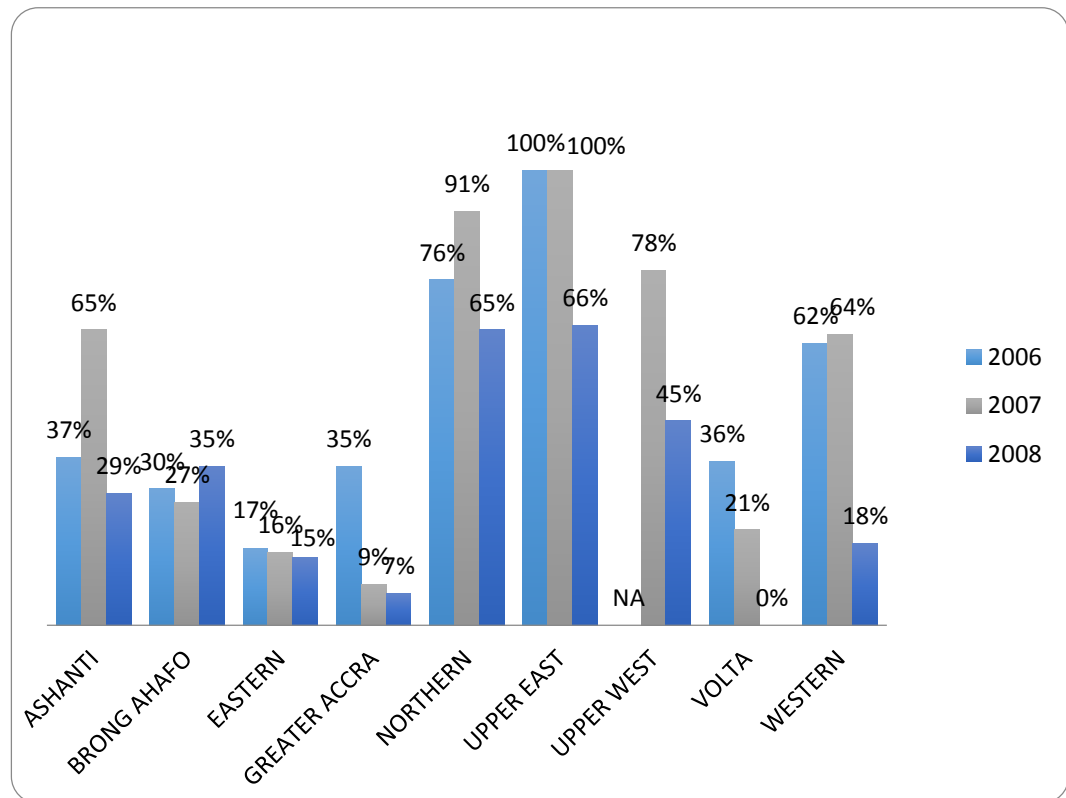
The country has ten (10) administrative regions spanning over three geographical belts (the coastal, forest and savannah belts). The economy of Ghana relies heavily on agriculture from the middle belt. The people in the coastal belt are predominantly fisher folks and traders. Ghana is endowed with many minerals such as gold, bauxite, manganese and has recently discovered crude oil. Rich as the country may seem in mineral resources, its wealth is not reflected on the lives of its people. Most striking is the North/ South divide of the Ghanaian context, which affects almost all indicators of development, including education (Rolleston, 2009). The northern (or savannah) belt constitutes the three poorest regions of the country. Due to the dry and harsh climatic conditions prevalent in the northern region, there is poor vegetative cover. The people are dispersed and as a result lack many basic amenities.

2.3 Basic Education System in Ghana

The Educational system in Ghana was originally modeled on that of the British system. However, it has undergone several changes, notable of which is the 1980 reforms which departed from a purely academic module to one that is geared towards the nation's workforce needs (Dei, 2005). The 1961 Education Act (Act 87) saw the introduction of science and technology subjects in the curriculum. These were designed to generate the required workforce for industrialisation and to enhance the technological base of the country.

Currently, basic education in Ghana is delivered in public and private schools via a predominantly centralized top-down system. Basic education consists of two years of kindergarten, six years of primary, and three years of junior high school (JHS). All learners have a common and compulsory obligation to attend these three levels of basic education. All schools use a common basic school curriculum. To ensure equity in the cost of education especially with children, pro-poor policies and strategies have been put in place. In spite of this, significant socio-economic disparities still exist among the nine (9) out of the ten (10) regions in Ghana as illustrated in figure 2.2 (see p 16).

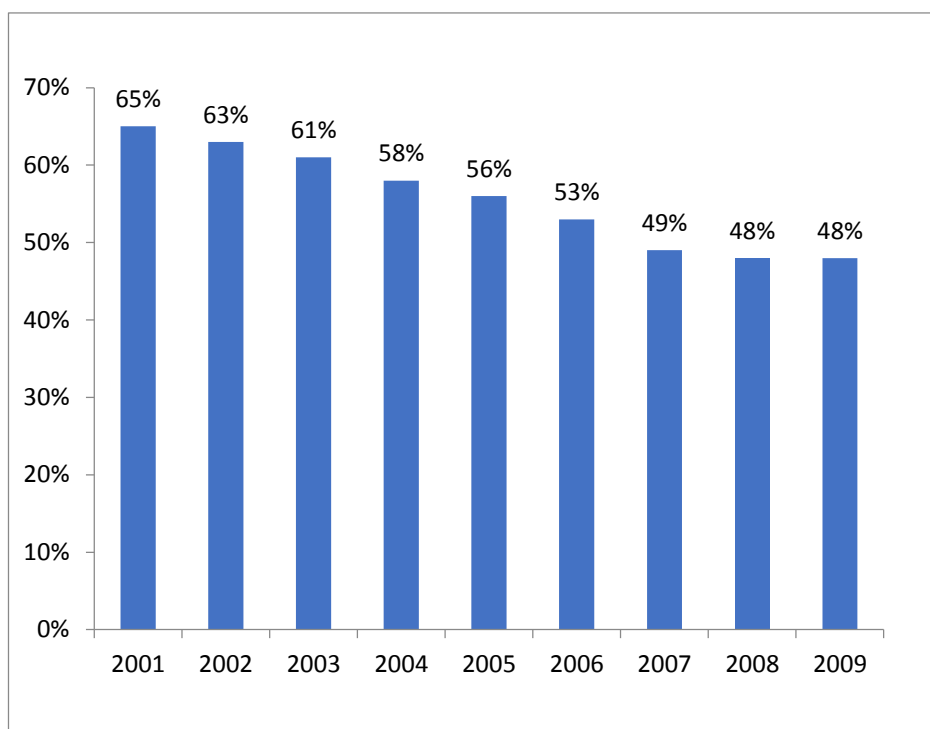
Various studies by the World Bank have established that the per-child expenditure (PCE) in deprived districts in Ghana has increased significantly lately in the Primary and Junior High Schools. However, there is an imbalance in the distribution of teachers as well as teaching and learning resources (World Bank, 2011, NESAR, 2013). These regional expenditure patterns reflect the disparities in the distribution of trained teachers in basic schools in the country (World Bank, 2011).

Figure 2.2: Education Expenditure per Child by Region and Year

Source: Adapted from World Bank (2011, p.132; NEA 2011, p.4)

Over the years, the number of trained teachers employed at the school level has been declining (see figure 2.3, p. 17). Several reasons may be assigned to this downward trend which requires further investigations. However, as a Municipal Director of Education in Accra, the situation is different. There is a high concentration of teachers in my schools. The categories of teachers needed especially in mathematics and science are rather in short supply in my municipality. This presupposes that inequity in teacher supply may have consequences on teaching and learning.

Figure 2.3: Percentage of Trained Basic School Teachers in Ghana from 2001 -2009.



Source: Adapted from World Bank (2011)

Though it is reported that the Eastern Region seems to have a higher percentage of trained teachers as compared to the regions in the northern part of the country, they are unequally distributed (World Bank, 2011). The pupil/teacher ratio has remained below 40:1. The percentage of trained teachers fell gradually from 72% in 1999 to 52% in 2012 (World Bank, 2011).

2.4 Basic School Mathematics Curriculum in Ghana

In Ghana, both public and private schools use the same national mathematics curriculum which is developed centrally by the Curriculum Research and Development Division (CRDD) of the GES. The Ghana Education Service (GES) is responsible for implementing the national curriculum, through the use of textbooks production by private

publishers. The curriculum provides detailed instructions regarding the instructions for textbooks such as the number and topics of the lessons to be covered. The CRDD is also in-charge of assessing all textbooks and also reserves the right to amend, delete or and reject a part or the whole of any textbook. In view of such control, the contents of textbooks are more or less the same in all the regions though this may have been published by different private publishing houses.

The basic education curriculum describes and explains assessment requirements for all content areas. The curriculum also describes levels of learning, termed ‘profile dimensions’, whereby outcomes can be determined from a lower level to higher order learning (Bloom, 1969). The GES provides detailed guidelines on mathematics pedagogy for teaching the subject at all levels. These guidelines are broken down into themes containing a vast array of concepts. Consistent with the national policy, the curriculum is aligned with behavioural cognitive framework that outlines the cognitive levels to be covered. These levels follow Bloom’s (1969) taxonomy of fact recall, application of knowledge and understanding, analysis, synthesis, and evaluation. Teachers should be guided by the weight assigned to each level in planning lessons as indicated in Table 2.1.see p. 19. Though this has received criticisms, Stobart (2010) explains that it still serves as a useful framework for analysis of test items. Teachers are able to identify the number of items belonging to recall of facts, comprehension, application, analysis and synthesis to evaluation.

Table 2.1: Profile Dimensions and Weight Measures at the Basic school Level

Level	Profile dimension	Weight (%)
Primary School	Recall of facts	40
	Application	60
Junior High School (JHS)	Recall of facts	30
	Application	70

Source: Adapted from GES Basic School Curriculum (2011).

School textbooks and curriculum documents e.g. syllabuses are written mostly in deterministic style that correspond with and validate the prescriptive and authoritarian structure of teaching and learning. At the same time, many teachers do not have access to other reference materials apart from government prescribed textbooks which then become the only source of material for teaching (Akyeampong et al, 2007). As noted, in such situations, textbooks have enormous institutional authority, which compounds the ideological impact on pupils (Durrani and Dunne, 2010). The primary school mathematics syllabus can be described as ‘teacher-proof’. It contains a teacher’s guide which describes step-by-step topics that can be taught in each lesson (Croft, 2002).

The last three to four decades have seen curriculum changes, especially in science and mathematics and have replaced “colonial material with nationally determined content and learning objectives” (Lewin and Dunne, 2000 p. 382). Due to frequent changes in Ghanaian education policy, teachers are obliged to respond to new demands of assessment within a changing framework in a relatively short period of time. In the face of the rapidly evolving nature of education and assessment systems notwithstanding, classroom testing

has as yet received limited attention (Oduro, 2009). The next section sheds more light on that.

2.5 Assessment in Basic Schools in Ghana

Since the colonial era, assessment in Ghana has been for placement purposes; that is, to select candidates to progress through the levels/ stages of the educational system and for employment in white ‘collar jobs’ as administrative clerks (McWilliams and Kwamena-Poh, 1975). This selection process has been perpetuated through generations over the years. In 1970, the **Middle School Leaving Certificate Examination** (MSLCE) was introduced. Alongside this, there was the British-Originated General Certificate of Education (GCE) Ordinary and Advanced level examinations for secondary schools. These forms of assessment were abolished in 1993 and 1996 respectively, and replaced by the Senior Secondary School Certificate Examination (SSSCE). With this system, pupils in primary grades 1 to 5 enjoyed automatic promotion to the next grade until completion of primary six. Up to the 1970s, there was a Common Entrance Examination for selecting qualified and a privileged few for secondary school education. The rest continued up to middle school form 4 where they wrote an examination for the (MSLC).

Continuous Assessment was introduced from primary one to JHS in 1987 as part of the 1987 educational reform to complement the Basic Education Certificate Examination (BECE) which is a one-shot end of year and external examination. For the past three decades, both the Junior High School (JHS) and the Senior High School (SHS) teachers have practised a system of Continuous Assessment (CA) in which 30% of the score complements that of the external BECE result. Such CA includes class exercises, tests,

quizzes, homework and projects that are set throughout the school term. Teachers are expected to conduct these assessments systematically and aggregate the results. However, the work involved in computing CA marks appears cumbersome for teachers. As documented by the GES Assessment Services Unit (Pennycuick, 1990; ASU, 2008), the situation in Ghanaian schools indicates that teachers experience difficulty in assessment administration and there is a need to build capacity of teachers in assessing pupils (NEA, 2011). Several challenges have been identified with classroom assessment. Chapter 1 (sections 1.1 and 1.3) highlighted the challenges faced with its implementation and pitfalls in teachers' classroom assessment practices respectively. Furthermore, the kinds of policy contradictions about assessments that teachers encounter in schools are also likely to impact on their classroom practices in both internal and external examinations (Agbeti, 2011).

For example, teachers seem to be burdened by endless marking and compilation of results in addition to an overloaded curriculum, and other classroom requirements such as managing large classes and attending to pupils' individual needs. The persistent disparities between West African Examinations Council (WAEC) results and those obtained in schools have triggered calls from Subject Associations, Teacher Unions and the Chief Examiners of Senior High School Examinations and the Assessment Services Unit (ASU) of the GES to examine and review the assessment practices in basic schools. Despite this call, educational sector documents such as the National Education Sector Review (NESAR, 2010 - 13), and the Education Strategic Plan 2013 - 2020 ESP and the NEA, (2013) report draw comparatively little attention to the discourse on assessment and many of the central issues concerning CA in Ghanaian schools are missing.

However, many factors, such as inadequate resources, untrained teachers, high levels of teacher absenteeism, high pupil drop-out rates, large class sizes and high teacher attrition may contribute to low levels of educational quality. Despite these factors listed earlier, standards and measures of quality education remain ill-defined. Nevertheless, approaches to improving quality in many countries of the Global North have included the introduction of formative assessment as a continuous process for ensuring high performance standards. There is ample evidence on the positive role that formative assessment plays in ensuring high performance standards (Kellaghan and Greaney, 2001; Pryor and Lubisi, 2002; UNESCO, 2005, Black and Wiliam, 2010; World Bank, 2013/ 14). In all these, the big question is whether the successful introduction of formative assessment elsewhere might be worthwhile or even successful in improving pupil performance in Ghana?

2.6 Basic School Pupils' Performance in Mathematics

The purpose of assessment, among other things, is to test pupils' understanding of what is taught and ultimately equip them with the requisite knowledge and skills as well as to improve learning. Assessments that pupils are taken through in school are likely to impact on pupils' performance in both internal and external examinations (Agbeti, 2011). Mathematics education in Ghanaian basic schools has traditionally recorded very low achievements (NEA, 2011/ 13). Low achievement in school has implications on an individual's knowledge, skills and opportunities for further studies. Despite the development aspirations of Ghana and the high premium placed on science and technology (ESP, 2010 - 2020), at the tertiary education level, only about 40% of pupils specialise in scientific, technological or health-related disciplines, compared to a policy target of 60% (MOE, 2008, NESAR, 2013).

In 2003 and again in 2007, Ghana's participation as one of 45 countries in a comparative study - Trends in International Mathematics and Science Study [(TIMSS), 2007] at grade 8 revealed the gravity of the situation (Anamuah Mensah et al, 2004, 2009). As shown in the analysis in Table 2.2 of the TIMSS report since Ghana joined it in 1995, shows low scores in mathematics with very little improvement over the years. For instance, in the 2011 report, Ghana was next to last (with a score higher than only that of South Africa) on the list of countries that participated in the assessment (see table 2.2).

Table 2.2: Selected TIMSS Scores in Mathematics

Country	Scores in Mathematics	
	2003	2007
Singapore	605	593
Tunisia	410	420
Botswana	366	364
Ghana	276	309
International Average	467	500

Source: Adapted from Anamua Mensah et.al. (2004, 2009 p.77)

Again, from table 2.2, Ghana's TIMSS score in 2007 was higher than that in 2003. However, 2007 scores remained lower than almost all other countries that participated in the assessment as per the international average (World Bank, 2011). Analysis of the report further indicates that performance was low in both the content (numbers, data, algebra, geometry, measurement) and cognitive domains (factual procedural knowledge) in the examination. These results are alarming and call for immediate attention by policy makers and all educational stakeholders in Ghana. There is an evident need to review the kind of

mathematics teaching and assessment that is employed in basic schools as the foundation for helping future pupils

The available statistics of pupils' performance in mathematics from the NEA report is also not encouraging. The majority of pupils who complete primary school do not achieve proficiency in core subject areas such as mathematics (Anamuah et.al. 2009, page 77).

Table 2.3 illustrates NEA results collated biannually from 2005 to 2013.

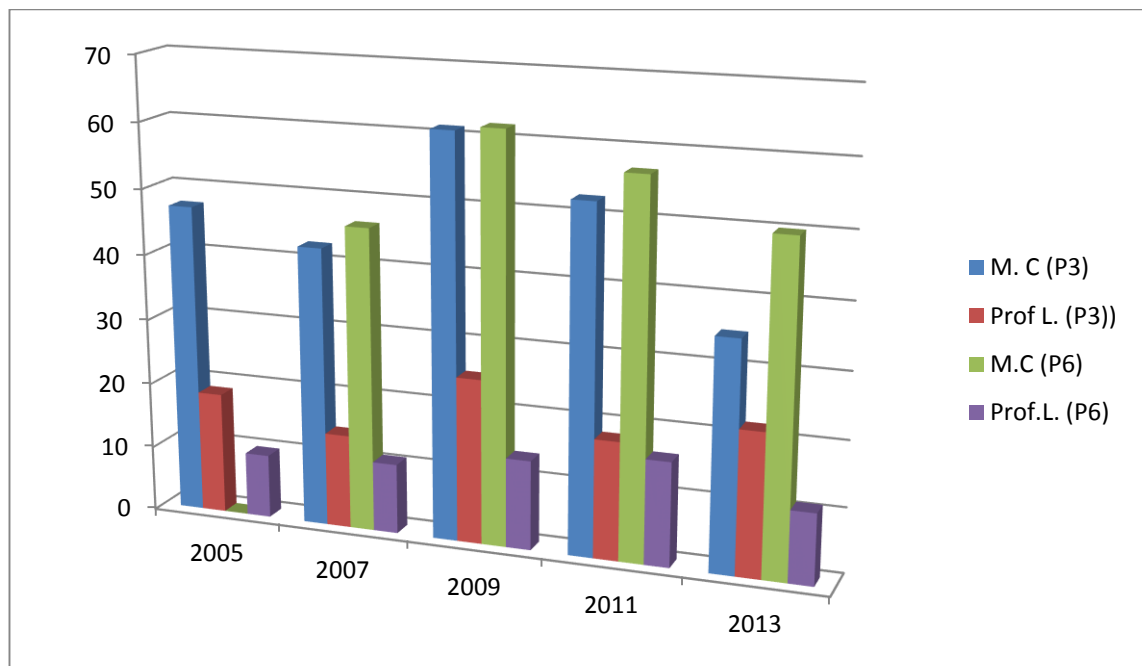
**Table 2.3: Pupils Reaching Competency (MC) and Proficiency (Prof) Levels
Bi-annually from 2005-2013**

Year	Primary 3 (P3)		Primary 6 (P6)	
	Minimum Competency Level (%)	Proficiency Level (%)	Minimum Competency (%)	Proficiency Level (%)
2005	47.2	18.6	42.2	9.8
2007	42.6	14.4	46.2	10.8
2009	61.2	25.2	61.9	13.8
2011	52.6	18.2	56.9	16.1
2013	35	22.0	50.0	11.0
Av	47.7	19.6	51.4	12.3

Source: Adapted from National Education Assessment (NEA) report (2012 p. xv).

From the table 2.3(p.24), in 2005, 2007, 2009, 2011, and 2013 pupils in P3 attained the national minimum competency³ level of 35% (NEA, 2010, 2011). However, in the same years proficiency levels were very low. Pupils could not attain the proficiency level of 55% in mathematics. Similarly, in 2005, 2007, 2009, 2011 and 2013, pupils in P6 attained the minimum competency levels. In the same years, the proficiency levels of P6 pupils were very low, the lowest being the 2005 NEA results where only 9.8% of the pupils were proficient in mathematics. The number of pupils attaining Proficiency level of 55% test scores was 11% in 2013 (see figure.2.4).

Fig. 2.4: Pupils Reaching Competency (MC) and Proficiency (Prof) Levels Bi-annually from 2005-2013



Source: Author

³ Pupils are defined as having achieved “minimum competency” if they answer at least 35% of the NEA test items correctly. Pupils who answer at least 55% of the items correctly are defined as having achieved “proficiency.” Note: international standard for proficiency is (those who answer at least 70% of the questions correctly).

From the graph fig 2.4 (p.25), it is evident that both P3 and P6 more pupils are able to attain the national minimum standard of 35% and beyond in mathematics but majority about 75% of pupils are unable to reach the proficiency level of 55%. The pattern is similar in all the years for both P3 and P6.

Table 2.4: Pupils Reaching Minimum Competency and Proficiency Levels in the Eastern Region

	P3	P6
Below Min Competency (%)	40.8	37.3
Minimum Competency (%)	34.9	50.2
Maximum Competency (%)	24.3	12.5

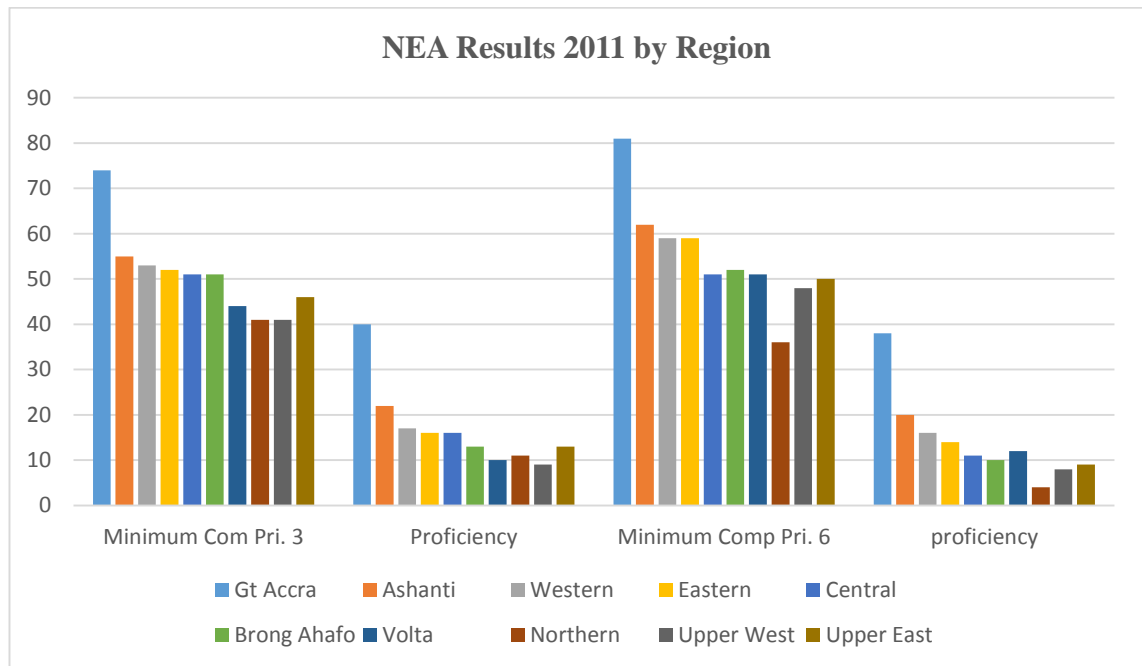
Source: Adapted from NEA, (2013 p.29).

In the Eastern region of Ghana, though pupils reaching maximum competency levels seem low, the percentage of pupils only reaching minimum competency is quite encouraging as compared with the NEA minimum standard of 35%. There is however, a lot more room for improvement. Overall, poor performance has been recorded in the application of theoretical knowledge and the exhibition of knowledge of concepts, facts, and test involving application and reasoning.

Comparing the NEA scores from the 10 regions (see figure 2.5 p.27), it is realized that Greater Accra has the highest number of pupils (80% and 81%) attaining 35% minimum competency in mathematics for both P3 and P6 respectively. A similar pattern is observed for the p6 pupils. Proficiency levels for both P3 and P6 in all the regions are low except in Greater Accra where about 40% of pupils are able to attain proficiency level of 55%.

The regional disparities appear to be consistent with the economic pattern in the country as pointed out by Rolleston, (2009) in Chapter 1.

Figure 2.5: Overall Performance of NEA by Region



Source: Author

It could be argued that, Greater Accra,(the capital) Ashanti, Eastern, Western, Eastern, Volta and Brong Ahafo, all have more urban communities which attract more trained and qualified teachers than the North, Upper West and Upper East. It could also mean that many pupils are not in school or the few who are there lack learning resources. These results and especially those of Eastern region have implications for this study.

2.7 Summary

This chapter has shed light on the political, social and educational landscape of Ghana. Ghana's education has followed that of the British over the years. In view of the gap between the urban and the rural communities in Ghana in terms of development, pro-poor strategies have been put in place to ensure equitable distribution of funds. Yet, significant geographical disparities exist in the Northern, Upper East and Upper West regions.

Basic education comprises 2 years kindergarten, 6 years primary and 3 years junior high school. Both public and private schools operate a common curriculum which is centrally developed and being monitored by GES/CRDD and the Inspectorate division. The curriculum which aligns more to the behaviorist philosophy provides the themes to be studied in mathematics. The deterministic and top down nature of the curriculum allows little room for teachers to be creative.

Performance in mathematics is generally low except in urban areas in regions like Greater Accra, Western, Eastern, Central, Brong Ahafo, Central and Volta where about 50% of pupils are able to attain the minimum competency level of 35%. Apart from Greater Accra where about 40% of pupils attained the proficiency level of 55%, results in all the regions were low. It is observed that the NEA results are linked to the regional disparities.

Over the years, assessment in Ghana had been for selection purposes. CA was introduced as an alternative assessment. Yet, it came with numerous challenges. In recent years, in order to have a more credible assessment, SBA has been introduced. However, implementation challenges still exist. Whilst it is important to recognise that many factors

may contribute to perceived low levels of educational quality, such as inadequate resources, untrained teaching staff, high levels of absenteeism, and large class sizes, teacher attrition and high drop-out rates, there is the need to examine and improve classroom assessment practices in Ghanaian classrooms. This study therefore seeks to use its findings to inform assessment policy and practice. The next chapter discusses relevant literature for the study.

CHAPTER 3: LITERATURE REVIEW

3.1 Introduction

In this chapter, a review of the research literature relevant to this study is presented. Specifically, I look at studies on purposes and forms of assessment, reforms in assessment as well as assessment in mathematics education and practices. Next, I develop a theoretical framework for understanding teachers' assessment practices which comprise both teacher-related and contextual factors. The teacher-related factors that I look at include teacher views, their knowledge of subject matter and pedagogy, their beliefs and understandings of the nature of mathematics as well as their attitudes to teaching mathematics. The contextual factors that influence teachers' assessment practices which I have reviewed comprise contextual factors which are related to institutional policies such as tests, examinations and time, professional development and classroom conditions.

3.1.1 Definition of Assessment

As a starting point, it is useful to begin with a definition of assessment. Morris and Adamson (2010, p.127) define assessment as, "those actions we undertake to obtain information about pupils' knowledge, attitudes or skills". Stiggins (2005) describes classroom assessment as "the process of gathering evidence of student learning to inform instructional decisions" (2005, p.5). In a similar vein, NCTM (2005, p.3) defines assessment in reference to mathematics as "the process of gathering evidence about the student's knowledge of, ability to use, and disposition towards mathematics and making inferences from that evidence for a variety of purposes.

From these definitions, I define assessment as all activities that the teacher uses, both in and outside the classroom to gauge learning outcomes. This process is undertaken to serve a range of purposes which I discuss next.

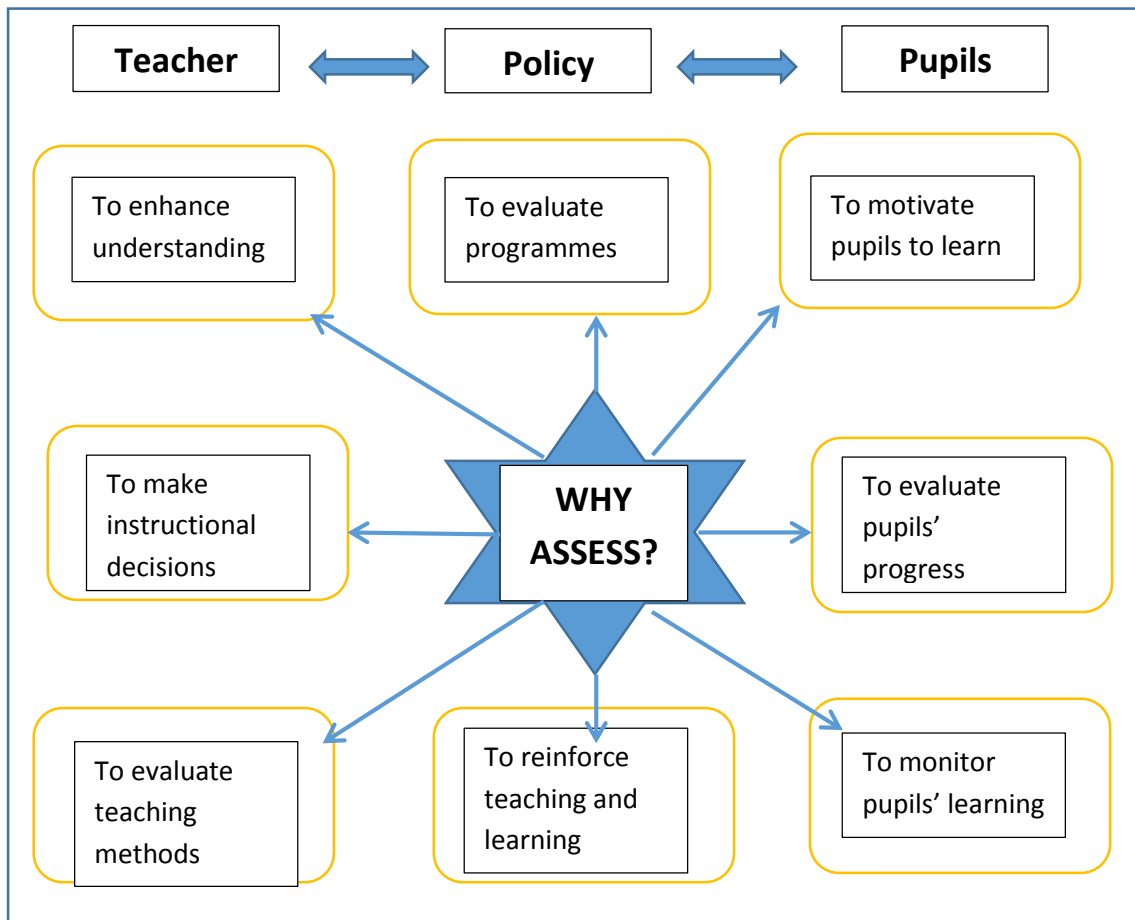
3.2 Purposes of Assessment

Assessment is an inextricable element of education. While it serves various purposes, its core function is to support and enhance student learning (Rust, 2002; (Joint Committee on Standards for Educational Evaluation [JCSEE], 2003). Assessment is linked to improving classroom activities and therefore to pupils' learning processes as well as monitoring the overall quality of education. The National Council for Teachers of Mathematics (NCTM, 2005) classified the purposes of assessment into four broad categories: monitoring pupils' progress towards learning goals, making instructional decisions, evaluating pupils' progress at a particular time, and evaluating programmes.

Stiggins (2005) describes classroom assessment as "the process of gathering evidence of student learning to inform instructional decisions" (2005, p. 5). He further suggested that assessment is to be effectively utilized, so that the accurate information acquired should not only reflect student achievement but also enrich student motivation and improve student success (Stiggins, 2005). The diverse nature of classroom assessment creates a challenge for effective teaching. "Teachers must discover, accept and apply this new understanding of classroom assessment to as a continuous means of describing achievement and promoting learning and motivation" (Stiggins, 2005, p. 1).

Assessment is integral to teachers in interpreting pupils' learning and can serve as a motivation for pupils in the learning process (Boud, 2000). Furthermore, teachers can use and interpret assessment to gauge whether teaching has been successful in achieving its objective(s). Assessment may also be used to reinforce learning as it indicates which concepts or processes pupils have not assimilated. The teacher may then use assessment results as the basis for advice on learning or reviewing teaching (Black and Wiliam, 2010). The overarching purpose of assessment therefore, is to give teachers the information needed to provide quality instruction (McMillan, 2001). The diagram in figure 3.1 illustrates the purposes of assessment.

Figure 3.1: A Diagram Illustrating the Purposes of Assessment



Source: Author

It may be seen from the wider purposes of assessment that there is more to assessment than just giving pupils tests or quizzes for grading purposes. Assessment gives direction for instruction, policy and pupils' learning.

3.3 Forms of Assessment

Assessment comes in several different forms, for example, formal quizzes, tests and examinations as well as informal observations, investigations and projects. In broad terms, assessment can be formal or informal and subjective or objective (McAlpine, 2002). Informal assessment occurs as part of teacher day-to-day practice (Atkin et al. 2001; Yorke, 2003; Marsh, 2004). For example, teachers posing questions during lessons and their general observation of the pupils. Formal assessments are the more deliberate and planned programmes of testing which are normally conducted after a lesson, a unit or end of course (Firestone et al. 2004; Marsh, 2004). A test, which focuses on certain parts of the course material only, is more limited in outlook than an examination. A quiz is even more limited in length. It covers only a unit of a module or after a lesson. Both tests and quizzes can be formative or summative in nature. According to Stiggins, the above forms of assessment can be used to monitor pupils' learning or to evaluate pupils' comprehension which is formative and summative respectively. These two major forms of assessment will be discussed in the subsequent sections.

3.3.1 Formative Assessment

Many assessment specialists have attempted a definition of formative assessment though Davies and Ecclestone (2007) note that “there is no watertight definition of formative assessment” (p. 72). For example, Gareis (2007, p. 18) suggests that “formative assessment is any means by which a teacher figures out what pupils are getting and what they are not understanding in the classroom, for the purpose of teaching and learning, but not for purposes of grading”. Black and Wiliam (1998a p. 8) define formative assessment as “all those activities undertaken by teachers, and/or by their students, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged”. Furtak (2003, p.4) describes the feedback process as a “feedback loop”.

These definitions confirm that formative assessment has varied definitions depending on the focus of assessment. It is either to attend to students’ needs (Bachman and Palmer 1996) or for teachers to adjust their teaching methods (Brookhart et al., (2010). This lends credence to the observation of Black and Wiliam (1998b) that a variety of activities can lead to improved pupil success. Similarly, they confirm Popham’s (2008) idea of formative assessment as a process not a test. As a process, attention should be more on qualitative insight into pupils’ understanding rather than quantitative scores (Shepard, 2008).

It is noted that formative assessment provides information about pupils’ learning processes which is used to make informed decisions on how to design the classroom learning so that learning can be optimized (Wiliam, 2011). Arguably, the distinguishing characteristic is when results are actually used to adapt the teaching to meet pupils’ needs

as suggested by Black and Wiliam (1998). Formative assessment is also used for diagnostic purposes. A special form of formative assessment in which assessment is used to obtain detailed information about individual pupils' prior knowledge, ways of reasoning, use of strategies, and misconceptions (Keeley and Tobey, 2011; Crisp, 2012; Sach, 2012).

3.3.2 Summative Assessment

Summative assessment or large-scale standardized assessments refer to the testing of learning that is administered at the end of a lesson, course or programme after a given period of instruction (e.g. term, semester, academic year). According to Black and Wiliam, (1998) summative assessment is an 'overview of previous learning' (Black and Wiliam, 1998, p.28), either by accumulating evidence over time or by testing at an end-phase or other transition time. Gipps (1994) proposes two descriptions of summative assessment, namely, 'summing-up' and 'checking-up'. She explains 'summing-up' as creating a picture of achievement based on accumulating evidence that was originally formative, example is the Records of Achievement in the United Kingdom, and 'checking-up' as tests or tasks at the end of learning.

These definitions illustrate that the objective of summative assessment is to measure the achievement level of the learner. That is: what the child can do as well as how the teacher has performed in teaching. Summative assessment informs instructional practice in a different yet equally important way as formative assessment. For grading and at times for accountability, teachers often collect and use summative assessment information. Summative and formative assessments may have the same objective which is to monitor

learning. Nevertheless, they differ in terms of how they are administered and how they are used.

3.4 Reforms in Assessment

Over the last four decades, assessment has undergone a paradigm shift. In 1994, Gipps observed the shift as moving from psychometrics to a broader model of educational assessment, and from a testing and examination culture to an assessment culture (Gipps, 1994 p. 283). Ever since, various reforms that have dominated the education agenda throughout the world identify assessment as a critical factor in raising education quality (e.g., Black and Wiliam, 1989, 2004, 2010). This statement emphasises the centrality of assessment to the teaching and learning process.

Attempts have been made to develop initiatives related to continuous assessment in different countries (Lewin and Dunne, 2000; Akyeampong, et al., 2007). These initiatives were intended to replace external examinations, or use continuous assessment to provide performance data that could either be reported separately or aggregated with external examination results. For example, in the Ghana SBA, the standardised form of continuous assessment system was to serve this purpose but, as I explained in section (2.6), this reform is yet to see its full implementation in basic schools.

This worldwide move for reform in assessment of student achievement has become critical due to the demands for new knowledge and abilities in today's world. In the global economy of the 21st century, pupils need to understand the basics, think critically and be

able to analyse and make inferences (OECD, 2011). This presupposes that assessment reform has implications for setting a more appropriate target for learners, encouraging curriculum reform and improving pedagogy as well as learning materials. There is also the need for changes to be made in the skills and knowledge required for success in understanding how pupils learn and in the relationship between assessment and teaching that are changing learning goals for pupils and schools. Consequently, Bond, Herman, and Arter (1994) emphasise the need for change in assessment strategies to tie assessment design and content to new outcomes and purposes for assessment. To meet the needs of the 21st century, calls have been made on teachers to incorporate challenging tasks which will elicit higher order skills (e.g., NCTM, 2005; Shepard, 2005; OECD/ CERI, 2005; Black et al. 2010; Tan, 2011).

In view of the well acclaimed pedagogical potential of formative assessment, there is currently a considerable global recognition and promotion for its use in classrooms (Black and Harrison, 2001; Orsmond et al., 2002; Coffey, 2003; Berry, 2011). Formative assessment is now dominant in many countries such as UK, USA, Australia, New Zealand, Barbados, Canada, Portugal, Belgium, Israel, Hon Kong, Iran, Chile, Singapore and some francophone African countries (OECD/ CERI, 2005; Hodgson and Pyle, 2010; Black et al., 2010; Tan, 2011). Several international institutions such as UNESCO and World Bank frequently make reference to the positive impact of formative assessment on teaching and learning. They are both strong advocates of formative assessment methods for the positive influence they can have on raising standards and quality of education (UNESCO, 2005).

Another important but often neglected part of assessment is the time given to pupils to think during questioning. Many studies have drawn attention to the need for teachers to provide challenging, interactive teaching and sufficient ‘wait’ time to encourage pupils to answer questions (Kirton et al., 2007; Webb and Jones 2009; Ko et al., 2013). Yet it appears teachers are still struggling to meet this goal. Pupils need time to reflect on questions asked before they can give answers. Improvements in the quality of questions have also been recognised as necessary in the assessment process (Torrance and Pryor, 2001; Dori, 2003; Gipps et al. 2005; Webb and Jones (2009).

3.5 Assessment in Mathematics Education

‘Recent changes in mathematics education draw on social constructivist approaches with emphasis on constructivist theories of learning (Gipps 1994; NCTM, 2005; Shepard 2005; Boaler, 2008). Consequently, they advocate the need for problem-solving approaches to promote pupils’ reasoning and communication skills. This is why I hold the view that assessment in mathematics need critical attention. Assessments that are aligned with and support these new ideas for effective mathematics pedagogy need to focus on important mathematical concepts, present a comprehensive view of mathematics, and include the full range of mathematical activities that reflect the important role of problem solving (Shepherd 2005; NCTM, 2005; Suurtamm et al., 2010).

From this perspective, assessment in mathematics needs to go beyond focusing on how well a student uses a memorised algorithm or procedure and must also elicit, assess and respond to pupils’ mathematical understanding and problem-solving skills. To do this,

and in an effort to minimise memorisation in mathematics classrooms, assessment strategies need to include more than the traditional practice of relying on end-of-unit tests and mid-unit quizzes, both of which tend to focus on knowledge recall and procedural learning (Shepard, 2005, Stobart, 2008). Assessment needs to be embedded in instruction and must be used to constantly prompt pupils' thinking. This requires the teacher to be a good listener and responsive to the learners' thinking. Assessment should also be seen as a constructive activity which can encourage active and lifelong learning (Stobart, 2008).

Activities which should develop mathematical understanding and insights into pupils' mathematical thinking include observations, interviews, performance tasks, reflective journals, projects, portfolios, presentations and self-assessments (Wiliam, 2007, 2009). These are considered essential parts of implementing current approaches to teaching and assessment in mathematics. Both assessment and mathematics education reforms point to the consistent messages that one short test cannot adequately assess the complex nature of pupils' mathematical thinking. This point suggests that teachers need to pay attention to pupils' mathematical thinking abilities and focus on assessment that will improve learning.

3.6 Kinds of Assessment Methods and Tools used in Mathematics Classroom

Important as it is, to understand teachers' assessment practices in mathematics, it is necessary to explore the kind of methods and tools they use in their classrooms. Research has shown that in most schools in the world, assessment in mathematics education involves merely testing and grading (Bezuk et al., 2001; Van de Walle, 2001; Lissitz and Schafer, 2002). The most frequently used assessment tools adopted by teachers are tests and quizzes (Senk, Beckmann and Thompson, 1997; Susuwele-Banda, 2005). A greater

percentage of teachers' assessments (77 %) have been devoted to tests and quizzes according to Senk et al. (1997). Further, it has emerged that test items are of low order thinking, questions that require very little reasoning. Oral and written assessment items are both important; however, it is the higher order questions that have the potential to improve pupils thinking skills as compared to lower order questioning.

Stiggins et al. (1989) found out that there was a difference between oral and written questioning in mathematics in terms of the thinking skills assessed. On the contrary, Chitsonga's (2010) study found no differences in the thinking skills required for answering between oral items and written questions that the teachers used in mathematics lessons. Both oral and written items assessed the same low order thinking skills: i.e. recall of factual information and engagement in routine procedures. Furthermore, teachers did not use open-ended assessment items. Similarly, Senk et al. (1997) observe that although tests seem to be popular with schools, teachers appear to have limited pedagogical skills. For example, Morgan and Watson (2002) revealed that, similar pupils' work were interpreted and marked differently by two teachers. It is for this reason that assessment in mathematics needs to carefully consider how teachers interpret pupils' learning during marking and other assessment practices.

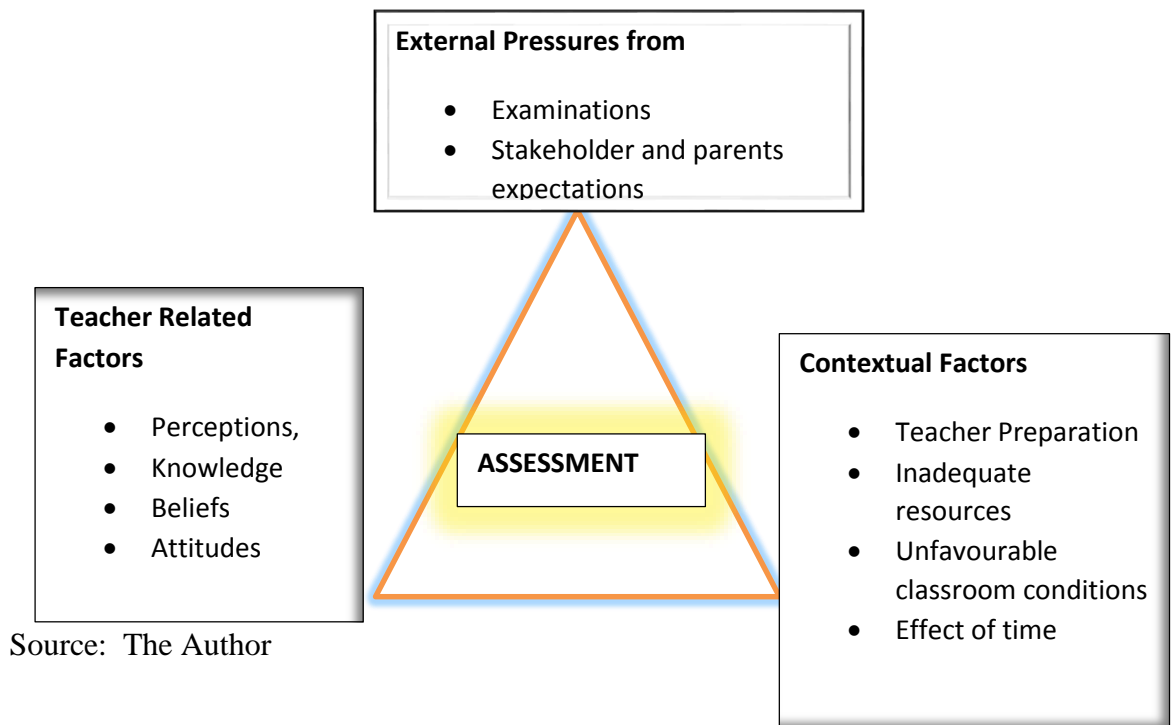
3.7 Factors Influencing Classroom Assessment Practices.

Several factors dictate the choice of assessment methods teachers employ to report on pupils' learning. I have categorised these factors into three groups:

- i. Teacher related factors which include, teachers' perceptions of assessment, teacher knowledge of subject matter and pedagogy, their conceptions of the nature of mathematics as well as their attitudes to teaching mathematics;
- ii. Contextual factors such as external pressure from examinations, teacher preparation and professional development, inadequate resources and unfavourable classroom conditions are seen to have great influence on assessment in mathematics classrooms.
- iii. External factors include examination, high stakeholder expectations

In the next section, I focus on the first set of factors. I follow with a discussion of the contextual factors in Section 3.8.

Figure 3.2: Factors Influencing Classroom Assessment



3.7.1 Teachers' Views Influencing Assessment

Teacher views on assessment are important because they provide the basis for implementing assessment in the classroom and also show ways in which it might be used

to improve teaching and learning. A study conducted by Chester and Quilter (1998) on practicing teachers' perceptions of classroom assessment, standardized testing, and alternative methods concluded that perceptions of assessment affect classroom practices. For example, those who attached less value to assessment used standardized tests most of the time. Furthermore, Chester and Quilter (1998) postulate that those teachers with negative experiences of classroom assessment and standardized testing are least likely to see the value of any form of examination. Accordingly, they recommend that in-service training should focus on helping teachers realize the value of assessment methods rather than 'how to do' assessment. A study conducted in Malawi by Susuwele Banda (2005) found teachers' perception of assessment as basically, that of testing.

3.7.2 Teacher Knowledge

Teachers' mathematics content knowledge makes a difference in their professional practice and their students' achievement (Thompson, 1992, Romberg, 2004). In addition to teachers' conceptions or beliefs about mathematics as a body of knowledge, Ernest (1991) argues that teachers' classroom practices are related to their knowledge of the subject matter (content) and of teaching (pedagogy). In recent years, teachers' knowledge of the subject that they teach has attracted increasing attention from policymakers. For instance, the USA's policy of "No Child Left Behind" which helps to provide pupils with high quality education, requires that teachers demonstrate competency through subject majors, certification, or other means. Programmes such as California's Professional Development Institute and the National Science Foundation's Math – Science Partnership are intended to provide content-focused professional development to improve teachers' subject knowledge.

The need for subject knowledge competence has arisen, at least in part, due to evidence suggesting that US teachers lack essential knowledge for teaching mathematics (e.g. Ball, 1990; Ma, 1999). However, what is important is to establish what counts as subject knowledge and how it relates to pupil achievement. In a range of studies teachers' knowledge have often been measured using proxy variables such as courses taken, degrees attained or results from basic skills tests (Ernest, 1991).

Education scholars have conceptualized pedagogical competence in terms of teachers' influence on pupil achievement. Particular, how teachers' understandings and use of subject knowledge especially in mathematics influence their teaching (Shulman, 1986; Wilson, Shulman and Richert, 1987; Ball, 1990). In this regard, mathematical teaching competence extends beyond what goes on in the classroom on basic arithmetical skills or attainment in courses taken. Teachers need to be responsive to the children's mathematical abilities by identifying their needs and supporting them to visualise mathematical concepts. That is why Ernest (1991) suggests that teachers should focus on both content knowledge and pedagogical knowledge to facilitate pupils' understanding of mathematics.

3.7.3 Teacher Beliefs

Apart from teacher knowledge, teacher beliefs are also important factors directing teaching, learning and assessment practices. Teacher belief concerning classroom assessment has been found to underpin the choice of assessment type used by teachers (Ernest, 1998; Brown, 2004; Dixon, Hawe and Parr, 2011). Beliefs consists of the

teacher's system of beliefs, conceptions, values and ideology which is sometimes referred to as the teacher's 'dispositions' (Kuh & Ball, 1986). Teacher belief is important in this study. This is because it has been found to have a powerful impact on teaching through processes such as the selection of content, styles of teaching, and modes of learning.

Evidence also exist to suggest that teachers' beliefs differ from society to society in that, conceptions tend to be consistent with the policies and cultural practices of a particular area of jurisdiction (Brown and Harris, 2009; Brown, Lake and Matters, 2009). For example, in an examination-driven environment, teachers believe that tests lead to better learning and enhance student motivation (Susuwele - Banda, 2005; Brown, Hui et al., 2011). In other contexts, teacher beliefs about assessment have been found to hinder innovation and affect pedagogical practices (Remesal, 2011). These are all issues that have implications for assessment in mathematics.

Bandura (2001) argues that the purpose of assessment, mutually and interactively influences government policy. Therefore, it is to be expected that since countries operate different education assessment systems and policies and have different cultural practices, teachers will have varying beliefs about assessment. In studies carried out in New Zealand (Brown, 2011) and Queensland, Australia (Brown, Lake and Matters, 2011), teachers specified the improvement of teaching and learning as the basic goal of assessment. In a study by Pishghadam and Shayesteh (2012) which investigated Teacher Conceptions of Assessment (TCoA) in Iran, it was found that teachers' mainly believed that assessment made pupils more accountable to their learning and thereby achieved higher performance.

Recent research has also identified inconsistencies between professed beliefs and pedagogical practices which require further investigation (Gebril and Brown, 2014). For example, in Egypt, there was the need for a new revised statistical model for the Teacher Conceptions of Assessment (TCoA) suitable in context. Egypt's high-stakes public examination system showed that the three distinct purposes for assessment could be identified as improvement, school accountability and relevance.

The improvement aspect of assessment was highly associated with evaluating pupils. While new items are needed to fully understand TCoA in Egypt, it was found out that Egyptian teachers' conceptions were more similar to those of Chinese and Hong Kong teachers' who also work in high-stakes public examination systems than the conceptions of teachers in New Zealand and Queensland, Australia who work in low-stakes, formative assessment systems. This issue about teacher beliefs is highly relevant to this study and helps to understand the impact of accountability and contexts on teacher beliefs.

3.7.4 Teachers' Conceptions of the Nature of Mathematics

Earlier notions about teachers' conceptions (knowledge and beliefs) of mathematics pedagogy have drastically changed. This is because mathematics education reforms in recent years put more emphasis on problem-solving approaches so as to promote pupils' reasoning and communication skills rather than the memorisation of facts which used to be the norm (Ernest, 1991). In order to understand the assessment practices of teachers, teacher beliefs and their conceptions of mathematics are worth noting. These will be explored thoroughly in the research as conceptions about mathematics have been found

to influence the methods teachers use to teach mathematics (Ernest, 1991a and b; Thompson, 1992; Boaler, 2002; Brown, 2004).

Many researchers have suggested differing views on how conceptions influence teachers teaching and the development of mathematics (Good, Grouws, and Ebmeier, 1983; Thompson, 1984; Brown, 1985; Cooney, 1985; Owens, 1987). Whilst some view mathematics as a static discipline, others view it as a dynamic discipline which is changing constantly as a result of new discoveries from experimentation and application (Crosswhite et al., 1986). As such, since the Greek era to date, different views on conceptions of mathematics exist. The lack of a common philosophy of mathematics has serious ramifications for both the practice and teaching of mathematics. As argued, this lack of consensus is the reason why discussions on these differing philosophies have currently ceased. There are other views that these conceptions are transmitted to pupils and help shape their ideas about the nature of mathematics (Cooney, 1987; Brown, Cooney and Jones, 1990).

One of Ernest's (1991) numerous researches came up with three possible views of the nature of an academic discipline and this aligns with that of Lakatos and Lerman. The first, called Instrumentalist, views the discipline as an isolated body of discrete skills. The second, called Platonist regards the discipline as a body of connected and unified knowledge. The third, called problem-solving-process requires inquiry that is continuously expanded by human creation. Among these three views, two of them are very distinct; the absolute (e.g., instrumentalist) and fallible (e.g., problem-solving) which I discuss in the next paragraph.

Lerman (1983) had earlier identified two alternative conceptions which he termed ‘absolutist’ and ‘fallibilist’. He suggested that learning “mathematics could be radically influenced by such views” (Lerman, 1983p 45). For the absolutist, mathematics is seen as an objective, absolute, certain and incorrigible body of knowledge, which rests on the firm foundations of deductive logic. Logicism, formalism, and to some extent, intuitionism, may be said to be absolutist (Ernest, 1998, 1991). Lerman (1983) further describes mathematics as rigid, fixed, logical, absolute, inhuman, objective, abstract and ultra-rational.

Teachers who view mathematics as absolute appear to use routine mathematical activities that demand the application of learnt procedures to produce unique, fixed and objectively right answers. The absolutists’ view may not allow questioning of the principles of mathematics or the means by which they are derived. Pupils learning in this context might reasonably understand mathematics as problematic, abstract and rigid.

The fallibilist on the other hand regards mathematics as an essentially manufactured pursuit invented by humans and therefore subject to human fallibility (Lakatos, 1978). Invariably, the absolutist view had met reactions from researchers like Lakatos (1978), Rogers (1978), Nickson (1981), Kitcher (1983) and Ernest (1991) who hold a contrasting view that it is humanly impossible to accept mathematics as purely absolute. Teachers’ philosophical positions, absolutist or a fallibilist, is to be related to how mathematics lessons are presented in the classroom and the type of tasks given to pupils (Ernest, 1991).

Teachers who embrace an instrumentalist view often look at mathematics as a sequence of fixed skills or concepts similar to the absolutist view. This view assumes that, rules

are the basic building blocks of all mathematical knowledge and all mathematical behaviour is rule-governed (Thompson, 1992, p. 136). Thompson (1992) argues that there is a consistent relationship between teachers' beliefs and instructional practices in mathematics. This is because the instrumentalist philosophy contends that mathematics is seen as static and predetermined.

According to Davis and Hersh (1986) the teacher's view of how teaching should take place in the classroom is strongly based on a teacher's understanding of the nature of mathematics, but not on beliefs or the best way to teach. These two views make the study of teachers' conceptions of the nature of mathematics very important.

Goffree (1985) presented a model for the way textbooks are developed and how teachers might employ them in the classroom to portray the nature of mathematics.

The four textbook models found were (a) the mechanistic, (b) the structuralist, (c) the empiricist, and (d) realist or applied. Three models were developed from these four characteristics and presented as follows:

Instrumental use; where the teacher uses the textbook as an instrument, following its sequence and using its suggestions for dealing with the content.

Subjective use; where the teacher uses the textbook as a guide and provides a constructive overview of the materials, followed by a further discussion of the concepts, principles, and procedures based on the teachers' experience.

Fundamental use; where the curriculum is developed from a constructive viewpoint. This fundamental approach is concerned with both the content and pedagogy involved in the teaching of mathematics.

However, in many mathematics classrooms the prevailing model is mechanistic and instrumental though modern reform documents such as the (NCTM, 1989) advocate for a realistic-fundamental situation. The enormous distance between these two models indicates the important role that the teacher's conception of the nature of mathematics can play in the teaching and learning process as it applies to school mathematics.

3.7.5 Teacher Attitude to Mathematics Teaching

An essential factor which is believed to influence greatly teachers' classroom practices is their attitude towards mathematics (Ernest, 1991). The teachers' attitude and approach to teaching have a most significant and telling effect on the success of delivery. This is due to the effect they can have on a child's attitude to mathematics and its learning (Aiken, 2000; King, 2006). Though the definition of attitude is not straightforward I find Allport's 20th century definition still relevant. Allport (1935) defines attitude as "a mental and neural state of readiness, organised through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related" (p.810). This definition, points to suggest that real life experiences are important in the formation of attitudes. In this regard, this study finds Allport's definition very important. It also shows that educational experiences cannot be downplayed in the formation of attitudes.

In the view of Ajzen (1989), "attitudes are not merely related to beliefs, they are actually a function of beliefs" (p.247). In effect, a belief about an attribute of an object reflects in the attitude held towards that object. Like other science subjects particularly in

mathematics, a belief about mathematics may directly or indirectly affect that attitude towards mathematics positively or negatively. For example, a person who enjoys mathematics may have a positive attitude towards mathematics and may not see it as ‘difficult’ but ‘fun’. On the other hand, a person with a negative attitude may not enjoy mathematics and will see mathematics as ‘difficult’ or ‘rigid’. It follows that having a positive attitude in mathematics may include liking, enjoyment and interest in mathematics or their opposites (negative attitude), which in the extreme case can include mathematics phobia (Ernest, 1991). Teacher’s confidence in the appreciation of basic mathematical concepts and the value placed on mathematics is vital. It is noted that lack of confidence can keep teachers from engaging in learning about a new curriculum or teaching approach, especially mathematics, particularly, if it requires some degree of experimentation (Drake, Spillane, and Hufferd-Ackles, 2001). The enthusiasm and abilities demonstrated by the teacher for the teaching of mathematics is crucial in enhancing positive attitudes in mathematics classrooms.

3.8 Contextual Factors

Contextual factors are very necessary in determining how successful an assessment programme could be implemented. This is because differences exist in context which may negatively or positively influence the delivery of assessment policies. Contextual factors in this study refer to those factors that have direct or indirect influence on classroom assessment in the study schools. This section discusses the three factors that emerged as important influences on teacher assessment practices—the effects of external testing and examination, time constraints and training in assessment.

3.8.1 External Testing and Examinations

Testing and examinations are important components in the teaching and learning process. They provide a means of communicating information about the profile of pupils. However, high stakes assessment can have significant impact on both teaching and learning (Black, 1998; Greaney and Hassan; 1998; Assessment Report Group, 1999; Kelleghan and Greaney, 2001; Stobart, 2008). Similarly, it can operate as a barrier to the feasibility of introducing assessment for learning (AFL) as a main approach to developing teachers' classroom practice because of its links with accountability mechanisms (Stobart, 2008). School assessment controlled by externally mandated bodies have great influence on narrowing curriculum and increasing time on task geared towards the content and format of tests (Smith and Rotenberg, 1991). The emphasis on high-stakes tests may distort teaching, which becomes too much focused on the requirements of the test at the expense of promoting deep learning by students. Much concern of this kind, related to the need of teachers to reconcile formative and summative assessment, have emerged in different studies as one of the main difficulties for the implementation of AfL (Torrance and Pryor 2001; Gipps, 2005; Kirton et al, 2007; Black and Wiliam, 2009).

Again, teachers are always under considerable pressure from the local community and parents to raise standards (Smith and Rotenberg, 1991). The heavy emphasis on assessment was evident in comments teachers made in the small scale research I conducted in which they described it as hectic, never ending, and overloaded (Oduro, 2009). Assessment dictates teaching and learning approaches and where the washback⁴ effect is negative, it can hardly play any positive role in improving quality education.

⁴ The washback or backwash effect has generally been defined as the effect of assessment on teaching and learning. This effect can be either positive or negative, according to Bachman (1990)

Examination papers are seen not to be representative of the entire curriculum. An observation from my previous workplace as a teacher revealed the common practice where teachers and pupils mostly relied on one prescribed textbook. Exam questions were predictable since they were observed to be repeated at least every three to five years. In Ghana, WAEC sells ‘model papers’, which are accessible to teachers and pupils. Teachers and pupils therefore rely on such questions and put their content to memory. This encourages pupils to memorise facts rather than using their creative thinking and independent analyses.

3.8.2 Effects of Time

Another important but often neglected part of assessment is the time given to pupils to think during questioning. Assessment administration, particularly the practice of submission of material and remedial processes is reported to take considerable teaching time and cause good lesson planning to suffer. Difficulties and challenges associated with time are more pronounced in developing countries, such as Ghana where class size is huge and learning materials inadequate. Time has been identified as one of the major factors militating against mathematics teachers’ assessment practices especially with formative assessment. Borko et al (2000) believe that new assessments (e.g. projects) will be too time-consuming as reported by Torrance and Pryor (2001), Cheung (2002), Hargreaves Earl, Schmidt, (2002), and Mabry et al. (2003). Newer forms of assessment, generally took on the average, twice as much time to prepare and twice as much time to grade (Senk et al., 1997, p. 2009). These “newer” forms of assessment might include those such as oral or written projects or computer laboratory assignments. Since teachers need much time to prepare for such newer forms of assessment, there is the tendency for some teachers to gloss over them.

Likewise, the challenges teachers face in the effective implementation of assessment policies relate to the enormous workloads for meeting the policy requirements (Ramsuran, 2006). In South Africa, clear evidence is presented on the large volumes of paper work required for the recording of assessment information (Educator Labour Relations Council [(ELRC)], 2005)]. Similar revelation on effect of teacher workload has been reported in Ghana (MOE, 2010, NESAR, 2013).

3.8.3 Training in Assessment

Lack of assessment literacy and implementation difficulties have been identified in most of the WAEC member countries (Ghana, Nigeria, Togo, Benin, Cote D' Ivoirs) since the introduction of CA about three decades ago. For instance, Quansah (2005) described the CA system as only frequent test-taking which did not really serve the critical purposes of CA. Amedahe (1998) found out that both teachers who received instructions in measurement at teacher training institutions and those who did not, failed to follow basic principles of test constructions. Similar studies, WAEC (1990 & 1993) discovered that teachers appeared to be more generous in the award of marks to their pupils in the school-based assessment than the pupils achieved in the external examination in all subjects investigated. It was also observed that teachers attempt to make CA scores usually close to the maximum mark. Emeka (1996), Alausa (1988) and Emmanuel (1990) all made similar findings. These findings raise concerns about the lack of assessment literacy among teachers and point to suggest that teachers need orientation and training in assessment. Brookhart (2003) recommends more training in assessment at both pre-service and in-service levels in order that teachers may build a repertoire of methods for high quality classroom assessment.

Research Questions

After a careful study of literature on assessment, the study addresses one main research question: ‘What are teachers’ assessment practices in mathematics classrooms in Ghana?’ This question has the following sub-questions as follows:

- (i) How do teachers perceive assessment in mathematics classrooms in Ghana?
- (ii) What kinds of assessment methods do mathematics teachers use to assess their pupils?
- (iii) How do Ghanaian teachers’ conceptions of the nature of mathematics influence their assessment practices?
- (iv) What are the factors that influence teachers’ assessment in mathematics classrooms in Ghana?

In order to answer the research questions, six participants (two headteachers and four teachers) were selected through a preliminary interview. These are discussed in detail in Chapter 4. It was expected that in answering the study’s questions, the findings would be useful for education assessment practitioners and ultimately improve the assessment system in Ghana.

3.9 Summary

In this Chapter, a review of the research literature relevant to this study is presented. Further, an overview of the different forms of assessment has been discussed. I also developed a framework for analyzing teachers’ views about assessment in order to

understand their classroom practices. Purposes and forms of assessment, reforms in assessment as well as assessment in mathematics education and practices have been discussed. I also developed a theoretical framework for understanding teachers' assessment practices by examining both teacher-related and contextual factors. The teacher-related factors include teacher views, their knowledge of subject matter and pedagogy, their beliefs and understandings of the nature of mathematics as well as their attitudes to teaching mathematics. The contextual factors comprised institutional policies such as tests, examinations and time, professional development and classroom conditions.

As earlier discussed, assessment is seen to have both formative and summative functions. Summative assessment involves gathering of evidence about pupils' learning through a range of methods including testing, quizzes and examinations at the end of a course or programme. On the contrary, formative assessment includes "all those activities undertaken by teachers, and/or by their students, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged" (Black and Wiliam, 1998). Further, it includes "those actions we undertake to obtain information about pupils' knowledge, attitudes or skills" Morris and Adamson (2010). For teachers of mathematics, assessment involves the process of gathering evidence about the student's knowledge of, ability to use, and disposition towards mathematics and making inferences from that evidence for a variety of purposes definitions (NCTM, 2005). Feedback given to pupils makes formative assessment more essential in the learning process.

Various purposes of assessment have been identified. However, the overarching purpose of assessment is giving teachers the information needed to provide quality teaching that will improve learning. The demand for knowledge in our current 21st century world has

attracted a reform in assessment. In this view, pupils now need to understand concepts especially in mathematics and think critically to be able to analyse and make inferences.

There is the need for teachers to design appropriate teaching strategies and employ assessment that will demand critical thinking and problem-solving skills. Assessment in mathematics should align with the new subject emphasis, new forms of pedagogy and also contribute to improve teaching and learning.

Teacher assessment practices are found to be influenced by a range of theoretical constructs, including their perceptions of what assessment is, their beliefs and conceptions of the nature of mathematics, their knowledge of mathematics and of teaching, and also their attitudes towards mathematics.

Teachers' assessments are found to be influenced by a number of factors which include their beliefs, knowledge of the subject, pedagogy and attitudes. In addition, it has been established that various contextual factors affect teachers' classroom assessment practices, including high-stakes external examinations as well as other institutional challenges.

Recent research put less emphasis on traditional forms of assessment whilst advocating for new approaches of assessment. Yet, these new approaches are yet to be widely implemented especially in Ghana. Reforms in assessment have implications for teaching, especially in mathematics. Since mathematics education has also seen a reformation to include a focus on problem solving skills.

CHAPTER 4: RESEARCH METHODOLOGY AND METHODS

4.1 Introduction

In this chapter, I describe the research methodology and methods employed in the study. Dunne, Pryor and Yates' (2005) illustrate that research involves the complex interrelations between the physical, theoretical and contextual aspects of research projects. They assert that these processes are perpetually in contention and are inextricably linked to researcher identity. Consistent with this, the methodology for the present study integrates the process of inquiry with substantive and theoretical issues to answer the research questions.

In the next sections of this chapter, I present the research paradigm that led to positioning the study according to my ontological and epistemological assumptions. I follow it with the research design and strategies, sampling procedures, data collection methods and instruments as well as evidence from the pilot study. In the remaining sections, I discuss ethical issues and present the methods of data analysis. I conclude with a summary.

4.2 Situating the Research

Social scientists view social research through different lenses and have different interpretations of it (Cohen et al., 2007). These views – usually referred to as paradigms – influence the way any given research project is conducted. “Such paradigms are based on beliefs and/or assumptions related to views that the researcher holds on the nature of reality and knowledge construction; they are also associated with the relationship between

the researcher's area of study, the role of the values he or she holds, and the process of research itself" (Fraenkel and Wallen, 2008, p. 423). It is also clear that social science research traditionally adopted natural science methods due to belief in the existence of universal laws and objective verifiable indicators. However, the application of natural science to social science research has been challenged, resulting in the emergence of a new paradigm in social inquiry (Fraenkel and Wallen, 2008).

Although my background as a student of science and a mathematics tutor skewed my interest in favour of research paradigms that offer opportunities for experiment and hypothesis testing, in addressing the present study, I was drawn to Walsham's (2005) interpretive research methodology, which is highly acclaimed in social research and seems to be a more appropriate approach for my study. Juxtaposing this situation with my research design, this study has been aligned to subjective and interpretive approaches to make it more discursive in order to allow for a free flow of discussion and information. It therefore follows the tenets of the interpretive paradigm "where reality is what participants perceive it to be" (Taylor and Bogdan, 1984, p. 2). This study focuses attention on the meanings teachers gave to their practices in an attempt to unravel this 'reality of practice' from their perspectives. It is their conception and perspectives on assessment practices, which opens the door to the black box of teaching and learning. Through this, effective policies can be implemented to improve the outcomes of education, as I have argued previously. As a guide to the orientation of the present study, two philosophical underpinnings of research – i.e. ontology and epistemology – are explored in the ensuing sections.

4.2.1 Ontological Position

Positioning the study within an interpretive paradigm was informed by my ontological assumptions; such assumptions are concerned with that which exists and what constitutes reality. In this study, I adopt a nominalist position in accordance with my view that reality is a construct of the individual rather than of any independent external essence. In addition, objects of thought are regarded as mere words which may have various interpretations (Cohen et al., 2007; Westat, 2002). This separation from an objective reality provides the space for subjective interpretations and in this research I attempt to explore the different perspectives of my research respondents. In effect, my intention is to discover the participant's own framework of meaning whilst being careful to avoid the imposition of my own assumptions as much as possible.

4.2.2 Epistemology

Burrell and Morgan (1985) state that epistemology concerns how one might understand the world and communicate that understanding to others, as it deals with the nature of perception and the relationship between the researcher and what is known. Accordingly, the present study adopts the notion of a subjective, descriptive and interpretive position that opposes the mechanistic and reductionist view of human nature espoused by positivism. In order to understand the subjective world of human experience and to access the inner thinking and understandings of the study participants, this paradigm promotes a subjective view of the individual that is interpretive in the view of the researcher (Cohen et al., 2007). I considered such an interpretive approach most useful as it enabled the teachers to express their own views. In addition to the adoption of these philosophical

assumptions, I also examined the macro- and micro-political contexts within which the research was conducted. These aspects of the study are discussed next.

4.3 Positioning and Reflexivity

4.3.1 Macro-Political Issues

As captured by the 2008 Education Act 778 of Ghana, the Ministry of Education (MoE) has overall responsibility for providing policy direction for education in the country. This law makes the Ghana Education Service (GES) the implementing agency. The GES has decentralised offices established in all the 170 administrative districts, and each is headed by a Director of Education, whose responsibility it is to ensure high quality teaching and learning (education delivery) in schools. There is a strong top-down hierarchical power structure in the GES, which means that the command structure flows from the MoE through the GES to regions, districts, and finally to basic schools. This is why I have the opinion that teachers and school heads have limited freedom in their implementation of the national curriculum or in evaluating pupil achievements.

4.3.2 Micro-political Issues

My position as GES Mathematics Coordinator of the Teacher Education Division, National Coordinator of the Teacher Professional Development Unit, and a member of the National Education Assessment (NEA) Team certainly reflect some hierarchical power relations between the teachers and myself. However, as an insider as well as outsider, I anticipated this inevitable challenge and sought to ensure that all tensions were dispelled by striving for mutual trust and confidence between the teachers as research

participants and me, as the researcher. I tried to focus on the research activity and avoided any collegial issues. To a great extent, my position as an insider provided a distinct advantage in terms of familiarity with and understanding of the participants' culture and afforded an awareness of hidden dilemmas. I was also aware of ethical and methodological issues associated with going into a school, positioning, and disclosing my identity. Therefore, the assumption that 'insiderness' provides the researcher with greater access and deeper understanding appears to be true. However, Laberee (2002) asserts that the degree of insiderness is related to a number of critical factors that are determined by the circumstances of the moment.

In selecting schools and participants for the study, a number of issues were considered. These are my own positioning in relation to my professional identity – real and perceived, and my perceptions as well as those of the participants about the knowledge-production process (Darlington and Scott, 2002). I also recognised my own professional status as a limitation in terms of the power dynamics of the GES. I tried to negotiate and re-negotiate with the teachers for their consent in everything I did whether on one on one basis in the classroom. I assured them of confidentiality regarding the information they gave, thereby allaying any fears and suspicions.

4.4 Research Approach

4.4.1 Selection of Appropriate Research Approach

To identify appropriate methodology for the present study, I revisited my research questions in the light of the decision concerning theoretical perspective. The main question “what are teachers’ assessment practices in mathematics classrooms in Ghana?” has the following sub-question as follows:

- (i) How do teachers perceive assessment in mathematics classrooms in Ghana?
- (ii) What kinds of assessment methods do mathematics teachers use to assess their pupils?
- (iii) How do Ghanaian teachers’ conceptions of the nature of mathematics influence their assessment practices?
- (iv) What are the factors that influence teachers’ assessment in mathematics classrooms in Ghana?

In this regard, I examined three approaches to research proposed by Creswell, (2003), which are qualitative, quantitative and mixed methods. According to McKnight et al, (2002), quantitative research and statistical data mainly provide knowledge about what is happening, rather than *why* or *how* it happened. Hammersley (1992) suggests that the quantitative–qualitative divide was unreasonably created to explain methodological similarity and diversity. Furthermore, quantitative research positions the researcher outside the field of enquiry; while qualitative research is an interactive and reflexive process, an approach that suits the present study of classroom assessment in the subject of mathematics. Mixed methods research also considers the knowledge for both what is

happening and *why* or *how* it happens and could be used in large scale projects as both breadth and depth of a research topic can be undertaken.

My research study lends itself to the qualitative approach as this tends to focus on single concept or phenomenon, bringing personal values into the study, studying the context or settings of participants and validating the accuracy of findings (Creswell, 2003); hence, my choice of a qualitative approach. My choice of using qualitative methods was based on the notion that it enables the researcher to observe, describe and interpret data in a given context as they derive from structural or behavioural characteristics which are peculiar to the subject of my study. Qualitative method is also well grounded in the apprehension of the subjective meaning that events hold for the individual or organisation experiencing them and the researcher's own interpretation of such means (Patton, 2002; Eisner and Pushkin, 1991; Denzin and Lincoln, 2005). In this view, the teachers' subjective meanings are important as far as understanding their assessment practices are concerned. In this regard, I formulated my research questions to elicit understanding and in-depth knowledge of teachers' views of their classroom assessment practices. By adopting a qualitative approach, my position was to allow teachers to derive their own meanings and views based on their experiences. The questions also aimed at providing an atmosphere conducive to natural conversation, and understanding the actions and experiences of teachers as they conducted classroom assessment.

4.4.2 Research Design

As defined by Denzin and Lincoln (2000, p. 22), research design should comprise "a flexible set of guidelines that connect theoretical paradigms; first, to strategies of inquiry

followed by methods of collecting empirical material.” The present study adopts a qualitative research strategy, and draws lessons from the case study research design approach following Ragin’s (1992) assertion that all studies can be considered case studies due to specificity to time and space. Other definitions portray the case study “as employing strategies that integrate the different components of a research project in a cohesive and coherent way” (Wilson and Southbury, 2009, p. 57), and investigate a contemporary phenomenon within a real-life context when the boundaries between phenomenon and context are not clearly drawn, and in which multiple sources of evidence are used (Yin, 2003).

Case studies are preferred when *how* and *why* questions are being posed, when the investigator has little control over events and when the focus is on a contemporary phenomenon with real life context (Yin, 2003). The examination of all the qualitative research traditions revealed that a case study would best fit my study. My study therefore is a case of the relationship teachers’ assessment practices have with teacher-related and contextual factors including the curriculum policies and structures. An attempt is made to capture teachers’ thoughts about assessment and the meaning they attach to it. My assumption as stated earlier is that how teachers think about assessment and its meaning is the key to how they practise assessment. Any improvement in teachers’ assessment practices without a deep understanding of the meaning they attach may cripple any reform.

4.4.3 Research strategies

This study follows a qualitative and interpretive methodology, using a case-study design and engages in activities that are framed according to the constructivist perspective on knowledge. As a phenomenological inquiry, the study employs explorative approach to gather data. Observation was the main data collection tool used in the study. This was followed by in-depth interviews and documentation. The analysis involved close reading of text and identifying how teachers in qualitatively different ways understood and practiced assessment. I collected data that provided many incidents of the categories which illuminated diversity of the dimensions under the categories. Key issues, recurrent events or activities that became categories of focus were explored and put into themes using the constant comparison method (Strauss and Corbin, 1990, Corbin and Strauss, 2008). I worked with the data and emerging model to try and establish the influence among assessment, learning and teaching.

4.4.4 Case Study Research Approach

Traditionally, case study research has examined events, collected data, analysed information, and reported the results with the end goal of describing the case under investigation fully and accurately (Demetrio, 2006). The case study has also been described as a versatile, qualitative approach which provides many opportunities for the researcher to collect evidence or supply illustrations that the reader can readily observe. Case study has been categorised into two types: single-case and multiple-case studies. A single case study can be seen as single scrutiny bound by time and activity that necessitates the collection of detailed information (Merriam, 1998). Multiple case studies are special and examine issues having a number of cases, parts, or members

when four or fifteen cases are involved (Stake, 2006) as a number of cases might involve an empirical investigation of a particular contemporary phenomenon and seek a range of multiple sources of evidence. This evidence must be collated to derive the best possible answers.

The study documents a case study of mathematics teachers' classroom assessment practices in Ghanaian basic schools in the New Juaben Municipality in the Eastern Region. The study of mathematics teachers' classroom assessment practices involved multiple cases for the different teachers who took part in the study. As a result I used various data sources in order to portray incidents in a particular situation or capture reality at close quarters, by means of a "thick description" (Stake, 1994 p.242) of the "actors" actual experiences of, thoughts about and feelings for a situation. Looking at a phenomenon, education issue, or "instance" from different angles relates to the triangulation technique, which is described in more detail later in this chapter. The following subsections describe the strategies I adopted for my research. It also explains how and why I selected two schools, and also provides details of the research sites and its participants.

4.5 Sampling Procedure

Following Merriam's (1998) suggestion that in qualitative research, sampling should be purposeful and the sample small, I employed a purposive method to select participants for this study. I selected two basic schools in the New Juaben Municipality. Within each school, the participants included two teachers (one each from primary and JHS) and a headteacher. In total, six participants were selected, four teachers and two headteachers. According to Merriam (1998), purposive sampling allows the researcher to choose a

required sample that will provide the best possible information. The purposive sampling of the schools, classes and teachers was therefore informed by the following:

- The New Juaben Municipality was chosen because it is one of the new districts identified as a model district (NIU, 2011). Model districts have peculiar characteristics. First, they have fulfilled all training requirements expected for the establishment and implementation of school/cluster-based INSET by giving orientation and training to all staff development providers. Second, such districts are seen to have exemplary leadership qualities that drive the implementation of the INSET programme. Thus, the National INSET Unit identifies such districts to give them further support and to use them as exemplars for other districts.
- The Junior High School was chosen because pupils at this level are perceived to have done enough course-work in mathematics and many of the teachers have higher level (University degree) Mathematics. At this level, pupils will also be preparing for the final Basic Education Certificate Examination (BECE) and therefore it is assumed that teachers will strive to complete the syllabus.
- The choice of the stages Basic 4 and Junior High School (JHS) 2 was to find out if there is any difference in teachers' assessment practices at these different levels. Primary school teachers were chosen to facilitate a comparison between the primary level teachers' perceptions' views and practices on assessment with that of JHS teachers.

Table: 4.1 Characteristics of Selected Participants

District. Jew Juaben Municipal Office			
Calvary School		“Obatan” School	
P4 ⁵	Teacher	Teacher	P4
JHS2 ⁶	Teacher	Teacher	JHS2
HT	Headteacher	Headteacher	

My primary criterion was to select two high performing basic schools from a list of 30 others out of the 80 basic schools in the New Juaben Municipality in the Eastern Region of Ghana. Within the two schools, four teachers (three males and one female) were selected after consultations with their headteachers and the District Training Officer (DTO). The four teachers who participated in the research study were experienced teachers with at least five years’ teaching experience. They were familiar with the basic school curriculum which emphasises formal written examinations as the major means of assessing learning. It is worth noting that teachers are also supposed to conduct frequent exercises and tests for Continuous Assessment (CA) purposes. Other criteria used included biographical data on prospective participants such as their age, academic background, work experience, and grade taught. As a female mathematics teacher, and advocate of inclusion of females in mathematics teaching myself and an advocate, I was happy that my sample included a female which had the potential to enrich the research by including views of both sexes (Ezzy, 2002).

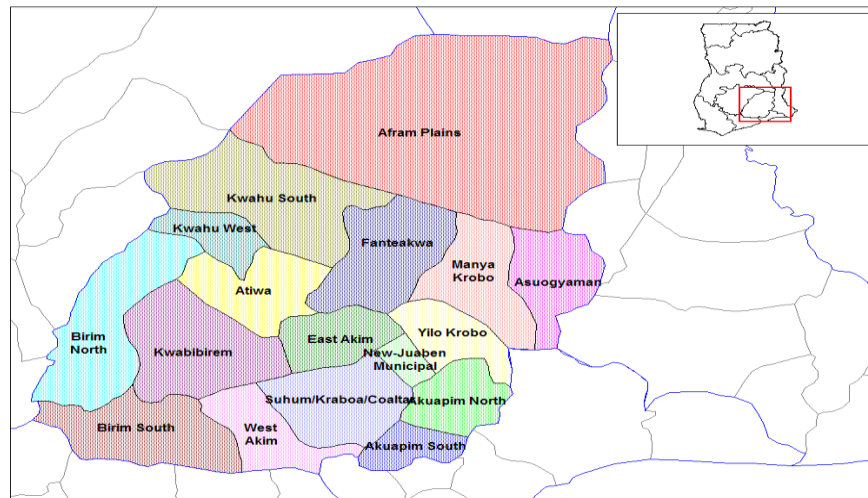
⁵ P4 means primary four.

⁶ JHS is junior high school

4.6 Research Setting

The research took place in the New Juaben Municipality (NJM). Koforidua is the municipal capital and the centre of most administrative, commercial and political activities. The Municipality has 52 settlements many of which have small population sizes and thus do not merit having essential services such as police stations, hospitals and institutions of higher learning. In this regard, most people in the rural areas, as well as other districts migrate to Koforidua to seek jobs. On the other hand, the proximity of the district to the national capital Accra also attracts a good number of people from the municipality especially the youth to the national capital in search of jobs, which are mostly non-existent. The municipality had a population of 136,768 as at the year 2012 with a growth rate of 2.6 %. Females are the dominant group and constitute 51.5% of the population and males 48.5 % of the population. The geographical location of the research site is next (fig 4.1).

Fig 4.1: Map Showing the Districts of the Eastern Region of Ghana



Source: Dickson and Benneh (2000).

The research was conducted in teachers' own classrooms with their usual pupils. This helped them quickly become accustomed to the study and reduced the likelihood of creating a tense atmosphere in the school. The involvement of individuals from different schools, who taught various grade levels, reflects my assumption that differences in mathematical backgrounds notwithstanding, all teachers may be capable of engaging in the process of assessment in the mathematics classroom.

4.6.1 Profile of Schools Visited

The two basic schools selected for the study have been assigned the pseudonyms 'Obatan' and 'Calvary' respectively. Obatan School is a relatively extensive institution situated in a big compound and surrounded by municipal offices. It accommodates a primary section that comprises five streams (A–E) operating on a shift system (where one school stream closes before the other starts). The school normally runs its timetable from 7.30 a.m. to 3.00 p.m. All the teaching staff, other than those primary teachers who teach in the shift system, remain on site until the end of the afternoon classes.

I visited Obatan and the Calvary school from the 12th May 2011 to 20th September, 2011. As stated earlier, the B Stream of Obatan School was selected on the recommendation of the headteacher (HT) and confirmed by the Circuit Supervisor of the area. The total population of the B stream was 468. All the classrooms were big with large numbers of pupils. The Primary 4 (P4) class had a population of 67 pupils. They sat on twin desks and the boys sat at the back of the class. There were 52 pupils in the JHS2 class. The teachers arranged their tables either at the back of the classroom or outside on the veranda, where they occasionally sat to mark exercises.

Calvary basic JHS was not a 'shift' school. It only operated one stream. It was one of a cluster of schools. The school opened at 8.00 a.m. and closed at 2.30 p.m. There were two classes for each grade in the primary section operating a 'shift' system whilst the JHS section had only one class for each grade. The participant profiles and number of pupils in each class have been summarised in tables 4.2 and 4.3 respectively

Table 4.2: Profile of Teachers

School	Headteachers	Grade/Form Teachers	Grade/Form
Obatan	1	1	JHS2
		1	P4
Calvary	1	1	JHS2
		1	P4
Total	2	4	6

Source: author

A total of six (6) participants were selected from the two schools. Made up of two headteachers (1 from each school) and 4 teachers (1 each from P4 and P6 respectively).

Two of the participants were females (one of them a headteacher).

The population of the primary section was higher than that of the JHS (see Table 4. 3) p.73. There are 65 pupils in primary 4 and 58 pupils in JHS 2. It is evident that class sizes in the two schools are high with an average of 60 pupils. Females outnumber the males in each class with an average of 31 females against 29 males.

Table 4.3: Number of Pupils in Each Class

School	Class/Form	Girls	Boys	Total
Obatan	JHS2	22	30	52
	P4	35	32	67
Calvary	JHS2	31	27	58
	P4	37	28	65
Total		125	117	242
Av		31	29	60.5

Source: author

4.6.2 Knowing Participants

All the participants in this study are professionals with each having at least five years' teaching experience each. They are familiar with the basic school curriculum, which emphasises formal written examination as the principal means of appraisal, although teachers are supposed to conduct many of other classroom exercises and means of testing such as continuous assessment (CA). It is expected that those who teach mathematics at the JHS level and primary levels will be in a better position to reflect on their mathematics assessment practices. Selecting teachers and their headteachers from two schools for the study is also meant to avoid any contextual peculiarities. Sam, the JHS teacher at 'Obatan' School holds a diploma in statistics and has been teaching mathematics for the past eight years. He began his career working as a general teacher (he taught all subjects to a grade) in a nearby village until he was posted to his present school. He taught in the primary section for five years and then obtained a study leave

to continue his education in statistics. Although mathematics was not originally his favourite subject, he developed a passion for it through attending a series of in-service education and training (INSET) programmes organised by the Ghana Mathematics Association.

Ebow is a young P4 teacher at the ‘Obatan’ School and has a diploma in basic education. His preferred subject is literacy and he specialises in the local language “Twi”. He teaches mathematics because he is the only teacher for his class, which means that he has to teach all subjects. Ebow started teaching at the ‘Obatan’ School right after graduating from Teacher Training College (now known as College of Education). He has since attended only one INSET programme.

Tony is the headteacher of ‘Obatan’ School. He is a very experienced teacher who has taught for more than 20 years. He has been a headteacher for 12 years but was posted to ‘Obatan’ four years ago in the same capacity. Tony trained as a teacher after completing his elementary education, having obtained the then Middle School Leaving Certificate (MSLC). After eight years of teaching, he returned to his studies and obtained a Technical Teachers’ Certificate. He taught technical skills at the JHS level for five years until he was appointed headteacher of a village school. By dint of hard work, he rose through the ranks of the GES and he is now an Assistant Director of Education.

The story was quite different in the Calvary school where both teachers selected had post-diplomas in basic education. John, the JHS teacher, had a first degree in social studies but taught mathematics out of interest because he was good at it at secondary

and college levels. He had attended three mathematics INSET sessions and was equipped with additional knowledge and teaching skills.

Awo is the P4 teacher at Calvary school. Although she was a very experienced teacher who had taught for ten years' she confessed a 'phobia' and lack of interest in mathematics, and found teaching the subject a considerable challenge. She had taught at two other schools before moving to Calvary, where she has been teaching P4 ever since. Awo started teaching as a four-year Post-Middle School Leaving Certificate holder. She later achieved a diploma in education, and has recently enrolled to pursue a post-diploma programme through distance learning. Despite her lack of interest in mathematics, she has no choice but to teach it since she too is a class teacher who is required to teach all subjects. Mansah is the headteacher of Calvary School. She holds a diploma in Basic Education and she is an experienced teacher who has taught for ten years. She has been a headteacher for only two years at Calvary. Prior to her promotion as headteacher, she had taught in two other basic schools for a total of eight years. Mansah is also an Assistant Director of Education.

4.7 Methods of Data Collection

Qualitative data collection methods were used to gather data for this study and qualitative data analysis techniques were employed to analyse them (Myles and Huberman, 1994). The data collection methods involved lesson observation; semi-structured interviews including focus group discussions (FGDs); and documentary research. These methods are further discussed in the following sections.

4.7.1 Lesson Observation

In the first phase of the study, I began my field research with lesson observations. Indeed, Creswell (1998) asserts that a researcher can collect data by conducting observations as a participant observer or non-participant observer. Observation was therefore used as a tool as it satisfied my research purpose, as espoused by Merriam (2001). While employing observation as a data collection tool, I was mindful of Merriam's (2001) caution that this method can effectively be implemented only if it is planned deliberately, recorded systematically, and subjected to checks and controls on reliability and validity.

Ary, Jacobs and Razavieh (2002) also affirm that the best way to enhance validity is to carefully define the behaviour to be observed and to train the people who will be making the observations. However, these researchers identify two sources of bias that can affect validity: observer bias and observer effect. According to Ary, Jacobs and Razavieh (2002), observer bias occurs when the observer's own perceptions and beliefs influence observations and their interpretations; while observer effects are manifested when the people being observed behave differently just because they are subjected to scrutiny. Bearing this advice in mind, I reflected on my actions constantly throughout the data collection process.

Observations concentrated on teachers' classroom assessment practices from the third week of May to the fourth week of June 2011. I had to discontinue this process in order to attend the 2011 Sussex summer school, where I discussed the data I had collected and transcribed with my supervisor. I also had the chance to outline my approach to data

analysis and coding. Lesson observations on the field resumed in the last week of August and ended in the first week of September 2011. In all, the study lasted for six weeks. There were two cycles of school visits to observe the assessment practices of each teacher in two lessons in May and June 2011, a process that was repeated in August and September. Data were collected at the primary school first followed by the JHS. This procedure was intended to minimise any observer bias in respect of the different educational levels in question. Data were categorised for observation. As far as possible, I observed all that took place during the lesson delivery and with the permission of the teacher recorded it via my digital audio device. I also took notes in my field diary.

Each primary lesson lasted for 60 minutes and the JHS lesson, for 80 minutes. There was thus a total of eight lesson observation sessions. In all, a total of 11 hours of lesson observation was recorded. During observations, any activities which sought to assess or identify pupils' difficulties or explain concepts were recorded with thick descriptions, which were transcribed for significant episodes. As much as possible, I recorded interactions between teachers and pupils, by watching closely as pupils had verbal exchanges with teacher. There were pupil–pupil interactions where they communicated or shared ideas and discussed their written work on the blackboard. Assessment activities, including the type of formative assessment implemented by the teacher, questions asked by the teacher, pupils' reactions to questions and their responses, time spent waiting for instructions, and participation in learning activities were all recorded. I also took note of the frequency and form of questioning by the teacher and the feedback obtained from pupils.

4.7.2 Interviews

Interviewing is necessary when the required data cannot be collected through observation, such as information on feelings, beliefs, perceptions and opinions (Merriam, 2001). In this study, I looked for significant episodes that revealed the interviewee's opinions on the use of formative assessment in the mathematics classroom (Appendix 2). I then followed up immediately after each lesson observation with interviews as I probed what teachers did and how they explained their actions. According to Merriam (2001), interviewing is the best method to employ when conducting an intensive case study of a few selected individuals.

The problem with using a highly structured interview format in qualitative research is that rigidly adhering to predetermined questions may not allow the researcher to capture participants' perspectives and understandings of issues (Merriam, 2001). Rather, the researcher tends to obtain reactions determined by the informant's pre-conceived notions of ideas or concepts (Merriam, 2001). Conversely, a semi-structured interview format should prompt each individual respondent to define such issues in a unique way, although it takes a skilled researcher to handle the greater flexibility demanded by the completely unstructured interview (Merriam, 2001).

These interviews involved a mixture of informal conversation and the use of an interview guide, as prescribed by Patton (1990). Accordingly, the interviews mostly took the form of informal conversations, using the guided approach in a more open and friendly manner. In this way, information was elicited that related to intangible issues such as feelings, beliefs, perceptions and opinions (Merriam, 1998). Furthermore, they provided insight into the implications of participants' experiences (Kvale, 1996), and

their views on the assessment process. Interviews were conducted about 50 to 100 metres away from the school premises (normally in a church building near the school or in a vacant room or under a tree) to avoid all physical interruptions. In such an informal atmosphere, individuals shared their ideas freely. I also tried to maintain a cordial atmosphere and decrease the power asymmetry, by maintaining eye contact, which also ensured that all actions and body movements were noted. Thus, they, by their own accord provided information regarding particular beliefs and practices, and how these related to personal experiences.

4.7.3 Focus Group Discussion

Focus group discussions (FGDs) were conducted involving teachers and headteachers in September 2011, where separate meetings were held for each school. Due to the long writing process, follow-up discussions were conducted during the latter part of the year 2013. Each discussion lasted between 45 minutes to an hour. Teachers had the opportunity to comment on their beliefs and express opinions on formative assessment practices. A second round of FDGs was held with all four teachers and the two headteachers separately to verify how reliable their first accounts were. In all, there was a total of four hours of FGD sessions, that is, an average of one hour per session.

At “Calvary” school, the FDG was conducted under a mango tree in the school compound to afford some relief from the heat in the headteacher’s office. The headteacher’s views dominated most of the discussion with the other teachers scarcely speaking at all. Realising this, I occasionally directed some questions directly to the teachers. At “Obatan” school, the headteacher’s presence did not seem to deter the teachers from freely expressing their sentiments and contributions and that enhanced the quality of

information from “Obatan” as compared to the quality of information from the “Calvary” school.

4.7.4 Documentary Research

Merriam (2001) and Creswell (2003) contend that documentary analysis can be just as rich a data source as primary observation or interviews. However, it could be argued that documentary analysis is even more profitable in that it has the potential to reveal information that interviewees do not readily share and may not be available through observation. In any case, multiple sources certainly allow for the triangulation of data, which reduces the likelihood of bias and helps to develop a deeper understanding of the phenomena under study. In the present study, the documents reviewed included teachers’ lesson plans, assessment records, and marking schemes and reports from the Assessment Services Unit (ASU). I studied plans before lesson observation in order to ascertain the rationale for classroom activities. Then I wrote down all different assessment tools used for close observation in the classroom. Documentary evidence was also used to triangulate data obtained from lesson observation. Document analysis at school level was used also to contextualise and draw conclusions with regards to the situation existing in mathematics classrooms. This approach was a learning experience and proved to be quite beneficial.

4.8 Field Notes

Field notes provide an opportunity for reflection and self-evaluation, as well as a medium for recording hunches, insights and observations (Sharkey, 2005). In the

present study, such records served as a supplement to what was recorded and/or observed during interviews, lesson observations, and other interactions between participants and myself. This afforded me the opportunity to reflect on my findings and conduct self-evaluation of the research process. Again, it also served as a means of triangulating key findings.

4.9 Pilot Study

To test the instruments designed and to identify any potential for refinement, I conducted a pilot study in a school close to the Headquarters of the National INSET Unit, Accra (my place of work) for convenience. This school was one of a cluster of five basic schools. I decided to study a group of teachers whom I had involved in a previous assignment for my International Doctorate Programme in 2011. These teachers already knew me as a researcher, and this afforded me easy access to their classrooms. That notwithstanding, I first enquired about individuals' willingness to participate in the pilot study. The biographical details I recorded included their experiences in this particular school, those gained in other schools, the educational institutions they had attended, their socio-economic status, and whether they were currently enrolled in any INSET programmes.

The pilot study highlighted the need for close attention to observation criteria and the ability to capture critical events, especially in terms of teacher–pupil interaction, as well as the teacher's questions and the responses they elicited from the class. In all classes, lesson introductions were prolonged, and this affected the length of time left to observe the main topic. This gave a clue that it would be beneficial to discuss teachers' lesson plans beforehand and ask them to apportion ample time for each section of the lesson in

the main study. Nevertheless, in the pilot, in view of the consequent difficulty in using the observation guide, I decided to concentrate on observing the lesson and making notes, in addition to using an audio recorder and asking follow-up questions in the subsequent interviews, in order to gain a deeper understanding of certain events.

4.10 Methods of Data Analysis

4.10.1 Analysing and Interpreting the Data

As a phenomenological and interpretive research project, my analysis focused on the objectives of the study within the context of each lesson observed. I began the data analysis with the transcription of lesson observations and interviews. Given the qualitative and interpretive methods employed, a systematic process that involved several readings of data was employed. The basic task involved in a systematic management of data is to extract meanings underlying various issues raised during interviews or observations.

The observation process was guided by an observation protocol (see Appendix 1). Each of the four teachers was observed two times. A total of eight observations produced data from interactions, peer work, teacher questions, monitoring and feedback given to pupils by teachers which were recorded as field notes and through a digital tape recorder. I listened to the recorded lessons on the digital tape recorder carefully and transcribed all the conversations between teacher and pupils, as well as those among students. I carefully read the transcribed data several times and constantly redefined problematic issues that emerged based on the observed data. Furthermore, observational data was triangulated

with information collected from schemes of work, lesson plans and performance tasks to explain some of the information collected that helped to situate the observational data in context. Using the constant comparison method, coding was done by comparing common themes emerging from the text (Strauss and Cobin, 1990). Data collected were analysed to identify 2 key issues: first I tried to map classroom assessment practices in the two schools using observation transcript and document analysis with the purpose of trying to understand what common practices were exhibited and how teachers carry out assessment in their classrooms. Second, identifying and interpreting key issues in detail from the data, seeking clarification and confirming patterns tentatively mapped out descriptively.

The tape-recorded interviews and discussions were transcribed verbatim from the oral to the written forms as notes then were typed out. Similar to the analysis of the observations, I critically read the transcribed text several times, marking out statements relevant to the issues being explored to identify themes and sub-themes. After, the common themes which were identified were coded by labeling concepts and phrases. Coding has been described as a means of identifying and labeling concepts and phrases in interview transcripts and field notes. Coding helps to dissect concepts and phrases meaningfully and at the same time keep the relationship between the parts intact (Miles and Huberman, 1994).

The systematic coding of every response from each participant from both the observations and interviews generated several codes for each lesson observation and interview transcript. The full codes were then grouped into themes for analysis. For example, the themes that emerged from the initial coding were as follows:

- Perceptions of assessment
- Teacher Procedures for assessment

- Use of instructional materials
- Use of mathematical terminology
- Views on mathematics

These were later amended to focus more closely on the research questions as follows:

- Perceptions of classroom assessment
- Assessment methods
- Conceptions of nature of mathematics
- Teaching mathematics
- Contextual influences on assessment practices

Throughout the following empirical chapters, data extracts from interviews and transcripts of lessons are identified with reference to the researcher (R) and pseudonyms for respondents (i.e. teachers and/or pupils). The four teachers, two headteachers, and school children involved in this study have thus been assigned the following pseudonyms:

Ebow:	Teacher at Calvary Primary School
Awo:	Teacher at Obatan Primary School
Sam:	Teacher at Calvary JHS
John:	Teacher at Obatan JHS
Mansah:	Headteacher of Calvary JHS
Tony:	Headteacher of Obatan JHS
P:	Pupil at primary school
S:	Student at JHS
WC:	Involvement of whole class

To ensure anonymity, pseudonyms are used for all teachers who participated in the study. Note that student and pupils are used interchangeably.

4.10.2 Documentary Analysis

At the national and district levels, documents analysed included GES policy papers on the establishment of the national education assessment system, and reports on NEA, SEA, and SBA from the Assessment Services Unit (ASU) at the school level. This was to identify critical issues on assessment that warranted investigation. Teachers' lesson plans, pupils' exercise books, classroom assessment forms and marking schemes were also analysed. Analysis of these documents was intended to provide additional information and for the purpose of triangulation. Document analysis at school level was also to contextualise and draw conclusions with regard to the situation existing in mathematics classrooms. This approach was a learning experience and proved to be quite beneficial: as I transcribed the data, themes began to emerge.

4.10.3 Trustworthiness or Reliability of Data

Qualitative data production, analysis and interpretation are sometimes viewed as lacking in rigour due to the usually small samples utilised, which are normally not considered to be representative. The potential for bias lies in the fact that the "researcher brings a construction of reality to the research situation which interacts with other people's constructions or interpretation of the phenomenon being studied" (Merriam, 1998, pp. 22 - 23). Consequently, qualitative researchers feel obliged to address the standards of quality and trustworthiness of their findings in their work. Denzin and Lincoln (2005) as quoted in Trochim (2008) propose four criteria for judging the soundness of qualitative research as opposed to quantitative research, which are shown in Table 4.4.

Table 4.4: Qualitative versus Quantitative Validity

Traditional Criteria for Judging Quantitative Research	Alternative Criteria for Judging Qualitative Research
Internal Validity	Credibility
External Validity	Transferability
Reliability	Dependability
Objectivity	Confirmability

Source: Trochim, (2008) [Research Methods Knowledge Base
www.socialresearchmethods.net/kb/qualval.php](http://www.socialresearchmethods.net/kb/qualval.php).

Credibility, Transferability, Dependability and Confirmability

Credibility: Credibility refers to internal coherence of the data in relation to the findings, interpretations, and recommendations. The credibility criterion involves establishing that the result of the qualitative research is credible from the perspective of the participant. From this perspective, the purpose of qualitative research is to describe or understand the phenomena of interest from the participants' point of view. I telephoned the teachers in the study to check the accuracy of facts and observations that took place as data collection segued into data analysis. This crosschecking process was necessary to maintain reflexivity by encouraging self-awareness and self-correction. After the initial write-up of the study, feedback on some of the findings was sought in the field from the teachers I studied, my colleagues on the International Professional Doctorate programme at Sussex as well as other teachers in the study schools who did not participate in the study.

Apart from the peer reviews, I organised seminars, conferences and validation meetings with participants of the study. At least two persons from each research site were asked to confirm the accuracy of my observations. They were also asked to comment on whether my interpretations were meaningful to them. This process provided participant validation of the findings.

Furthermore, I had frequent debriefing sessions with my supervisors on all the tools developed namely observation protocol and interview guides and on my developing ideas, emerging analysis and interpretations. I also presented my research to the scrutiny of my peers, that is, other lecturers at the Education Faculty of the University of Cape Coast, Ghana for their comments and refinements. Instruments were then trial tested at a micro level of three (3) teachers in a basic school in Accra. Triangulation was a means of corroboration, which allowed me to be more confident of the study conclusions. Likewise, at various stages, I shared my work with other doctoral students within the Department of Education.

Finally, in addition, my own personal reflections also supplemented data from the field. To enhance rigour in the quest for verification (Strauss & Corbin, 1990), I conducted negative case analysis involving re-examination of every case, after the initial analysis was completed. I had to find out whether the characteristics or properties of the emergent themes were applicable to all cases. The peer reviews indicated no negative cases or disconfirming evidence, therefore I considered the analysis complete. Likewise, with the help of my reflective journal, I tried to be reflexive of my researcher position which made me question the very basis a pure positivist perspective from which I started.

Confirmability: confirmability replaces objectivity and refers to the degree to which results can be confirmed or corroborated by others. Since, it implies an objective reality, such a stance is problematic with a qualitative/interpretive paradigm. I used data triangulation to emphasise confirmability, that is, I gathered data from multiple sources and multiple methods – in particular, interviews (supplemented with focus group discussions), observations of lessons, and document reviews. Both observations and interviews took a lot of time but I was careful not to rush and took my time throughout the study to determine critical incidents. The difficulty was drawing from the data

transcribed to write the research report. This difficulty was minimised by constructing compelling narratives and including them in the report. The emerging themes formed part of the results (Chapters 5, 6 and 7). Field observations were done during the same period as the interviews. I conducted the observations first and followed immediately with the interviews. I had to determine the extent to which what was observed stacked up against what was said in interviews whilst making cross-referencing with the document review.

Transferability: transferability refers to external validity or the extent to which findings from one study are applicable to another context. My study presented findings with ‘thick’ descriptions of teachers’ assessment practices. I elucidated all the research process from data collection, context of the study to production of the final report. This richness of detail is to enable the reader to determine a judgment regarding transfer from my study to theirs.

Dependability: Denzin & Lincoln (1994) refer to dependability as the stability of the findings over time. In view of this, an audit trail was used to accomplish dependability and confirmability simultaneously (Lincoln & Guba, 1985; Padgett, 1998). I invited peer reviews, that is, my colleagues on the International Doctoral programme who demonstrated their understanding of the research process and the coding method of analysis from the transcription stage to theory. My two supervisors also endorsed the analysis by a continuous refinement of the analytical report. Differences in our perspectives were resolved. The overall agreement between the “auditors” (supervisors and colleagues) and I about my analysis, as reflected along the trail, convinced me that my study was sound with respect to the findings and conclusions.

4.11 Ethical Considerations

An interpretive study demands a great deal of attention to ethical considerations. The first consideration involved my familiarity with the research site and coupled with the power dynamics that were likely to influence my relations with the participants. However, as noted earlier, I had privileged access to the teachers and all six of them voluntarily consented to take part in the study. The nature of this small-scale study initially posed challenges for teachers in terms of critically engaging in discourse. Consequently, I constantly had to negotiate access to participants. The consent was sought of all ‘gatekeepers’: the Municipal Director of Education, circuit supervisors⁷ (CSs), and the headteachers of study schools as well as the teachers who directly participated in the study. However, I sought to smooth the process by adopting the following three major ethical considerations identified by Cohen, Manion and Keith (2007): (i) informed consent, (ii) confidentiality, and (iii) consequences of the interview

The basis for ethical decision making in social research, include a commitment to participants’ rights (e.g., the protection of privacy); a commitment to ‘respect’ for participants; a commitment to knowledge (or the right for others to know e.g., how specific organisations operate); a commitment to the promotion of respect for social science (i.e., to avoid ‘spoiling the field’); and, protecting the researcher (e.g. from litigation) (see Alderson, 2004; Homan, 1991; Homan and Bulmer, 1982). From this advice, I reflected on my own processes of gaining consent and gathering information. I also kept a research diary to enable self-triangulation of data interpretation. This ensured

⁷ Circuit Supervisors (CSs) are in charge of circuits of about 15 to 20 basic schools and they offer support to teachers.

that my experience as a long-serving mathematics teacher did not interfere with the gathering of data specific to this study.

All forms of legal requirements and regulations were complied with. Furthermore, the range of competing priorities, that is, the research interests and aims, participants' interests, and the informal and formal interests of gatekeepers were balanced. To ensure confidentiality, participants were assured of anonymity in whatever they said and did, although this was somewhat difficult to comply with absolutely due to gatekeepers' expectations. Moreover, teachers seemed to fear that headteachers might use my observations to critically appraise them. Coomber (2002) asserts that since teachers want to protect their identity, divulging any information runs counter to ethical principles. However, teachers in Ghana understand the hierarchy of authority at the GES and the education practice that makes such observations acceptable. Nevertheless, the teachers were provided with information sheets that spelt out the details of the study and the purpose of the study was discussed with all of them. Materials to be used in interviews were also disclosed to them.

In order to satisfy the ethical requirements of the University of Sussex, individuals who agreed to take part in the study signed a consent form. Parents and all other stakeholders were informed of my visits to the schools through meetings of the Parent Teacher Association (PTA) and School Management Committee (SMC). On each familiarisation visit to the schools, the headteachers introduced me to the pupils and teachers during their usual morning assembly and explained the purpose of my visit. All conventional legal requirements on research ethics were adhered to. Guided by the Data Protection Act (1988), data collected were treated with appropriate confidentiality and anonymity,

interviewees were referred to only by a unique identifier (code or pseudonym), and lists of which were stored securely and separately from the research data. All data files were kept on a secure password-protected computer that only I had access to.

4.12 Summary

This Chapter has highlighted the methodology adopted for the study. A qualitative and interpretive design was employed to provide a deeper understanding of the philosophies underpinning teachers' understanding and practices of assessment in the mathematics classroom. The research design, methodology, methods and approaches utilised for data collection and analysis have all been highlighted. Ethical issues have also been articulated.

It has identified and discussed my strategies and methodological procedures used. I adopted a case study approach in order to explore teachers' assessment experiences in basic schools. In an attempt to fill gaps in the literature, an interpretive research approach was employed to address the beliefs of teachers that underlie their choice and practice of formative assessment, with a small sample size of six participants. The chapter also discussed the use of observation, interviews and documentary research as the main data collection tools. Finally, the method I used for data analysis was explained. The next three chapters present the study findings. Chapter 5 describes teachers' perceptions of assessment and their assessment practices used. Chapter 6 looks at teacher conceptions of the nature of mathematics and Chapter 7 focuses on contextual factors that influence teachers' assessment practices.

CHAPTER 5: TEACHERS' PERCEPTIONS AND PRACTICES OF ASSESSMENT IN MATHEMATICS CLASSROOMS

5.1 Introduction

In this chapter, the qualitative data gathered from in-depth interviews and observations are analysed to illuminate teachers' views about classroom assessment. Further, teachers' classroom assessment practices and how these assessments influence teaching and learning are explored. The analysis is informed by the main research question: What are Ghanaian teachers' assessment practices in mathematics classrooms? This overarching question was deconstructed as follows:

- i) How do teachers perceive assessment in mathematics classrooms in Ghana?
- ii) What kinds of assessment methods do mathematics teachers use to assess their pupils?
- iii) How do teachers' conceptions of the nature of mathematics influence their assessment practices?
- iv) What are the factors that influence teachers' assessment practices in the mathematics classroom?

The above questions are explored in three Chapters. This Chapter addresses the first two research questions, whilst the subsequent Chapters 6 and 7 respond to the third and fourth research questions respectively. I begin this chapter with a discussion on the teachers' background in order to gain a better understanding followed by their views on assessment in subsequent sections.

To begin with, data on teachers' background collected through observations and interviews are presented in Table 5.1. In all, there were six participants in the study. These included: four teachers, Ebow and Awo for Primary Four, Sam and John for JHS and two headteachers Mansah and Tony. Of the six participants, only two (one teacher and one headteacher) were females. The teachers' professional experience ranged from 5 -21 years (see table 5.1).

Table 5.1: Participants' Teaching Experience and Grade Taught

Participant	Grade taught/position	Number of years' teaching experience
Ebow	P4	5
Awo	P4	11
Sam	JHS2	12
John	JHS2	8
Mansah	Headteacher	20
Tony	Headteacher	21

5.2 Teachers' Perception of Classroom Assessment

The focus of this analysis in this chapter is upon the teachers' perception of assessment in the context of their mathematics teaching and learning. As discussed in Chapter 3,

exploring perceptions of assessment is important as it informs the ways assessment is being used. In addition, it also shapes teachers' practices of assessment (Brown, 2004, 2008). As discussed also in section (3.7.3) mathematics teachers may perceive assessment to serve a range of purposes. Some researchers have analysed conceptions in binary opposition. For example, Wolf et al., (1991) links assessment as having opposing cultures: the testing culture and the assessment culture. Similarly, Clark et al., (1996) also see assessment as serving two opposite functions: a formative function guiding the pedagogical practices of the teacher as well as the learning process, and an accounting function addressed at taking decisions about pupils' organization and about their subsequent academic career. In this study and in line with Brown's (2008) research, I categorised teachers' conceptions of assessment as follows: assessment as testing, assessment as a tool for improving pupils' learning, assessment as a tool for improving teaching and assessment as an accountability tool. These are discussed in subsequent sections.

5.2.1 Assessment as Testing

The most dominant perception that emerged from the interviews was the notion of assessment as testing. For example, both teachers and headteachers referred to the word "assessment" when they really meant "test,"⁸ and "continuous assessment" when they meant "continuous and frequent tests." Tony, the headteacher said that continuous assessment was "giving tests more frequently during the term other than just at the end of the term, or better put, giving exercises more regularly". Two of the teachers commented as follows:

⁸Test refers to teacher-made test, quizzes, end of term or year test.

“I mostly give exercises or test after teaching. This is how I am able to know those who understood the lesson” [Ebow].

“I give my pupils test to find out how they have followed my lesson” [Awo].

Similarly John commented as:

“Pupils do not learn if there is no test so I constantly test them to be able to adjust my methodology accordingly” [John].

Teachers made no distinction between teacher made tests, quizzes and examinations. The frequency of tests suggests that less time is given to projects, and observations. Though teachers used their assessment data to inform teaching formatively, their dominant perceptions of assessment as tests (i.e., quizzes, class test and end of term or year) were consistent with their practices of assessment which I elaborate upon in section 5.3.

5.2.2 Assessment as a Tool for Improving Pupil Learning

Assessment as a means of improving pupils’ learning has been widely researched and found to be highly effective in the classroom (Black and Wiliam, 1998a and b, 2001, 2004). In this study, although assessment was largely equated with testing, all the four teachers recognised the importance of assessment for improving pupils’ learning:

“During lessons, assessment is very useful because there and then, the child is able to know whether he (sic) is on the right path or not” [John].

John’s comment portrays his view of assessment as a corrective measure. He regards the child as a beneficiary of assessment because it improves learning. Teachers who

understand the importance of assessment are more likely to adopt a systematic way of identifying and meeting the needs of pupils (Black and Wiliam, 1989). The teachers in this study did acknowledge this point and claimed that to ensure that pupils learnt, they adopted a range of assessment strategies such as asking questions, both orally and in writing, and in the use of individual pupils to explain mathematical problems on the chalkboard.

“I ask oral and written questions. I check to see what they are doing and make sure that they do the correct thing. I ask those who are good to help others” [Sam].

Ebow’s strategy follows:

“I take my time to study the class to know their background and their weaknesses. This helps me to re-arrange them in a way that I will know how to deal with them. The academically weak ones are nearer to my table, the average sit in the middle and the good ones sit to the extreme right. I do this so that I can always be very close to the weak ones and offer support” [Ebow].

Awo also devised a strategy to engage all her pupils.

“I pause to ask questions so that I will know whether they are following what I am teaching. Some of them feel shy so I have to pause and engage them” [Awo].

These teachers were evidently sensitive to importance of the classroom environment to learning. It seems that re-arranging the class or pausing to ask questions, listening to pupils' answers and creating an enabling classroom environment seem conducive to the gaining of greater understanding of lessons by pupils. I will return to this theme in section. 5.3.

5.2.3 Assessment as a Tool for Improving Teaching

The literature refers to the use of assessment to improve teaching and the evidence of this research suggests that tests and exercises in classrooms were considered the main sources for obtaining information about pupils' understanding of lessons. Where test results were positive, it implied that the pupils understood the lessons and this made the teachers to feel satisfied with their teaching and to continue with the same teaching method. On the other hand, where the test result proved negative, it informed teachers that their teaching approach was not yielding the right results, hence the need to adopt new strategies.

The teachers' self-evaluation depended on what pupils could do within a particular lesson and assessment records were also used to appraise their performance in teaching. For example, John demonstrates the general practice as per the transcript below:

“Assessment gives me the feedback of what I am doing because when I teach and give exercises I am able to understand the pupils after marking. I am able to evaluate the pupils' difficulties, I mean... their difficult areas, so that before I teach the next lesson, I try to explain those topics that they do not understand and help them to overcome” [John].

According to Sam, pupils' assessment offered him the opportunity to improve his teaching:

It helps me to assess myself. It helps me to assess the methods I use and then it gives me an idea of how effectively I have performed. Any time that I give the pupils a test. I use that assessment to assess myself as well" [Sam].

Likewise, Ebow claimed to be engaging in self-assessment by conducting tests in the classroom:

"It [classroom test] helps me to assess myself; it helps me to assess the method used and then it gives me an idea of what I have done. For example, after teaching, I have to ask myself, whether the pupils understood what I taught anytime I give pupils assessment, I use that assessment to also assess myself ... That is my way of seeing assessment. If it is okay (performance of pupils) for me, then I continue teaching the topic, but if it is not okay for me, then I think of how to improve my own teaching methodology. It gives me the feedback to know whether the children have understood what I taught them or not" [Ebow].

Teacher self-improvement through pupil assessment as demonstrated by three teachers (John, Sam and Ebow). For these teachers there is a strong relationship between their teaching methodology and teachers' self-evaluation. Pupils' assessment results constitute an important factor in teachers' self-evaluation and improvement in their teaching methodology. A negative self-evaluation provides a basis for improving teaching.

5.2.4 Assessment as a Tool for Accountability

Teachers in Ghana are involved in various assessment practices in accordance with the national and local institutional requirements. The national assessments include NEA, SEA, and BECE. At the school level (local), assessment of pupils include Continuous Assessment (CA) now referred to as School-Based Assessment (SBA) which covers

classroom tests, weekly and daily exercises, homework, projects and end of term examinations. The key stakeholders, MOE, district and circuit officers of the GES and community leaders use pupils' results as a measure of teacher effort. For example, the District Profile reports provide local level data to inform all school administrative authorities about pupils' performances which gives an overview of trends in educational achievement in the district.

This study has established that teachers kept pupils' assessment records to account for their teaching. All the four teachers expressed their frustrations when it came to accounting for their pupils' performance. Ebow and Awo in Obatan School said they reported on pupils' work to their headteachers every week. Perhaps this was why they resorted to frequent class tests. Sam and John in Calvary school also confirmed the same procedure. The Headteachers ensured that these records were kept intact and handy. Such records were made available to stakeholders on request. One headteacher remarked:

"I think assessment has its positive and negative sides. If a child is awarded marks in all classroom assignments but falls sick during the end of term examination, the continuous assessment marks could be used to assess the child's performance. You know that we have different categories of pupils, so sometimes they work better in groups. The homework, and quizzes as well as the project work, help us to know those who are doing well and vice versa. I think the marks are very useful in helping the teachers to differentiate between those who do well and those who do not. The negative aspect of assessment is that teachers manufacture marks. They fail to mark most of the exercises, and so tend to "manufacture" the marks. I have given them several warnings but they seem to be doing the same thing. When they do not mark the work of the pupils, they won't know the pupil's actual performance. This does

not give a true reflection of the pupils' performance thereby compromising the authenticity of the assessment. Pupils will not learn from their mistakes and therefore may repeat the same mistakes in their final external examination" [Mansah].

The quest for accountability unfortunately drives teachers to adopt negative practices in recording marks rather than using assessment as a tool for improving learning. Such a preoccupation with records confirms an acute awareness of pressure from parents and the education directorate demanding schools to maintain standards of accountability by keeping comprehensive records of pupils' work. This raises the question about the processes of accountability and whether this might be achieved in a different form that does not have such a negative influence on assessment for learning. According to Mansah, in Calvary School these pressures on teachers to mark exercises caused them to fabricate marks so that they can provide information on pupils on demand or in their absence. Tony the headteacher of Obatan School also remarked as follows:

"These days, schools are judged by BECE results, so teachers have to work hard to make sure that pupils do well" [Tony].

The notion of using school results as a tool for accountability certainly put pressure on the teachers in this study. There appears to be little or no evidence about the ability of schools to ensure that what teachers record reflects what pupils actually do. It appears little is done system- wide to ensure that what is generated as marks reflects learning outcomes. Akyeampong and Stephens (2000) similarly found that teachers felt pressured into assuming classroom roles that maximised pupils' chances of passing examinations which usually meant teachers adopting didactic methods of teaching.

5.2.5 Assessment Separated from Learning

Despite the strong relationship between assessment and teachers' self-evaluation as discussed earlier, another key point that emerged was a disjunction between assessment and learning. Although not articulated as strongly as other conceptions of assessment, three of the teachers in this study kept a distinction between assessment and learning. Where such a view was held, teachers reported that they conducted their assessment after they had taught their lessons.

Sam states:

“I tell my pupils to ask questions after my lessons. The time to teach is limited, so it is during the remedial lessons that we take our time to explain topics further to pupil. The syllabus is loaded and we have to complete major topics before they write the BECE” [Sam].

Similar views were expressed by Awo and Ebow. These teachers believed that there could only be adequate time for teaching if assessment was conducted as a separate activity. This is to suggest that rather than viewing teaching, learning and assessment as necessarily linked and as part of the continuous flow of classroom activity and interaction it is viewed rather as a separate and additional activity.

To summarise, the preceding discussions have captured how assessment is conceptualised by teachers and headteachers. I have presented the dominant perceptions of assessment, held by the participants which include assessment as: (i) testing, (ii) a tool for improving pupil learning, (iii) a way of improving teaching, (iv) a tool for accountability and (v) separate activity from teaching and learning. This provides a basis for understanding the way teachers practiced assessment as outlined in the next section.

5.3 Classroom Assessment Practices

This section explores the second research question which concerns the kinds of assessment methods used by mathematics teachers in practice to assess their pupils. It will enable an analysis of the extent to which the perceptions teachers hold regarding mathematics assessment are linked to their practices of assessment.

Teachers in this study used a range of formal and informal assessment practices. Formal assessment involved the use of homework, quizzes, and tests. Informal assessment involved oral questions (informal oral questions framed by teachers during teaching), monitoring, and listening to pupils' answers. I begin the analytical discussion below with informal assessment practices before moving to consider findings about formal assessment practices.

5.3.1 Informal Assessment Practices

I discussed earlier that some teachers considered assessment as a tool for improving learning (section 5.2.2). Asking pupils questions and providing them an opportunity to discuss their work were seen central to achieving this purpose. Feedback given as part of an assessment helps learners become aware of any gaps that exist between their understandings and skills required by the curriculum (or teacher) and their own current knowledge, understandings or skills (Ramaprasad, 1983; Sadler, 1989). Questions and answers were used to give feedback, facilitate discussions and refer to pupils' responses to shape lessons. Questions and answers were particularly used in the beginning of lessons and to clarify pupils' difficulties.

“I write the question on the board and then I ask pupils to show how they will solve the problem. I then allow them to express their views on how they think they can solve it. They come out with various ways of solving problems. You see, as a teacher you can even learn from them and then their methods can be used for further explanation. It then becomes easier for them to understand” [Ebow].

Although teachers used both open and closed questions, it was the latter type that was mostly used. This reflects points made in the literature about a predominance of questions that require short answers involving factual knowledge in African classrooms (Ackers, et al, 2001, NCTE, 2005). Such questions usually evoke responses that demand repetition rather than reflection or the development of higher order skills (Black and Wiliam, 1998; Madaus and Kellaghan, 1992). My observations in this study indicated that pupils either responded to closed questions in chorus or one person was called to provide the answer. Ebow explained in an interview that the chorus answers provided opportunities for all pupils to take part in the lesson. Some of the questions asked are as follows:

John: Who can give me the formula for finding the area of a circle?
 S: πr^2
 John: What is π ? The value; yes...?

There were occasions where teachers attempted to guide the pupils to reflect on what they (the pupils) knew already. Yet, questions did not go beyond the recall stage as in the example below:

John: How do you multiply $\frac{2}{3}$ and $\frac{1}{4}$?
 John: Yes....Francis.
 (Francis goes to the board and works it out)
 John: Is that correct?
 P: Yes, Sir
 John: Do you agree with Francis?
 P: (Whole class) ye- e- e – s Sir.

John: What did you learn about multiplication
 of fractions?

This is what Pimm (1998) calls gambit-strategies for classroom communication. Pupils were not required to do much thinking as the teacher gave clues and reframed questions. Only pupils, like Francis above, who were asked questions, were required to do some extra thinking. If he had been asked to justifying his answers this might have also promoted more and deeper thinking. In general, this latter scenario was not so evident all the eight lessons observed in the four classrooms (two lessons in each classroom), although a few examples were observed.

In one lesson, Awo attempted to prompt deeper conceptual work by enquiring about how pupils' were linking their practical activities on shading fractions with their conceptual understanding of the topic(s). Throughout the lesson, she paused intermittently to ask questions how and why the pupils were giving particular answers. For example:

Awo: Why do you call it half, Naomi?
Naomi: Because it is divided into two and one
 part is shaded.

Awo demonstrated the need to track pupils' understanding of what she taught. She would pause and say, "Do you understand? Are you sure?" Pupils usually gave chorus answers as "yes" whenever questions like these were asked. Though pupils usually sang the "yes" chorus to signify their understanding, teachers recognized that the chorus responses obscured a lack of understanding encountered by weaker pupils.

Another example from Ebow follows:

Ebow: If you want to write two fifths as a
 decimal, how do you go about it?
P (A pupil is called to work it out)

- Ebow: Why did you multiply the denominator by two and do the same with the numerator?
- P: So that we get the denominator to be 10.
- Ebow: Are you sure?

Ebow tried to use questions to generate general discussion as shown above. Ebow tried to ensure that all pupils in the class understood the lesson by probing further with questions such as; “*Are you sure? Is it Okay?*” By using this open questioning as his teaching methodology he allowed feedback from pupils, and was more able to see if pupils had understood what had been taught. Such questions as echoed by Ebow are indicative of the aim to track pupils’ understanding, and signify a desire to be supportive (Pimm, 1987). However, the pupils invariably answered in the affirmative to all such questions.

This is strongly a characteristic of Ghanaian classroom a tradition that in part might be due to the imbalance of power in the classroom, and the general adult–child cultural barrier that exists. In Ghana, and in many other sub-Saharan African countries (Kanu, 2005) this behaviour is deeply rooted in most cultures where children have been made to accept everything that comes from an adult as being good. In this context then, it is not surprising that pupils (and teachers) in most African countries think that the acceptable mode of teaching is engaging in a monologue to explain what has been read – a teacher directed and dominated view of the classroom. This is allied with teachers only testing pupils for recall, to see how well they can memorise the material contained in the reading (Kanu, 2005).

Evoking individual responses more clearly indicates for the teacher a pupils’ grasp of the concepts being taught and offers teachers an opportunity to devise strategies to help pupils

to understand the concept where pupils' responses indicated a lack of understanding. To elaborate from this study there was an observed lesson in which a pupil was asked to work out the problem $\frac{5}{6}$ (five sixths) divided by $\frac{2}{3}$ (two thirds). The answer given by the student was 10 over 18. In a subsequent interview with the teacher in that lesson I asked how the teacher reflected on pupils' thinking, the teacher answered:

“I realised that he had not understood the lesson. The purpose for this question was for the pupils to understand the relationship between multiplication and division, and how to get the reciprocal. I can't say they understood it and that is why I spent much time to go over that portion several times. I had to revise with them the inverse of multiplication. I also keep those with difficulty understanding the topic after class and explain things to them” [John].

While this teacher was aware of the learning difficulty, he suggested repetition as his main strategy for addressing the problem. There was no hint by John of using a different teaching methodology to further engage the pupils, for example through a mathematical investigation. This was not shown by any of the teachers in the study. John reported helping pupils to understand the algorithm of division and multiplication although he did not elaborate on their conceptual understanding of these algorithms.

As mentioned earlier, the usual dynamics of the primary classroom militate against easy communication which is important for informal assessment. The communication challenge is between teachers and pupils and especially those in the primary schools. In

some cases as I observed, code switching and code mixing⁹ across languages by teachers provided an avenue for pupils to understand concepts in their mother tongue. This is at least one effort to improve learning across a significant barrier to the active and dynamic participation of pupils in class (especially those at the primary level).

English language which is the language of instruction in Ghanaian schools seems to create a communication gap between teachers and pupils. This is because pupils in primary four have just to adjust quickly to speaking the English language whereas in class three the native languages were used more often. The teachers unanimously reported that in the event of spending long hours fruitlessly attempting to explain mathematical concepts, but to no avail, they occasionally resorted to the use of the native language for in-depth elaboration, either for the whole class or at least for those pupils particularly in need of support. The following quotations indicate how two of the teachers encouraged classroom interaction:

“There are times I have to use the local language to explain mathematical problems. To ease tension, I sometimes go down to their level and share some of their jokes. Sometimes, I call them by their nicknames and they will all laugh. I mean, I have to come down to their level or relate to them in a way so that they don’t even see me as their teacher or an adult but rather as a co-equal [Ebow]”.

As quoted in the transcript above, “Coming down to their level” suggests a struggle that teachers have in trying to explain to academic work to pupils using appropriate language and approaches that connect with pupils’ thinking and understanding. It appears that the teacher was using jokes to break the communication barrier between him and his pupils

⁹ Code switching and code mixing refer to situations where a teacher has to use the local dialect to explain concepts written in English Language.

and this strategy encouraged them to communicate with him. John describes how he has tried a similar teaching strategy:

“I think the girls ask more questions as compared to the boys. Only a few of the boys in this class are very active. The girls are more active. I don’t see any readiness on the part of the children to learn. I therefore give them encouragement to talk in class and to respond to questions by answering them,” [John].

It is interesting to note that, even though John claimed that girls asked questions in his class as compared to the boys, it later turned out that only three girls who were high achievers were vocal in the class.

Informal assessment offered teachers the opportunity to check pupils’ understanding of the subject. Besides asking for individual and choral responses to questions, John also used able peers to help pupils who were struggling. Such practices were consistent with his perception of assessment as a tool for learning as discussed in section 5.2.2. In addition John revealed:

“Sometimes, I call some individuals to the chalkboard to share their experiences with others in solving written mathematical questions. By this, pupils appear more comfortable with their peers and understand solutions better. Pupils are sometimes encouraged by a pat on the back. Through questioning, the responses pupils provide help me to know how well they have understood the lesson”. [John].

The phrase, “pupils appear more comfortable with their peers” seemed to suggest that the situation was different when it involved their teachers. Again, it seems that John was trying hard to reduce the cultural barrier that did not encourage critical engagement

between children and adults. It may be that the pat on the back was a way of ‘breaking the ice’ – so that pupils were less ‘afraid’ to engage in the lesson. However, little can be said about whether this strategy improved children’s conceptual understandings.

Likewise, Sam claimed to use questions as a basis for monitoring pupils understanding and considered the involvement of able peers as a valuable way of helping pupils who were finding it difficult to understand what he was teaching.

“During the lesson, I ask both oral and written questions. Based on the responses I get from the pupils, I am able to know whether they have understood what I taught or not. I ask those who are good to help their peers who do not understand the lesson and appear to be dull in class. The bright ones are the ones who answer questions most. Some feel shy to talk and approach me with their individual problems after the lesson. It is evident that the chorus answers given by pupils do not reflect the true scenario as far as the understanding of subjects taught are concerned” [Sam].

Pupils’ inability to talk or respond to questions can be partially attributed to “shyness” and once again, this attitude may as a result of to the cultural background and pupils’ identity relationship with their teachers. Tabulawa (1997) and others have pointed out that deeply rooted cultural assumptions have contributed to the resistance to educational change in African classrooms, particularly where this involves the idea of teacher and learner entering into dialogue and pursuing inquiries together. Thus, the impact of traditional social values and the adult - child relationship coupled with the teacher role identity on learning cannot be underestimated. In order to enhance their understanding, Sam, another teacher, used ability groupings to keep track of pupils in order to enhance their understanding:

I sometimes organise group work where pupils are able to discuss the questions I pose and share ideas with each other [Sam]

Ebow also recounted the following:

I have arranged the pupils into ability groups. I ask and give them questions based on their ability groupings. I go round to help the slow learners and take time to answer all their questions. When I am going round, I concentrate on those who are slow learners and respond to their questions with the average group, I check their work when marking. If I realise that they are getting their answers wrong then I repeat the lesson. The class is large and noisy so I have a 'policeman' who 'arrests' those who disturb in class [Ebow].

Repeating a lesson as in the case of Ebow above suggests that the teacher is trying to enhance understanding of concepts by pupils. Ebow adopts different teaching approaches to let the pupils understand. The practice of a "policeman" as a classroom management style does not provide any suggestion of enhancing learning and needs further interrogation.

To ensure that lessons were understood by all pupils in her class, Awo spent some time to offer further explanation and encouraged active participation of pupils in her class. Repeating the lesson appears to suggest that the teacher is unable either to change their approach to teaching or fail to identify exactly what pupils need to understand in order to elicit the appropriate and specific response.

"I pause for five seconds after every explanation to make sure that they understand what I say. For some of them, I have to take my time to explain a concept to them several times before they get a grasp of what is being taught. When I go round the class I make sure that pupils are not sleeping. Sometimes, they sleep if

they are not being supervised. I also make sure that no one copies from their friends”.

Although Awo went round the class to mark exercises, and ensured that pupils had the correct answers, she seemed to see the value in allowing time for the pupils to think and react. She was also concerned with active participation by pupils so as to ensure that nobody slept or copied from a classmate. The preceding discussion indicates that teachers used other methods such as observation as they went round the class, eliciting information through questioning, and using group work as well as engaging peers to assess pupils' learning. Even though as discussed earlier on in section 5.1 of this study, that teachers confused assessment with testing, in practice they did use assessment practices other than testing but were not conscious that those were assessment tools as well.

It is clear that teachers actually engaged in a series of informal assessment which is indicative of their use of formative assessment. Strengthening teachers' skills in formative assessment may enhance pupils learning.

5.3.2 Involving Pupils in Assessment

The above examples have shown attempts by teachers to actively engage pupils and Sebba et al, (2008) have also asserted that in the context of formative assessment, pupils need to participate in decisions about actions they need to take in order to progress their learning further. However, there was limited evidence of pupil involvement in assessment in this study. In interviews, teachers expressed that pupils had to learn mathematics to a level where they were sufficiently knowledgeable to assess their own learning. For various reasons, teachers did not think that pupils should be involved in assessment.

“Well, I don't think pupils understand the essence of assessment” [Mansah].

Supporting this view, John believed that pupils had to be more committed to and engage in the subject being taught in order for them to be part of the assessment process.

Pupils have no understanding when it comes to assessing others, except to mark correct or wrong [John] .

All four teachers, during interviews reported that pupils had to learn the relevant subject matter first before they could engage in any meaningful assessment. They therefore hardly involved their pupils in the assessment process. The notion is that content comes first before assessment. They also seemed to have a very myopic view of assessment. In view of this, pupils were not given any opportunity for involvement in discussions. This shows a lack of understanding of assessment. Here is an instance where one teacher made the effort to involve pupils in assessment:

Ebow: Sometimes I make the children exchange their books and mark the exercises themselves. After that those who make mistakes are made to do their corrections and then I mark the corrections.

R: How do pupils understand how they should mark? I mean the criteria for marking?

Ebow: with subjects other than mathematics, we discuss all the questions, I write the answers and then they mark only the answers. With mathematics, they have to show how they came by their answers work so that they mark accordingly. They mark the steps; step one, step two and so on as the question demands.

Pupils' involvement in assessment has consequences that reach far beyond the mere accumulation of marks. Pupils are able to internalise the characteristics of high quality work by evaluating the performance of their peers. Peer- and self-assessment by pupils have been found to be very useful in classrooms where such methodology is practiced

(Sebba et al., 2008). This is also said to encourage pupil-centered learning whereby the teacher becomes a collaborator and guide (Hammond and Collins, 1991).

It is evident here that Mansah, the headteacher as well as John and Ebow exhibited their shallow views about mathematics as very discrete and static which cannot be understood by pupils. Pupils were therefore not considered as useful in the assessment process. I have discussed teachers' informal assessment practices. In the next section, I discuss teachers' formal assessment practices.

5.3.3 Formal Assessment Practices: Marking and Grading

As discussed in section 5.2.1 and 5.2.4, my participants held testing as a primary purpose of assessment and as an accountability tool. It is not surprising then that their assessment practices indicated the primacy of marking and grading. It was observed that teachers conducted assessment in order to grade pupils' performance. Perhaps, that is why they relied mostly on tests, quizzes and exercises. Tests and quizzes were given at the end of a lesson as indicated by classroom observations whilst class exercises were mainly from text books as Ebow recounts (see 5.3.1). This is characteristic of the traditional practice in mathematics which researchers have recognised as a mainstay of current mathematics classrooms (Brookhart 2004).

It seems as though that test results were vehicles for ascertaining marks or a way of concluding the syllabus rather than being a tool for ensuring learning. It was observed that, marking pupils' work took much of the teachers' time in the classroom vis a vis teaching and pupils also appeared eager to get their work marked. Teachers' responses to

this enthusiasm on the part of pupils appeared to create a conducive environment for teaching and learning and enhance self-satisfaction on the part of the teacher. Likewise, the use of grades was identified as a major communication tool.

In the Ghanaian context, grading is essential. Assessing without assigning grades has great consequences for teachers. Given the dominance of ‘assessment as testing’ in the teachers’ perceptions as discussed in section 5.2, it is not surprising that the use of grades was observed as the major means of communicating pupils’ performance.

“When I give exercises I mostly use grading. I know that at the primary level that is what the pupils understand. I give comments such as very good, excellent and so on very few occasions to motivate them” [Ebow].

The over-emphasis of summative assessment for grading and reporting confirms the findings of previous studies (Kehr, 1999; McNair et al., 2003; Uchiyama, 2004). This widely practised means of assessing pupils appears to limit the use of feedback and teachers’ narrative comments. Grades are given because like in Ebow’s example, his perception is that pupils only understand grading and seeing their work assessed with marks. However, in grading pupils, it is important that they are made to understand why they got that grade (De Lange, 2007). While grades communicate pupils’ achievement to both parents and pupils in accessible ways, it seems to fail to communicate to pupils, useful information regarding their weak areas. It also conveys objectivity about their abilities, about mathematics itself and about teachers’ marks.

I have presented the various kinds of assessment my participants used in assessing their pupils. Formal and informal types of assessment were used. The informal assessment included oral questioning and feedback as well as monitoring of pupils' work whereas formal assessment involved testing and grading. Though formal and summative assessment dominated teachers practice, they understood assessment in learning and in accountability

5.4 Summary

This chapter has identified how teachers understood and practiced assessment in the mathematics classrooms. Teachers perceived assessment as testing and this was the most dominant view held among teachers. On the other hand, assessment was also seen as a tool for improving both pupils' learning and teachers' teaching methods. Despite the acknowledgement of assessment as a strategy for enhancing learning and teaching, assessment was also perceived as separate from learning. In addition, the teachers acknowledge that assessment results also offered the school the opportunity to be accountable to different stakeholders regarding the efforts they have put in pupils' learning.

In practice, teachers used a range of assessment methods both informal and formal. Informal practices included questions and answers, monitoring of pupils' course work, organizing pupils in groups and giving work based on abilities and involving pupils in assessment. Though two types of questions – open-ended and closed-ended - were used by teachers, the latter was mostly used. Much of teachers' efforts to keep classrooms interactive through questioning technique were thwarted by challenges with speaking the

English language. Teachers, in such instances, used code-switching to try to circumvent this barrier to communication and learning.

Formal assessment methods comprised quizzes, exercises and tests. Grading pupils' work was very common for two reasons. Teachers believed that pupils and parents understood numerical grades better than qualitative feedback. Although a range of assessment practices were used, teachers mainly focused on traditional formal assessments with limited use of informal assessment methods. The perceptions teachers held about assessment were directly related to the ways by which they practised assessment. Although the main focus of this study was on teachers' classroom assessment practices, in concert with other researches, this study found also that teachers' understanding and practices of assessment were closely linked to their conceptions. This is extensively discussed in the next chapter.

CHAPTER 6: FACTORS INFLUENCING TEACHERS'

ASSESSMENT IN MATHEMATICS CLASSROOMS

6.1 Introduction

The previous chapter analysed the ways assessment was perceived by teachers and practiced in their mathematics classrooms. As argued in the literature review (Sections 3.7.1 to 3.7.5), the conceptions teachers hold of mathematics are linked to the way and manner in which they teach the subject. Given that assessment is an important aspect of teaching, teachers' conceptions of mathematics can potentially influence the way they assess their students. In this chapter, my aim is to investigate teachers' conceptions about mathematics, using Ernest's (1989) model as a framework. This model which involves knowledge, beliefs and attitudes of mathematics teachers is found to be associated with the model of teaching adopted by these teachers in teaching the subject (Ernest, 1991). I begin the analysis with teachers' knowledge in mathematics which was exhibited in their teaching. I then follow it up with their beliefs and attitudes to mathematics and how this influenced teaching of the subject. The last section presents a cross-case analysis of teachers' conceptions of the nature of mathematics.

6.2 Teacher Knowledge of Mathematics

Ernest's (1989) model begins with the knowledge components. He argues that mathematics teachers need different types of knowledge including knowledge of mathematics and other subjects, knowledge of how to teach mathematical topics and ideas in ways that pupils can understand. He also emphasised the need for teachers to have specific knowledge of children in the school context and have adequate knowledge of

mathematics education. My analysis in this section focuses on the knowledge of teaching mathematics in other words the pedagogy or their teaching methodology. I first present the teachers' qualifications in table 6.1 in order to provide a better understanding of their teaching and assessment practices.

Table: 6.1. Teachers' Qualification and Professional Experience

	Ebow	Awo	Sam	John
Grade taught	P4	P5	JHS	JHS
Years of teaching experience	5	21	12	8
Education before teacher training	SHS	Middle School	SHS	SHS
Initial Teacher Training	Cert A 3-Year Post-Sec Teacher Training	4-Year Teacher Training	3-Year Post-Secondary Teacher Training	3-Year Post-Secondary Teacher Training
Further Training	Diploma in Basic Education	Diploma In Basic Education	Diploma In Statistics	Diploma in Basic Education
Area of Specialisation	General Arts (Post-Sec) Ghanaian Language Education	Primary Educ.	(Post-Secondary) Statistics	Diploma In Basic Education Social Studies and Maths at Post-Secondary

The summary of teachers' qualifications in mathematics as presented in table 6.1 indicates that all the teachers had basic background qualification in mathematics since it is a core subject required for entry into tertiary institutions in Ghana. While Awo and Ebow (primary school teachers) had diplomas in basic education, John and Sam, who taught at the Junior High School (JHS) level, had obtained higher qualifications in mathematics and statistics respectively. Unlike Ebow and Awo, Sam and John had qualifications in

Mathematics at the Post-Secondary level. None of the four teachers had a bachelor's degree before embarking on their teaching career, but they had improved their qualifications through distance learning and obtained university diplomas and Bachelors in Basic Education (B.Ed.). The qualifications of the teachers seemed to have a direct bearing on their knowledge of mathematics teaching which I discuss next.

6.3 Influence of Teacher Knowledge on Mathematics Teaching

Ernest (1989), drawing on Shulman (1986) considers pedagogical knowledge and the practical knowledge of teaching mathematics as important to teachers' knowledge. This section looks at the influence teacher knowledge has on their teaching. It was evident that the two primary school teachers' classroom practices portrayed their narrow understanding of mathematical procedures. The following narration presents Ebow's case as an example of low level knowledge of mathematics teaching and of basic algorithms involving percentages and division. He asked the pupils to just cancel the zeros at the end of the figures. For example, 100 divided by 20 became 50 by first cancelling the zero and diving 10 by 2. This he taught without giving them any meaningful explanation. I discussed the above episode with Ebow in a post-observation interview.

R: You told your pupils to just cancel the zeros. How sure are you that they understood why they had to cancel the zeros?

Ebow: We started with the chart, that is, 100 by 100; that is why I asked them to just cancel the zeros because that is how I understand it.

R: Did you get this understanding from college or on the job?

Ebow: It was not on the job; that was how we were taught at college.

Ebow taught in the same way as he had been instructed without exposing his pupils to a conceptual understanding of the topic, which is to identify division by 10s and 100s instead of cancelling zeros. In another instance, Ebow was teaching a lesson on changing decimals to percentages. He engaged his pupils in the use of ‘shortcut’ rules and procedures. The example below, once again demonstrates the teachers’ own lack of conceptual understanding of the subject.

“Turn it upside down, take it over to the other side, and multiply... Cross multiply... Multiply by 10 or 100... Always do to the left what you do to the right... Cancel the zeros... Shift the zero and insert a point” [Ebow].

In a follow up interview, Ebow explained that he uses this type of ‘instrumental’ approach with the aim of ‘training the minds’ of pupils. To him, being able to remember what rule (algorithm) to use at every stage of solving a mathematical problem was the right way which will lead to the right answer. Ebow’s instrumentalist approach dominated his teaching throughout his lesson. In introducing the concept of decimals, he used an instrumentally driven procedure as described above, instead of systematically allowing pupils to explore division by 10 and 100. Later, observations indicated that none of the pupils could apply the same principle to other fractions.

Current thinking suggests that assessment in mathematics needs to go beyond focusing on how well a student uses a memorised algorithm or procedure and must also elicit, assess and respond to students’ mathematical understandings (NCTM, 1995). In further discussions of his teaching, Ebow explained further that he did not specialise in mathematics in College. This point echoes Shulman’s (1986) recommendation that teachers should be assigned to areas of the curriculum in which they have formal training and certification.

To a large extent, the findings of this study appear to agree with the assertion of many researchers (e.g. Ball, 1990; Shulman, 1986; Wilson and Richert, 1987) that teacher knowledge of mathematics influences their classroom teaching practices. I present one of Ebow's lesson deliveries and teaching methodology as follows:

Ebow writes a question on the board and asks one of the pupils to solve it.

Ebow: If you want to write $\frac{2}{5}$ as a decimal

5

how do you go about it?

Ebow: What do you do Amina? I have told you that you have to multiply the denominator by a number that will make 10

Amina: Solves the problem: $\frac{2 \times 2}{5 \times 2} = \frac{4}{10} = 0.4$

Ebow: In order to get the denominator to be 100 you have to multiply by 20 and cancel the zeros at the end. Then write the decimal.

So it becomes $\frac{2}{5} = \frac{2 \times 20}{5 \times 20} = \frac{40}{100} = 0.4$

Ebow: Now try this $\frac{14}{25}$

25

Ebow then solves the problem for pupils to observe the procedure:

Ebow: Now the fraction becomes

$$\frac{14 \times 4}{25 \times 4} = \frac{56}{100}$$

Ebow: Now, how will you write $\frac{150}{200}$ as

a Hundredth decimal?

Ebow: asks another question as follows:

Ebow: This is how to solve it;

$$\frac{150}{200} = \frac{150 \div 2}{200 \div 2} = \frac{75}{100}$$

- Ebow: 'Moatease'? (Meaning, do you understand? *In a local dialect*)
- Ebow: What is the hundredth decimal for this?
- W: 0.75
- Ebow: Follow the example and work the four problems (2 to 5) in the text book page 20. The first one has been done for you.

It is evident that teachers struggle to make children understand mathematics. In part, this may be because the teachers themselves lack the skills for effective teaching. From the excerpt above, it is seen that Ebow dominated the lesson. He taught P4 pupils who had just begun to learn in the English language. Ebow seemed to be the sole initiator of ideas and activities and he dominated all discussions. His approach of constantly telling pupils what to do and what not to do, why it is done and then expecting correct answers demonstrates an absolutist¹⁰ view. The absolutist views mathematics as a body of knowledge whose truths appear to everyone to be necessary and certain.

Strict absolutists hold that mathematics is almost independent of humankind, existing as it does in its governing of nature, binding the universe together with unfailing consistency across time and space. To the absolutist, such consistency is one of the most powerful appeals of mathematics. The absolutists' view does not allow questioning of the principles of mathematics or the means by which they are derived. Ingrained in his absolutist view, for example, in line 10 Ebow says "*This is how it is solved*" and he goes ahead to solve the problem alone on the chalkboard. As I observed, pupils appeared to be passive listeners and whether they understood or not accepted all that Ebow said. Such an

¹⁰ Absolutist views of mathematics are not to describe mathematics or mathematical knowledge... thus mathematical knowledge is timeless. Superhuman... it is pure isolated which happens to be useful because of its universal validity; it is value-free and culture free, for the same reason". Ernest (1996, p.2):"

atmosphere accentuated the teacher-student imbalance of power and worked to suppress pupils' curiosity, enthusiasm and willingness to ask questions. Ebow's experience of learning to teach mathematics seemed to reflect his attitude and beliefs and also reflect how he was taught to teach mathematics, which was pointed out in chapter 5.

Observation in Awo's classroom also revealed challenges in her mode of teaching of mathematics. As seen in table 5.1, Awo has no higher qualification in mathematics and has expressed her frustrations in the subject. It is not surprising that her mistakes on basic mathematics were exposed when she taught a lesson on handling data. Her attempt to label the x- horizontal and y- vertical axes was the wrong way round. The pupils repeated what she said several times and had consequently learnt an erroneous concept by the end of the lesson. My interaction with her after the lesson revealed that she was not familiar with the topic. Although she had been coached by a colleague who explained to her how to introduce the new topic, she still made mistakes whilst teaching the subject. During interviews, Awo recounted her difficulties in mathematics:

“... I am still finding mathematics difficult. I know I am not good at mathematics. I did the 4-year teacher training course and completed in 1986. [At] that time, mathematics was not compulsory so I opted out. Little did I know that I would be meeting it again in the classroom as a teacher” [Awo].

Awo has clearly confessed her status and limitation in the knowledge of mathematics which she traces from her initial training college. It follows that the teacher training programme needs to take into account those who have interest in the subjects.

Awo herself realises her short-comings in her teaching as far as mathematics is concerned. Ball (1990) and Ma (1990) point out the significant effect of teachers' intellectual resources on pupil learning. Awo's approach of soliciting support from a colleague in

order to enhance her teaching is considered by Torrance and Pryor (1989), who point to the positive benefits of working collaboratively with other colleague teachers especially in providing encouragement and support to their peers.

This is another episode of Awo's teaching. The topic is about data collection. Awo begins as follows:

- Awo: Who can tell me the meaning of data?
 P: Facts ... information.
- Awo: We drew a table with tomatoes on the board. Now on the board we have information (talking still facing the board); we have a data or information (talking to pupils) and the distribution of tomatoes among them.
- Awo: Who can tell me the name of the first pupil?
 P: Kofi, Kwame, Esi and Amina.
- Awo: How many tomatoes belong to Kwame?
 I have told you that each of the tomato represents 10 units so you have to multiply by 10; she stressed.
- P: 50
- Awo: Why 50 because I can see only five (5).
 P: This is because each tomato represents 10 units.
 (Pupils count: 10, 20, 30, 40.....140.)

The above section conveys a message about techniques in questioning. The use of “*who can*” and “*why*” questions were used by Awo. Whilst the “*who can*” question appears to limit participation in class to only those who think they can answer the question, the “*why*” questions may provide opportunity for pupils to think deep about the question being asked. The rest of the teaching focused on finding quantities

belonging to each child on the graph. Then Awo continued by saying: Today we are going to use the graph. Now who can read what is written on the board?

- P: Representing data using block graph.
- Awo: Now I'm going to draw a line. Who can tell me the name of this line?
- P: vertical.
- Awo: What about the second line?
- P: Horizontal.
- Awo: Now who can name the axis?
(Meanwhile the axes were mislabeled. She mislabeled the horizontal(x) axis as y and the vertical horizontal(y) axis as x
- P: Naming the Vertical (x) and horizontal (y) axis.
- Awo: Now on the graph how many books does Kofi have?
- P: 5
- Awo: We now have our block graph. Looking at the graph that has the least books.

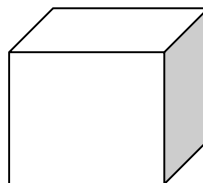
The discussion on tomatoes suddenly turned out to become that of books. There was no connection between the discussion which took place before the drawing of the table and what ensued afterwards. This brings to bear the need for connectivity of ideas in teaching. Awo seemed to lack conceptual understanding of statistics and how to make teaching more practical. It was also clear that Awo lacked knowledge of mathematics content as well as pedagogy and this was as a result of her low mathematics qualification (see 5.3).

Awo was not the only one who faced difficulties with mathematics knowledge as we can see in the following extract from Sam's class described through the scenario below.

Sam shows a box and says ... “This is a picture of a cuboid.”

Sam: How many faces has the box?

Sam: what will be the area of the box?



Two questions were asked at the same time and the pupils looked confused as the teacher explained the work on the chalkboard. Sam went on as follows:

Sam: When you calculate the area of the shaded surface what do you get if length is 6 and the width is 8?

Sam: Yes ...6 by 8 is what?

P: 48 cm.

Sam: Do you understand?

Sam: Now if the height is 5 then the volume of the cuboid is...?

Sam then introduced the formula for finding the volume of a cuboid as $V = L \times B \times H$.

Applying the formula to the previous question, the Volume = $6 \times 8 \times 5 = 240$.

“Now use the formula to find the following” he told the class as he flipped the pages of a textbook and gave them more exercises. Pupils were guided mechanically to follow procedures that would lead to the attainment of the correct answer.

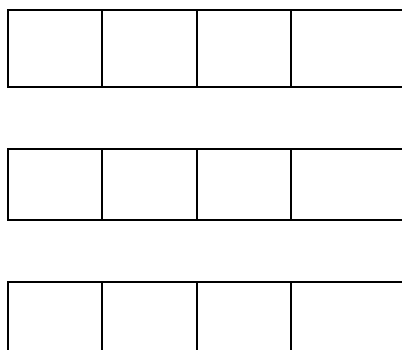
As in the illustrates at p.128, Sam employed the transmission mode of teaching and controlled most of the whole class discussions. The linear conversation whereby pupils

merely waited to respond to his questions limited his ability to elicit information from pupils Sam's advanced qualifications in mathematics notwithstanding, he still engaged in the dissemination of procedural knowledge that tended to encourage pupils to learn by rote.

In contrast to Awo and Sam, John's mathematics class was very practical and this enhanced the development of conceptual understanding of his pupils as he taught. In the example below on 'Division of whole numbers by fractions', which according to John was very challenging to pupils he allowed pupils to visualise the fractional parts practically. John divides three rectangular shapes into 4 parts and says:

Look at the question; we have 3 divided by $\frac{1}{4}$ that is; 3 divided by one quarter. He then asks pupils to divide their papers as shown in fig 6.1.

- John: How do we go about solving 3
divided by $\frac{1}{4}$?
- John: Oti, can you read what I have here?
- John: How many one-fourths are there in 3
wholes?
- Oti: There are 3 whole blocks and each block
is divided into four parts
- John: Good

Fig 6.1: A diagram showing division of 3 by $\frac{1}{4}$ 

John: This means each part is....?

W: One – fourth

John: The first part has been divided into 4 parts so each part makes what?

P: $\frac{1}{4}$

John: That fraction there is— $\frac{1}{4}$

John: Now how many of the one fourths ($\frac{1}{4}$) are in the three wholes?

P: Twelve

John: So if you divide three by one-fourth, the answer is what?

P: Twelve.

It is evident that the teaching and learning experience provided by John is quite different from those Awo and Sam's classes. This approach by John, where pupils explore connections between whole numbers and fractions is a demonstration of fallibilist (problem-solving) skills as evident from the transcript. Prompt feedback to the pupils allows learners to employ multiple approaches to explore mathematics. He also uses mathematical word problems to engage his pupils in 'mathematics talk'¹¹, thereby

¹¹ Discussions in the classroom to elicit understanding of mathematical concepts. The NCTM Standards emphasize the importance of developing mathematical language and communication in order to understand concepts rather than merely following a sequence of procedures.

creating an enabling environment for learning. Importantly the teaching approaches used by John also provided the opportunities for him to gauge the students' capabilities and learning progress. This illustrates the important and useful interconnection of teaching and assessment in mathematics classrooms.

In this section I have illustrated different approaches to the practice of mathematics teaching used by teachers. While it is evident that John and Sam have higher qualification in mathematics than Ebow and Awo, this does not totally explain their approaches to teaching. Certainly John and Sam appeared to have greater confidence in their content knowledge. However, their approaches are also quite different and offer different opportunities for assessment especially informal and formative assessment.

To further explore the influences on teachers' practice in the next section, I discuss the teachers' beliefs about mathematics and consider how this helps to shape their teaching.

6.4 Teachers' Beliefs about the Nature of Mathematics

The kind of belief a teacher has about the nature of mathematics has consequences for the teaching and learning of mathematics. Ernest (1989) argues that knowledge of mathematics alone cannot take account for the differences in the caliber of mathematics teachers. The ways teachers teach mathematics are also shaped by teachers' beliefs regarding the conceptions of mathematics as a body of knowledge. As discussed in Chapter 3, the literature suggests three views of mathematics as a discipline. First, an instrumentalist view which views a discipline as an isolated body of discrete skills, similar to the beliefs discussed by Cooney et al, (1988). Second, the Platonist view which regards a discipline as a body of connected and unified knowledge. Third, the problem-solving

view which deems a discipline as a process of inquiry that is continuously expanded by human creation. Among these three distinctions the absolute (e.g. instrumentalist) and fallible (e.g. problem-solving) views are more pronounced in shaping beliefs about mathematical knowledge and legitimate mathematics (Thompson, 1992; Romberg, 2004). I concentrate on the absolute (e.g. instrumentalist) and fallible (e.g. problem-solving) views in my discussion in this section.

Though the teachers were not asked specifically to describe their beliefs about the nature of mathematics per se, facets of mathematical conceptions or beliefs were manifested during observations and interviews which I present for each teacher.

Ebow's Case

Ebow did not see any reason why pupils should be given the opportunity to express their opinions during mathematics lessons, as expressed in an interview in the following transcript:

- R: How do you allow your pupils to express themselves in class?
- Ebow: No, I don't give pupils a chance to express themselves in the mathematics classroom. In other subjects such as social studies, children can give their opinions about issues.
- R: Why do you think this way?
- Ebow: Because, you see, this is mathematics; there is no opinion.
- R: If you allow children to express their opinions in other subjects, why not do same in mathematics too?
- Ebow: Mathematics deals with numbers and I think what we need is the correct answer.

It became clear that Ebow understood mathematics not as a coherent and connected body of knowledge but as static and unified – a bag of tools made up of an accumulation of

facts, rules and skills. He viewed mathematics as an exact discipline without any ambiguity or conflicting interpretations. This also meant that for him, doing mathematics entailed providing correct answers (absolutist). Ebow did not give pupils the opportunity to express their opinions during mathematics lessons as expressed earlier. Consistent with his expressed philosophy of mathematics, his teaching was characterised by his attempts to ‘tell’ pupils what to do rather than allowing them to explore ideas (see 6.2). This is contrary to the fallibilist view where the teacher engages in discussion, both student-student and student-teacher, since learning is socially constructed.

The literature provides examples of effective teaching that draw attention to the need for teachers to provide challenging, interactive teaching and sufficient ‘wait’ time to encourage pupils to answer questions (Kirton et al., 2007; Webb and Jones 2009; Ko et al., 2013). In Ebow’s class, pupils were not challenged with thought provoking questions. They followed and copied examples from the chalkboard as he provided several examples for them to study. He claimed that the examples given enabled pupils to have deeper understanding of mathematics. Mathematical skills, procedural knowledge, and factual knowledge are all assessable aspects of mathematics and in line with Ebow’s views of mathematics which also provide some explanation for his classroom practice. Given the consistency between Ebow’s beliefs and practices it is not surprising that in his lessons he did not include mathematical activities that would provide pupils with the opportunity “to formulate problems, reason mathematically, make connections among mathematical ideas, and communicate about mathematics” (NCTM, 1995 p. 11).

Awo's Case

Like Ebow, Awo too believed that ‘mathematics has single answers’, suggesting that she too believed in an absolutist view of mathematics as seen from her lesson in 6.3. Awo appeared preoccupied with the managerial aspects of teaching which led her to conduct her class in a way that allowed as little pupil interaction as possible. Awo’s teaching approach to mathematics was characterised by constant shouting at her pupils to stop copying from one another; she wanted to ensure that they worked independently throughout the lesson. “You see, at the BECE, one has to work independently.” She commented. Awo did not permit her pupils to help each other for two reasons, as described below:

“I don’t allow pupils to ask their friends for help. I noticed that some of the pupils collect two Ghana Cedis (GH¢2 about 6cents) from their friends as a remittance for helping them with their work. And I think this is not a good practice. Secondly, I want to prepare pupils for [the] examination. In the examination room, no one is supposed to copy from the other person. Mathematics has single answers which can easily be copied” [Awo]

Although Awo felt morally obliged to prevent pupils from extorting money from their classmates, she did not contemplate the importance of collaborative learning and peer support in the learning process. Awo believed that her diligence stopped pupils from paying “bribes” to their peers to get their exercises done for them. However, it is rather surprising that primary school children should think up this ruse in the first place. Such a situation might have arisen because of the competition for high achievement in examinations, which also led teachers to classify pupils into streams, as was observed in Awo’s class and, indeed, in all classes observed. Awo claims she wanted to prepare her

pupils for BECE by applying strict measures to encourage independent work. The implication of her action and explanation given confirms the assertion that examination and tests drive classroom actions (Black and Wiliam, 1998).

Sam's Case

Sam's belief about mathematics was similar to that of Ebow and Awo, despite his more advanced mathematical qualifications. He explained his understanding of the nature of mathematics as follows:

“Mathematics deals with a set of operations which demand specific answers and therefore only correct answers are accepted. I want the pupils to be fast, so anytime I give them work, I time them. Mathematics demands accuracy; that is why I train them to be sharp and accurate. I also have to cover all the topics in the syllabus and as such, there is no time to waste.”
[Sam].

The above explanation given by Sam appears to suggest that knowledge of the mathematical processes are of little importance. Sam seems to align with an instrumentalist view about mathematics. Sam therefore seemed to adopt teaching strategies based on an absolutist philosophy as seen in section 6.3 p. 125. Consistent with his belief that mathematics is about exactness and certainty, he taught mathematics by relying on rules and formulas and by ensuring that things were done the “right way” as presented above.

John's Case

Explaining his views about teaching mathematics, he commented as follows:

“I provide a variety of situations which will help my pupils to understand mathematics. I allow pupils to use their own procedures to solve problems and they

should be able to explain the procedures involved.”
[John]

John's espoused views about mathematics were consistent with his knowledge of teaching and this view appeared to have influenced his instructional decisions as seen in section 6.3 (p. 126). John's beliefs as well as his approach to teaching were quite distinct from that of those teachers who had an absolutist view of mathematics and applied instrumental methodology in their teaching. John engaged pupils in discussions which focused on the processes of learning mathematics rather than on providing correct answers as demonstrated by the other three teachers. For example in a topic I observed in his class which involved finding areas of surfaces, those pupils who measured along the sides of their shapes saw that they were rather measuring the perimeter as those who drew squares in their shapes or used the geo-boards or nail board (A tool for teaching shapes) and counted squares within the bounded areas understood the concept of area. However, John also adopted a pragmatic approach that included periods of a transmission approach to teaching and learning.

John stressed on procedure rather than the final answer. John was concerned about how to teach better and what would enhance pupil understanding with intermittent absolutist ideas though He tried to pose thought-provoking problems and expected pupils to think through and solve them (see 6.3). For example, he elicited ideas from individual pupils and the whole class brainstormed to find solutions. John tried to forge links between ideas, skills and 'cognitive activities' with limited investigations on one hand, and concepts on the other.

A close assessment of teachers' practices revealed that teachers appeared to ascribe to either the absolutist or fallibilist views of mathematics. However, the emphasis placed on these categories was different in the various classrooms as explained in previous sections. John also introduces mathematical ideas sometimes without the experimentation for the pupils even though he is very invested in getting pupils to understand the procedures.

Using John's classroom practice, it could be realized that the polarity between the absolutist and fallibilist may not always be the case during teaching. That is; it is not as simple as the binary split - absolutist versus fallibilist. How the teachers approach their teaching is also constrained by the demands of the curriculum and time constraints.

6.5 Teacher Attitudes

Teachers' classroom practices are shaped not only by their knowledge and conceptions of mathematics, but also by the attitudes they have about mathematics (Ernest's (1989). This refers to their liking, enjoyment and interest in mathematics as well as their confidence in their mathematical abilities. The attitudes of teachers towards mathematics were manifested in their different ways of teaching in the classrooms. Whilst the teachers who had either Post-Secondary or higher level training in mathematics and statistics (John and Sam) (see section 6.3) respectively had positive attitudes towards the teaching of mathematics, the others who had lower educational backgrounds in mathematics had negative attitudes. For the primary school teachers Ebou and Awo mathematics was seen as a difficult subject that generated negative feelings for them. This finding confirms other evidence that primary school teachers hold narrow conceptions of the nature of mathematics (Balacheff, 1990; Boaler, 2008).

Ebow and Awo reflected upon incidents in which they recalled negative feelings about learning or doing mathematics. :

“My interest is in Ghanaian language and I have to teach mathematics as the class teacher. I am therefore forced under this circumstance to design some strategies to teach mathematics. It has not been easy but I always try to do my best. When I am in difficulty, I always consult the JHS teacher who teaches mathematics” [Ebow].

As discussed earlier in (6.3), Awo was aware that she made numerous mistakes whilst teaching. This explains why she opted to consult other teachers for help. She realises the need for pupils to pass mathematics as a pre-requisite for further studies. During the interview, both Awo and Ebow admitted that they were frustrated by the prospect of having to teach mathematics. Yet, regardless of the challenges that this presented, they seemed to appreciate the importance of helping their pupils to attain a good grounding in the subject if they were to pass their examinations. For example, they both reported that they always ensured that the pupils did their homework and during observations, I witnessed that they discussed homework with their pupils before the start of the day’s lesson.

One positive practice that emerged was the collaborative efforts made by teachers in the JHS to give support to their colleagues in the primary school. They were able to do this by explaining issues as narrated by Awo in the following extract:

“Anytime I am in difficulty, I approach the mathematics teacher at the JHS to help me. I accept the fact that I am not very good at mathematics, so I always try to learn what I have to teach before I go to the classroom” [Awo].

Ebow reported a similar experience. While the attitudes of the primary teachers to mathematics was rather negative, the ways they asked and were given support from colleagues shows a very positive and professional attitude to their teaching and their willingness to keep learning.

Unlike Ebow and Awo, John showed a positive attitude towards teaching mathematics. Though his higher level degree was in Social Studies, he had a solid foundational knowledge in mathematics during his initial years of training as a teacher. The following extract gives an indication of his approach to the teaching of mathematics which exemplifies a positive attitude towards the subject:

“I like mathematics because it provides a platform for further studies in other disciplines. In my teaching, I like doing practical demonstration. Sometimes, I use word problems to help pupils to deduce answers. When pupils understand what they have to do, then half of the problem is solved. At times, too, I put them in groups for them to discuss and come out with appropriate solutions. When they are in their groups, they learn from each other. Children learn when they see and touch objects; so that is why I use objects, tables, diagrams and other teaching aids to help them understand what I teach.”[John]

It may be inferred from John’s description of his teaching methodology that he encouraged his pupils to learn by moving from the known to the unknown, as pupils were able to visualize the fractional parts in three wholes from the concrete to the abstract when he represented the fractional parts with mathematical symbols. He used practical tools other than abstract materials to facilitate an easy understanding of concepts by pupils. Importantly, he engaged pupils in group work to offer them the opportunity to share ideas.

6.6 Cross Case Analysis of Teachers' Knowledge, Beliefs and Attitudes to Mathematics

A close comparison of the four teachers revealed some common strands. The two primary teachers who had low qualification in mathematics exhibited narrow conceptions of mathematics which was consistent with their beliefs and teaching of mathematics. These primary teachers also appeared to have negative attitudes towards the teaching of mathematics as they claimed to have less interest in the subject (see section 6. 5). On the other hand the two JHS teachers who had relatively higher qualifications in mathematics had more sophisticated conceptions of mathematics and positive attitudes towards the subject as well. However, whilst John's teaching approach was consistent with his conception about mathematics, it seemed different in the case of Sam. John understood mathematics as fallibilist and tried to adopt constructivist approaches to his teaching whereas Sam held narrow absolutist conceptions of mathematics and taught in a limiting way, not allowing interaction with pupils.

All the three teachers (Ebow, Awo and Sam) exhibited more absolutist ideas than John. They appeared to regard mathematics teaching as important for 'training the mind' ('pure, hierarchically structured' body of objective knowledge.) and for work preparation, in this case preparation for examination. John, the other mathematics teacher, on the other hand believed and showed that personal exploration by pupils was to be facilitated (fallibilist), an approach that Ebow did not seem to be highly in favour of as no child could express an opinion in his classroom. Amongst the three teachers in this study, the absolutist style dominated.

6.7 Summary

In this chapter, the findings demonstrate that teachers' classroom practices reflected their beliefs and conceptions of mathematics. It was apparent that the philosophies and beliefs that teachers held of mathematics penetrated their classroom teaching. It was noted that teachers' pedagogical styles were influenced by their personal responses to these philosophical traditions, beliefs about mathematics and its teaching and learning, thereby the corresponding assessment practices observed.

With specific reference to the main focus of this research, since the absolutist view dominated, there was little connection seen between teaching and assessment (see Chapter 5). This undoubtedly presents challenges to the new dispensation of introducing learner-centered methodologies and new assessment strategies as prescribed in the school curriculum.

In contexts of curriculum change it would seem imperative that teachers' conceptions, beliefs and pedagogies are analysed and understood within the larger cultural context. The lack of such understandings is likely to inhibit the process of change at all levels of teaching, learning and assessment. So far, in this study, the focus has been on the classroom and teacher views and practices as they influence teaching, learning and assessment in mathematics in Ghana. However as Tabulawa, 1997 and Kanu, 2005 assert there are wider cultural factors at play that work to resist innovation and change in teaching.

It has been argued that deeply rooted cultural assumptions have contributed to the resistance to educational change in African classrooms, particularly where this involves the idea of teacher and learner entering into dialogue and pursuing inquiries together

especially in African countries (Tabulawa, 1997; Kanu, 2005). As this teacher-student relationship is at the heart of learner centered pedagogies there is a potential constraining influence on the classroom environment and the influence of the cultural context that I turn to in the next chapter.

CHAPTER 7: CONTEXTUAL FACTORS THAT INFLUENCE ASSESSMENT IN THE MATHEMATICS CLASSROOM

7.1 Introduction

In the preceding two chapters, I identified that teacher perceptions of assessment and their conceptions of the nature of mathematics were related to their classroom practices. Beyond these two factors relating to the teachers themselves, there are contextual influences on the ways teachers perceive and practise assessment in mathematics classrooms. These are related to institutional policies, professional development and classroom conditions. This chapter focuses on these contextual influences.

To situate this chapter in context, it is important to note that in Ghana the Anamuah Mensah report (2008, 2009) has called for the diversion of the education system away from frequent examinations. However, this shift seems to have encountered various challenges. My study has established three of these factors which I explore in the subsequent sections. I first discuss a range of prevailing policies which have a bearing on the ways teachers perceive and practise assessment (7.2). This is followed by an analysis of the professional support and development opportunities available to teachers for developing skills in mathematics assessment (7.3). Finally, I discuss the classroom conditions which influence teachers' practices when it comes to assessing pupils (7.4). Although all three factors are interrelated, I have kept them separate for analytic clarity.

7.2 Policy Influences on Assessment

In Chapter one, I discussed the 2007 education reform which in part focused on reducing the impact of traditional tests and examination-oriented education and sought to replace it with education that enhances critical thinking and problem-solving. My data shows three other existing policies which are in tension with the implementation of the above policy. I examine the following policies in this section: the Basic Education Certificate Examination (BECE), national and district level assessments, and the ‘shift’ system.

7.2.1 Basic Education Certificate Examination (BECE)

The BECE, a high-stakes examination, which takes place at the end of nine years of basic education in Ghana, seems to be related to the strong emphasis teachers in this study placed on testing, both in their narratives and practices. Results obtained by candidates in this examination are used for selection into High Schools. In view of the competitive nature of placement into the so called well-endowed schools, schools as well as teachers place strong emphasis on this examination. Consequently, all the four teachers (especially, those in JHS, Sam and John) were engaged in a series of activities in preparation towards the BECE.

“The BECE is now our focus because the expectation of parents is that their wards will pass exams and gain admission into good senior high schools. We therefore need a series of tests to assess their progress” [Sam].

Given the high-stakes nature of this examination (BECE), it is not surprising that teachers focus on preparing pupils for passing BECE. This focus, however, seems to distract

teachers' attention from other forms of classroom assessment. Tony, one of the head teachers, explained why teachers and pupils alike were obsessed with achieving high performance in this examination:

“These days, schools are judged by examination results. There have been recent attacks on teachers and head teachers by some communities demanding the release and transfer of teachers from their schools for the poor performance of their pupils; therefore we have to do what parents want. Parents are interested in higher examination results so that their wards can get access to well-endowed schools. So they buy examination syllabus from the Examinations Council for their wards to ensure that no stone is left unturned. So we also follow the examination syllabus to help the JHS3 students.” [Tony].

Tony described how low-performing schools suffer serious public scrutiny and low public participation. Selection and placement into High School forces schools to improve upon their performance not only for their own goodwill, but also to avoid incurring public displeasure. In effect, considerable time is spent in preparing pupils for either a national or district examination because of parental demands on schools to ensure high examination results for their children. Any deviation from the public's expectation has serious repercussions for teachers and the schools in question. To meet the above expectation, teachers placed primacy on speed and accuracy. According to Sam:

“... in order to help pupils pass BECE, an attempt is made to teach all the topics in the syllabus. “We therefore focus on speed and accuracy. This practice helps us to complete the syllabus”.

All four teachers acknowledged the pressure on them to complete the syllabus hastily, believing that it will improve students' performance. Smith and Rotenberg (1991) equate such a situation (where teachers rush to complete the syllabus) with the narrowing of the school curriculum, and one which depicts pupils as recipients of knowledge and

encourages rote memorisation. This appears to clash with the intention of the 2007 reform, which requires that children should be educated to reason and apply the knowledge they acquire in solving problems in everyday life situations. The NCTM equity standard requires all pupils to be provided with opportunities which will enable them to demonstrate their “mathematical power.” Among other things, the standard indicates that pupils’ individual differences must be taken into account when thinking about assessments and should allow each student to demonstrate what he or she knows. The standard also states that “assessors should be open to alternative solutions” (NCTM, 1995, p. 15), taking into account students’ backgrounds and experiences. When teachers rush through the syllabus as Sam declared above, the equity standard of assessment may be difficult to achieve. Again assessing pupils with special/specific needs is very likely to be left out.

7.2.2 National and District Assessments

National and district level assessments take place in schools as a way of monitoring progress of learning. Whilst the Ghana National Education Assessment (NEA) is biannually conducted, the School Education Assessment (SEA) and district assessments are conducted annually. NEA and SEA are externally conducted examinations to evaluate the education system. These assessments seem to influence the ways by which teachers perceive and assess students. All the four teachers acknowledged the negative influence of the national and district level examinations on their assessment practices. A remark by Sam demonstrates:

“We conduct tests and examinations at the school level. The district office also organises district mock examinations which put a lot of pressure on us to finish the syllabus. Some schools are also selected at

random for the National Education Assessment (NEA) so we are I mean we are err... doing tests all the time which makes teaching less effective.”

[Sam]

The overemphasis on external examinations was apparent, considering the ways teachers were strictly teaching to meet test and examination standards. Agbeti, (2011) identified this situation in his study. Accordingly, teaching and learning have been determined predominantly by the examination syllabi, and school activities have become mostly oriented towards external examinations and tests. Apart from the national and classroom tests, there is also the district examination.

District examination cannot be done away with because decentralised governments through their district education offices invest heavily in school infrastructure and other inputs such as furniture and scholarships for teachers and pupils. Therefore, they require value for their efforts to say the least by ensuring high performance standards are attained. This explains the kind of burden put on teachers and the expectation of all stakeholders for high pupil performance. Tony one of the head teachers expressed his dissatisfaction with the assessment system in schools as follows:

“The current assessment system where examinations are conducted at the district as well as national level is not helping at all. This is taking its toll on the pupils as they have to attend one extra class after the other before the day ends. They usually get home very tired and exhausted. [Tony]

Tony’s dissatisfaction was not only with the system of examination and its impact on teachers’ work but he appeared to be concerned with the effects of examination on his pupils’ emotional and psychological wellbeing. He points out the stress pupils go through

which invariably affects their output of work. In addition, Tony seemed to be concerned about the numerous large-scale external assessments (e.g. the NEA, SEA, SBA, BECE) administered by independent organisations at the district and national levels. In his view, the schools were being assessed by the general public, which invariably constituted a judgment on teaching performance. Likewise, Mansah, the other head teacher, reported the cumbersome nature of assessment administration which forced teachers to provide false records. “.... *so when it comes to the time to record marks, they tend to “manufacture the marks”*”, she disclosed.

The intention of GES to reduce public examinations and unnecessary and excessive tests appears to be in difficulty and the number of external examinations and assessments conducted in the study schools was high. This situation has emerged as a result of the competitiveness of school selection and the placement at High School level and the numerous local, national and international assessments that the case-study schools participated in. This wider educational context puts into perspective the ways teachers perceived and taught mathematics. The importance of the external examinations and assessment has clearly influenced teaching and learning. This study indicates that despite the national government’s effort to reform examinations-oriented educational provision, in practice, examinations still lead teaching and learning in schools.

7.2.3 The ‘Shift’ System

Both primary schools in this study operated a shift system. The shift¹² system means having two schools using one classroom block with one school operating in the morning and another in the afternoon then changing over after every two weeks. The shift system was cited as a key issue militating against school time for teaching, learning and assessment. The shift system operates where the school population exceeds classroom capacity. One school begins at 7.30am in the morning and closes at 12.00 noon and another begins at 12.30 pm and closes at 4.30 pm in the same classroom block. In these cases instead of the normal seven and a half hours in school, each school lasts for about four hours. In these conditions following and keeping to time on the timetable becomes essential for ensuring a good coverage of the curriculum. This was often difficult as illustrated in a case study school which suffered loss of time. A comment from one teacher follows:

“We are running the shift system so I don’t get much time to be with them (pupils). ... I mean, time for actual observation to assess their competencies ... I am not sure I do that due to time limits.” [Awo]

Inadequate time available for various informal assessments such as projects, arising from the shift system was frequently alluded to by the teachers in the study and my observations during data collection corroborated this. I observed that the swapping over of shift sessions caused a lot of noise and loss of time. Teachers sometimes had to finish their lessons earlier than scheduled to allow the pupils to tidy the rooms for the incoming class.

¹²A Shift school takes care of two different schools operating in one school block. One school closes around 12:30pm and the other school begins. They change over every fortnight.

This perhaps explains why teachers only spoke about tests and quizzes instead of informal, observations and projects.

Ebow had this to say about observation and projects:

“As for projects, I hardly assess. The procedure for assessing projects is too cumbersome. Moreover, we spend only four hours either in the morning or in the afternoon shift” [Ebow].

Literature indicates that time constraints are often mentioned as a factor that prevents teachers from using assessment in ways that foster learning (e.g. Senk et al., 1997; Hargreaves et al., 2002). Time constraint was noted as the most common factor affecting classroom assessment in this study. Interview responses also emphasised time constraints, which is of course related to several other factors. The Shift system being one, was limiting the space for teachers’ to engage with their pupils in innovative activities and have the assessment of these activities in a diverse range of ways.

Lack of adequate time was the reason given by all four teachers for maintaining traditional assessment practices (tests, quizzes) in the classroom. All four teachers were of the view that constructive assessment practices and projects required time which was a scarce commodity as far as covering the curriculum was concerned. This was similar to findings by Borko et al (2000), and they also believed that new assessments (e.g. projects) will be too time-consuming as reported by Torrance and Pryor (2001), Cheung (2002), Hargreaves et al. (2002), and Mabry et al. (2003). Classroom assessment researchers continue to identify time as a significant issue for practitioners. As time has clearly been identified as a factor in the implementation of classroom assessment that supports student

learning, research that sheds light on ways to reduce time issues would certainly be beneficial to policy and practice.

7.3 Professional Support and Development in Assessment

Engaging teachers in professional development exposes them to new ways of doing things. In this section, the challenges of professional support for teachers in and outside the school are discussed. Professional support in this vein includes training and supervisory support from head teachers and professional development. Despite the significance of professional development when it comes to supporting teachers in implementing assessment reforms, it was disclosed during interviews that all the four teachers had acquired no training in assessment. Awo remarks as follows:

“Assessment was not part of my initial training”

Similar expressions were made by the other three teachers. Given the new assessment policies training in assessment would seem to be essential for teachers and in this case in the mathematics classroom. The case studies revealed that the primary teachers (Ebow and Awo) neither possessed a strong content knowledge in mathematics nor could they provide alternative assessment for their pupils. It is therefore not surprising that they had difficulty setting their own examination and class questions as Ebow disclosed:

“One of the major challenges I face is trying to set appropriate questions for children to understand and answer. The difficulty lies with how to frame the question appropriately in order to get the desired answer from the pupils. Sometimes, they know the answers to the question, but get it wrong because of the wrong frame of questions. This is a major challenge for me so I resort to textbooks for my examination questions.” [Ebow]

The difficulty in posing problems and varying assessments in the mathematics class was also observed in John as well as Sam's classrooms. Teachers' difficulty in getting children to understand concepts is rooted in their own struggles in teaching for understanding (Akyeampong et al, 2001). In this study, I found that the use of prescriptive textbook examples with routine problems was common. The implication is that non-routine problems which are not anchored in textbooks may not form part of assessment material used by these teachers who concentrate only on textbook exercises. This is in line with Senk et al's (1997) study where teachers relied on text books and did not make any changes to questions, in the bid to vary them. To add to this, research in African classrooms identifies prescriptive instructional behaviour, which has become so deeply entrenched in the professional culture such that, progressive teaching methods, such as 'child-centered' reflective practice approaches stand little chance of gaining ground in classroom practice (O'Sullivan, 2001).

Many of the school textbooks and curriculum documents in Ghanaian classrooms are written mostly in deterministic style that correspond with and validate the prescriptive and authoritarian structure of teaching and learning. Many teachers do not have access to other reference materials apart from government prescribed textbooks (NESAR, 2013) which then become the only definitive teaching and learning material for the content and process of teaching. Indeed textbook availability and supply has come to occupy such a vital part of improving basic education in developing countries (Lockheed and Verspoor, 1991) but still textbooks to pupil ratios can be as low as one is to eight (see Fobih et al., 1999; NEIDA 1992).

For professional development, the Assessment Unit (ASU) is mandated by policy to educate teachers on any changes in assessment procedures. However, it was evident from the teacher interviews that there was a lack of communication between the Assessment Services Unit (ASU) of the Ghana Education Service (GES) and the schools. Whilst the ASU had introduced school-based assessment (SBA)¹³, as a modified form of assessment, the case study teachers were still using the old continuous assessment format. During interviews, all four teachers portrayed a lack of awareness of the new changes and still practiced the old system of continuous assessment (CA) as Awo recounts:

“We went for a workshop on the school-based assessment, but up till now, we have not heard anything from them; so we are still using the continuous assessment format” [Awo].

Further investigations I conducted revealed that none of the teachers within the study had been trained for the implementation of SBA. Sam also said “I have heard about it but I am not practicing it now”. Similar expressions were made by John and Ebow which indicates that they knew little about the SBA. Teachers’ lack of engagement in new assessment practices and the lack of training could be linked to the disconnection between them and the ASU. Such a situation has implications for decision makers such as the ASU and teachers who are tasked to conduct assessment using the SBA.

The primary school teachers who needed help with their teaching received assistance from their colleagues in the JHS. In interviews, Awo and Ebow confirmed that they

¹³ School –Based Assessment is a modified Continuous Assessment with the inclusion of observations and projects in addition to the normal class exercises, quizzes and home work but with a reduced number of tasks. Teachers are required to record 12 tasks as SBA marks instead of the previous 33 tasks per week as output of work.

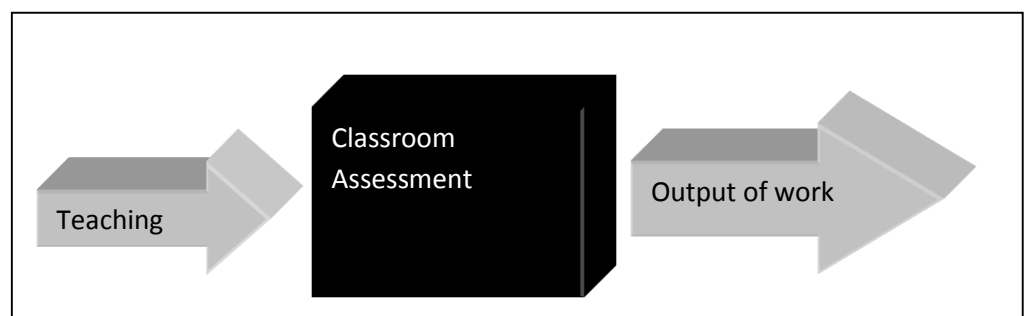
frequently received support from Sam and John. Supporting peers has been stressed by Cohen and Ball (1990), Carpenter and Fennema (1992),) and Richardson (1999).

Supervision of assessment was limited to the quantity of output of work produced by these teachers as indicated by Tony:

“I sometimes collect the homework to check how many times homework has been given”.

This notion, confirmed what Black and Wiliam (1998) referred to as the ‘black box’ model of assessment. It was observed that school administrators were normally blinded by setbacks to the efficient operation of their schools in such areas as shortages of furniture, books and funds among others, and were therefore less concerned about how such issues impacted teaching and assessment in the classroom. The two head teachers in this study admitted that they attended numerous meetings, responded to letters, received visitors, and dealt with complaints from pupils and parents and these were their major routine activities. Although I cannot recount recording lesson observation as one of their duties during my study, they tended to monitor work output by the grade levels. How such marks were actually awarded remained unknown to the head teachers, as represented by the black box in Figure 6.1.

Figure 7.1: The Black Box of Assessment



Source: author

Figure 7.1 shows how head teachers can be oblivious of assessment practices in the classroom, being more concerned about the measurable output of teachers. The pressure on schools for pupils to pass examinations may account for head teachers' interest in output of work. Despite the need for output of work and the strong influence of examinations, head teachers nevertheless sometimes support their teachers in diverse ways to make the practice more rewarding. Mansah explained how she supported her teachers:

“At times, I visit the examination class to give them support. I normally do this when I notice some challenges with [for] the teacher in the class during lesson delivery. Sometimes, I walk in to give the teacher some hints or invite him to my office for discussions [Mansah].

Although Mansah did visit her teachers' classrooms, the emphasis was on examination classes. This clearly exemplifies the high premium that schools place on external assessment as discussed in section 7.2. Echoing findings from elsewhere this study suggests the urgent need to strengthen head teachers' comprehensive supervision of their staff (Mpeirwe, 2007).

7.4 Classroom Conditions

Classroom conditions, such as class size, space and instructional resources have immeasurable influence on learning and assessment. It was observed during this study that the teaching conditions, coupled with the classroom environment were unfavourable for effective assessment of pupils' work:

“Monitoring pupils’ work is very difficult. My class has 62 pupils. Assessing their individual challenges becomes very difficult” [Sam].

For Sam, the difficulty in monitoring pupils was because of the large class size. Within the policy framework, the standard physical size prescribed by the GES, for pupil to teacher ratio (PTR) is 35:1 for primary school and 22:1 for junior high school (JHS). However, I observed that the pupil population in the case study classrooms exceeded these ratios: the average class size at Obatan JHS was 56, whilst that of Calvary was 55. In relation to these average class sizes, the physical standard size classroom appeared to be overcrowded (see figure 7.2). It is not surprising that teachers unanimously complained of restrictions to effective assessment, ineffective pupil engagement, and impaired classroom management, all of which corroborate the class size challenges as outlined by Reynolds et al. (2001). One of the teachers commented on her restricted classroom space as follows:

“My classroom is so full that there is little space left for me in front of the chalkboard. My movement in the classroom is limited to the front rows. This makes teaching, testing and marking more difficult [Awo].

Awo’s comment highlights the need to ensure favourable classroom conditions to enhance teaching as well as assessment. Limited movement in the classroom has consequences for assessment approaches. The continuous stay of teachers’ at the front row could create isolation for those pupils whose voices are not heard as a result of non-engagement in class discussions.

Figure 7.2: A Classroom at ‘Obatan’ Primary School



Source: Author's photograph, 2012.

Classroom conditions are favourable for learning and assessment when the needed resources required to enhance learning are available. It was observed in this study that schools were inadequately resourced. Text books used for class exercises were shared among pupils in the ratio of 1:3 and sometimes 1:4. Teachers had to write a lot of texts onto the blackboard for their pupils to copy into their exercise books. As Sam, remarked:

“The only challenge teachers encounter in this school has to do with lack of teaching materials. I have to distribute sheets of paper anytime I give Test.”

While the policy did not ensure the supply of adequate textbooks and exercise books, the burden was on teachers to provide writing materials during class tests and other routine exercises. Such a classroom environment did not seem to be conducive for effective teaching and learning, and consequently this could affect teachers' assessment of pupils' performance. All four teachers in this study reported that they did not allow pupils to take school books home. When pupils were supposed to write in workbooks, Ebow and Awo reported that they copied tasks onto the chalkboard to be done in exercise books.

Such practices undoubtedly limit opportunities for pupils to study on their own or to be creative in written tasks. Ebow explained the situation in his class:

“We are surcharged when textbooks get torn or stolen. Because of that, the only time the pupils use textbook is when they have to do class exercises. Most of the time, I copy the exercises on the chalk board.” [Ebow]

The situation described above constrains teachers in assessing how effectively pupils are learning. In a situation in which there was inadequate supply of teaching and learning materials, achieving high performance regarding teaching and assessment of pupils in mathematics could be extremely challenging. John also disclosed:

“Pupils who sit in threes are always at a disadvantage as they struggle for writing space, during class tests, I mean. In my class it is difficult to access individual children. They are sitting in threes and fours and you cannot separate them for independent work” [John].

Both teachers and pupils alike expressed their frustration because of these challenges encountered during class tests and examinations. If independent work appeared impossible, then the true academic profile of the pupil would be difficult to ascertain. In summary, the findings indicate that lack of adequate resources especially space, textbooks and writing materials appear to constrain teachers in assessing pupils.

7.5 Summary

This chapter has highlighted three sets of factors that influence assessment practices in the case-study schools. These factors are in relation to existing policies, lack of

professional support and development for teachers in assessment as well as classroom conditions. The educational reform of 2007 in Ghana ever since has aimed at transforming the traditional education which was examination-oriented, into a modified quality-oriented education. It is noted however, that high-stakes external examinations, participation in a range of national, district and international level assessments, the shift system, lack of professional support and development for teachers, large classes, and poor classroom resourcing all militate against the multiple educational reforms which have been pro-learner centred, and the emphasis on the new assessments paradigm. As illustrated by the case studies, the efforts made to reform the assessment system has had no significant impact on teachers' classroom assessment practices and has also had its fair share of challenges.

Lack of training in assessment at the initial training colleges have also been identified as a key factor limiting teachers' assessment practices. External examinations continue to be the driver of teaching and learning and are central to selection into the few privileged high schools. Correspondingly, the anxiety and high expectations of parents and stakeholders alike to get their wards into these privileged schools mount undue pressure on teachers. It is within this background that the teachers adopt strategies to complete their syllabuses with speed and accuracy. However, due to time constraints, this study could not ascertain how quickly, comprehensively or accurately the teachers completed their syllabuses.

In terms of professional development, all teachers had not received any training in assessment as part of their teacher education. Support for teachers in terms of professional support and supervision by the head teachers was seen to be limited to checking of output

of work. Although relations between teachers were collegial and teachers who lacked a strong knowledge base in mathematics were offered support by colleagues with a stronger background in mathematics, such collaboration between teachers was not observed in the area of assessment. The mandate by the policy for the ASU to expose teachers to new assessment practices is reported to be not happening. Consequently, teachers are left to perform their duties in relative isolation. Lack of professional training of the four teachers is seen as a limiting factor affecting effective implementation of the required assessment. This invariably affected their know-how in posing relevant assessment tasks.

The shift system was another key factor depriving teachers of adequate time to conduct variety of assessments. Coupled with the large class sizes, the reduced contact hours from seven and a half to four hours in favour of either the morning or afternoon shift all did not favour most of the assessment activities such as individual monitoring, marking and assigning projects.

Conditions in the classroom compounded the challenges faced by teachers in assessing their pupils. Large class size was also observed in this study, which has implications for both teaching and assessment. There was lack of adequate space which affected the teachers' class supervision and monitoring of pupils' work. Likewise, in terms of physical resources, classrooms were found to lack teaching and learning aids. Inadequate furniture and lack of writing materials for some pupils delayed the assessment processes.

The study has identified various challenges facing the classroom teacher in assessing pupils. In the face of these challenges, teachers and pupils alike are under pressure for high performance, leading to quality education being compromised. It appears that efforts

to meet the global and national standards where assessment determines the performance of a school have produced undue pressure in which the required qualitative changes in education are cramped in the local context of testing and high educational competition among schools and districts.

CHAPTER 8: SUMMARY, CONCLUSION AND IMPLICATIONS

8.1 Introduction

This study has been undertaken to explore assessment practices in mathematics classrooms in Ghana. It has been informed by my personal and professional experience as an assessment administrator as well as a former mathematics tutor in a Teacher Training College in Ghana and a member of the National Educational Assessment Team. Throughout my career, I have encountered a number of situations that brought into sharp focus the challenges in classroom assessment conducted by mathematics teachers. Some of those situations have formed the basis of my decision to embark on this study and use the findings to inform policy and practice of assessment in Ghana.

This Chapter begins with a summary of the key findings of the study which is followed by the conclusion which highlights the professional insights gained and policy implications. I then discuss some limitations of the study and end with recommendations for further research.

8.2 Summary of Key Findings

The study sought to explore the assessment practices of teachers in mathematics classrooms in Ghana. A qualitative research methodology was employed to obtain data

largely through observations and interviews. The study sought to find answers to the following questions:

- (i) How do teachers perceive assessment in mathematics classrooms in Ghana?
- (ii) What kinds of assessment methods do mathematics teachers use to assess their pupils?
- (iii) How do teachers' conceptions of the nature of mathematics influence their assessment practices?
- (iv) What are the factors that influence teachers' assessment in mathematics classrooms in Ghana?

The key findings are discussed next.

8.2.1 Teachers' Perceptions of Classroom Assessment

Findings from this study show that teachers hold several and varied perceptions about assessment. Although they understand assessment as being for testing pupil learning, teacher and school accountability and improvement in both spheres, it was assessment as testing that dominated all others. For instance, both teachers and headteachers referred to the term "assessment" when they really meant "test," and "continuous assessment" when they meant "continuous and frequent tests". Only one teacher, John, perceived assessment as a formative measure in which both the child and the teacher can learn from the assessment itself. Teacher self-improvement through pupil assessment was noted by three teachers (John, Sam and Ebow) and such perceptions and practices are in line with those highlighted positively by researchers such as Leung and Mohan (2004) and Brown (2006, 2008).

8.2.2 Kinds of Assessment Methods Used in the Classroom

Both formal and informal assessment was practised by teachers. The formal assessments included class exercises, quizzes, tests, and homework and end-of-year/course examinations whereas; the informal assessments included asking questions orally as well as monitoring of pupils' work during teaching. They also used assessment to diagnose pupils' problems. The teachers did not view assessment as just for assigning pupils grades but also, for other purposes as well, for example, assessment results were used as a means of improving teaching. The use of open-ended assessment items was almost non-existent.

Generally, teachers perceived assessment mainly for accountability purposes which overshadowed its improvement function with respect to pupil learning. As a result, testing dominated all other methods of assessment. This view of assessment restricted the teachers in exploring ways of involving their pupils in the assessment process and making them take ownership of their own learning.

8.2.3 Other Factors Affecting Assessment Practices

The factors that influence assessment practices are grouped into two. They are a) teacher-related which include teacher knowledge, belief, conceptions of the nature of assessment and attitudes, and b) contextual factors which also include institutional policies on internal and external examinations, time, training in assessment and other classroom related factors.

The teacher related factors included the ways that knowledge of subject matter as well as pedagogical knowledge were both crucial for effective teaching and assessment (Chapter 5). Those teachers who had better qualifications in mathematics (John and Sam) were

seen to be confident in teaching. Both teachers (John and Sam) had positive attitudes towards mathematics.

John however used a more diverse set of teaching and assessment practices than Sam who also had a higher qualification in mathematics. In their interviews they reveal different epistemological views about mathematics which seems to be related to their different understandings and practices of assessment and teaching. John appeared to lead his pupils with relational (fallibilist) understanding, employing a little problem solving approach whereas Sam's practices resembled those of an absolutist focusing on routine procedures in solving mathematical problems. Ebou and Awo had low qualifications in mathematics and it was not surprising that they both had a negative attitude towards mathematics and adopted more traditional and absolutist views and practices on mathematics and mathematics teaching (see section 6.5).

Teacher Beliefs

Teacher beliefs about assessment also influenced their practices. Teachers' conceptions of mathematics were varied and consistently reflected in their practices in mathematics teaching. The assessment methods teachers used as well as their teaching methods were related to their conceptions of the nature of mathematics. Three of the teachers who had strong beliefs that mathematics is a set of rules to be mastered (absolutist view), taught and assessed in the same manner following rigid rules. Conversely, in one case, John expressed some 'fallibilist' views placing more emphasis on processes, greater interaction and more varied assessment methods to be observed.

8.2.4 Contextual Factors Affecting Classroom Assessment Practices

In terms of context, three sets of factors that influence assessment practices in the case-study schools were identified. These were related to existing policies, lack of professional support and development for teachers in assessment, the shift system and classroom conditions.

First, despite the fact that since 2007, educational policy reforms aimed at transforming the traditional examination oriented education into a quality-oriented education (MOE, 2008), the teachers were still burdened by both high-stakes external examinations and assessment regimes at different levels. Both schools in this study participated in a range of district, national and international assessments and were held ‘accountable’ by a range of stakeholders for the results in these assessment regimes. In addition, given the high-stakes external examinations which determined student placement in a limited number of places in very good secondary schools, they also felt pressurised by the increasing demand by parents for high performance of their children in the examinations. The emphasis on examinations left little chance for the implementation of more diverse, informal and formative methods of assessment.

Training and professional development in Assessment

Teachers’ professional development is seen as key in bringing about any change in the classroom. It appears that it is only when teachers realise the need to change, that they may take ownership of their own teaching and pupils’ learning. Studies have shown that discussions in moderation meetings (Torrance and Pryor, 2001; Kirton et al, 2008), provided opportunity for teachers to identify what needed to be done. After identification of gaps through the collaborative discussions, teachers were able to design their own

methodology for classroom assessment. Lack of opportunities for teachers to engage in professional development in relation to assessment was a challenge for teachers in this study who reported that they experienced little exposure in assessment literacy in their initial Colleges of Education.

Barriers in the use of alternative and formative assessment might well have been mitigated if teachers had received appropriate training in assessment during the pre-service education or in-service training. Teachers need strong skills in classroom-based assessment practices to identify and help pupils who are struggling to learn. This suggests a gap in pre-service and on-going teacher education programmes in which teachers can be introduced to using assessment tools to detect learning difficulties early, and devise appropriate strategies to tackle these difficulties.

The shift System

The two primary schools in this study operated a shift system. The shift system (a policy to have two schools using one classroom block for morning or afternoon sessions and changing over after two weeks) militated against school time for teaching, learning and assessment. Therefore following and keeping to time on the timetable was essential for ensuring a good coverage of the curriculum. In the case study schools there was inadequate time available for various informal assessments such as projects. Teachers blamed the lack of time on swapping over of the shift sessions which might be part of the reasons why tests and quizzes dominated their assessment practices. The study established that time is the most common factor affecting classroom assessment and it

also prevented teachers from engaging their pupils in innovative activities likewise assessment in a range of ways.

Classroom conditions

In addition to inadequate professional development and time constraints, classroom conditions also impacted on the ways that teachers assessed. Teachers were unable to monitor learning effectively due to large class sizes which also militated against a more interactive classroom conducive for oral forms of assessment. The use of English language as the medium of instruction in which very few pupils could communicate further constrained the classroom which could be more conducive for good questioning (Torrance and Pryor (2001); Tapan (2001); Kirton et al., (2007). It became clear that pupils, especially at the lower primary were unable to express themselves in the English language and this posed as a challenge for teachers.

Furthermore, classrooms were without adequate textbooks and other teaching and learning resources. Lockheed and Verspoor (1991) have observed that the supply of textbooks limited the progress of schools especially in developing countries and Ghana being no exception where textbooks to pupil ratios can be as low as one is to eight (see NEIDA, 1992 Fobih et al., 1999; Anamuah-Mensah et al, 2002; Ramsuran, 2006, NESAR, 2013).

8.3 Professional Insights and Policy Implications

As part of the study's main intention, the data collected showed that teachers' knowledge, belief and attitude in a discipline such as mathematics had consequences for their teaching

and assessment, and for this reason, they ought to be given the needed attention. The findings suggested that teachers generally used formal summative assessment with limited use of formative assessment. Teachers' assessment strategies varied in terms of their qualification and backgrounds but not necessarily in a uniform way.

Firstly, different approaches to assessment, adopted by teachers were attributed to the differences in their teacher training and particularly to the absence of good training in assessment practices. The teacher training curriculum has been found to be inadequate for preparing teachers for classroom assessment practices. The challenges faced by teacher training institutions and by teachers are the result of (a) lack of institutional structures to offer academic and professional support services, (b) the absence of participatory pedagogical approaches that connect learners' experiences with classroom assessment and (c) feelings of frustration resulting from negative attitudes towards the teaching and assessment in mathematics due to the teacher's own inadequacies in mathematics knowledge and pedagogy or in assessment, and lack of adequate resources as against large class sizes, creating unfavourable classroom conditions.

Again, the school curriculum which is heavily aligned to behaviourist principles, according to Bloom's taxonomy, needs critical attention. The tendency for Ghanaian teachers at the basic level to teach using more low level recall strategies appear to be high. Consequently, classroom assessment has come to mean testing with little or no problem-solving skills. New learning theories and recent policy advocate a constructivist approach in mathematics and the increased use of problem-solving skills especially relevant in the light of the fast changing technological and globalised world. If Ghana wants to move towards a knowledge-based society, then there is the need for a second look to be taken

at the school curriculum and assessment strategies in textbooks and all other curriculum materials.

A number of challenges which have professional implications were identified in the study – these include:

Challenges in assessment implementation in schools due to pressure exerted on teachers to account for pupils' successes or failures in gaining admission into “high class” second cycle schools. The emphasis on mathematics as a key requirement qualifying pupils for further courses needs to be reviewed.

Other assessment policies; (NEA, SEA, and SBA) that exist from district to region and on to the national level have great influence on teaching, learning and assessment. Test and examination are conducted almost every year. Teachers concentrate on preparing pupils all the time for examinations and tests. All these forms of assessments need to be synchronised.

Advocacy with communities is also required to increase appreciation of the benefits of assessment for learning. The need to nurture a more consultative and broader feedback process with teacher educators, classroom monitoring staff and other stakeholders could help in reducing the policy-practice gap in classroom assessment.

Equally, adequate supply of learning materials such as teacher guidebooks and textbooks in the classroom will be helpful.

The Shift System which appears to reduce the instructional hours in schools does not provide adequate opportunities for learning and assessment. This system may need to be reviewed.

Local contexts and content must be taken into consideration when new approaches to education are being introduced. It should not be assumed that ‘one size will fit all’ or what works in one country would work in another (Zadja 2004; Kanu, 2005).

I therefore suggest that in a broader view, much effort is put into examining, what works in other parts of the world in terms of classroom assessment so that a cue is taken to help those that will be more suitable for the Ghanaian educational system.

8.4 Limitations to the Study

Limitations to this study stemmed from the exploratory nature and scale of my research. It was not possible to determine teachers’ practices within a short period of observations and interviews. A long period of time will be needed to observe teachers on a number of occasions to obtain a better understanding of their practices.

I also acknowledge the limitations of this study in the following areas: (1) the relatively small sample size of six participants (two headteachers and four teachers), (2) the use of only one region and (3) the use of only two schools. As such, the findings may be difficult to generalize to the population of headteachers and teachers in basic schools in Ghana. In this case, it would have been useful to include more headteachers and teachers from other schools. This would have provided a wider picture of how assessment is perceived and practiced in the region.

Again, including teachers from private schools would probably have given a different picture of their demographic data and practices of assessment. It would have been useful to find out whether their methods of assessment contribute to high achievement.

The quality of information obtained from the two schools may differ in view of the fact that at the “Obatan” school, the teachers were free to express their sentiments and contributions better than those from the “Calvary” school.

8.5 Contribution to the field

Substantive issues

This study becomes one of the pioneering works in the area of classroom assessment in mathematics in Ghana. This study contextualizes the subject of classroom assessment in mathematics and contributes to the macro literature, most of which are conducted in the Global North (e.g., Gipps, 1990, 1994, Black and Wiliam 1998a, 1998b, 2001, 2009, 2010; Stobart, 2008). In this connection, it is worthy to note that this study provides evidence to show that in the Ghanaian context, some teachers’ use both formal and informal assessment, yet the formal assessment dominates with limited use of higher-order skills. This is apparently because of the ease and standardised nature of formal assessment.

This study reveals a sharp contrast of the working conditions of teachers (inadequate resources, large classes and lack of interaction) in Ghanaian classrooms, weak teacher knowledge in assessment as well as mathematics, as against that found in the literature of Global North. This suggests that implementation of formative assessment in Ghana may not have the same results as that of Global North.

Theoretical Issues

The study adopted a framework of knowledge, beliefs and attitudes (Ernest, 1989) to understand the underlying philosophies of teachers’ assessment practices. These

theoretical frameworks have been developed by Northern researchers and applied to developed country contexts. My study has supported the applicability of these frameworks to a developing context, i.e. Ghana. My study has found evidence that supports the literature on knowledge, belief and attitudes as having great influence on mathematics (Brown, 2004; Susuwele-Banda, 2005; Chitsonga, 2010).

The study revealed that the school mathematics curriculum aligns more to behaviourist theories than constructivist. Teachers are made to teach by moving from one level to the other. This study shows that teachers tend to remain at the recall level as was the case of the primary teachers (Ebow and Awo). The study contributes to the discourse on curriculum development in Ghana. In this case, this study becomes one of the few studies of an insider to portray that issues of teachers' qualification, beliefs and attitudes and their level of operation in terms of assessment in mathematics practices are necessary for curriculum planning.

Methodological issues

The micro domestic literature on the subject of classroom assessment at the basic school level seems to be non-existent, so is research on teachers' classroom assessment practices in mathematics through observation and interviews. Most Ghanaian scholars prefer the use of the quantitative methods and are more familiar with the approach, in view of its relative ease and speed, its clarity, precision and standardisation (Ernest, 1994). Therefore, irrespective of their subjects of investigation, most Ghanaian researchers employ quantitative research methodology. This qualitative research method was used to gain meaningful understanding of the participants' subjective meanings of their assessment practices (McNeill and Chapman, 2005). This method is found to help

understand people's opinion, offer explanation and understanding of what is unique and particular to individuals and it allows individuals being studied to speak for themselves as subjects rather than being objectified through the research process (Kelly et al., 1994; McNeill and Chapman, 2005).

8.6 Recommendations for Future Research

The findings of this study have shown that there are still a number of things that need to be investigated concerning classroom assessment. Some of them are as follows:

- A study to determine pupils' perception of the concept of assessment in mathematics classrooms. This could guide text book and curriculum development to ultimately improve assessment practices.
- The same study could be conducted on a large scale. A greater number of teachers from a range of administrative districts representing an increase in the sample size would be useful in drawing conclusions that would inform policy decisions. Several other variables could be considered such as using teachers who are initially trained to teach mathematics.
- Another study could be conducted on tutors in teacher training institutions, to explore their practices and perspectives of mathematics assessment and how this impacts on teacher training of mathematics teacher educators.

Bibliography

- Ackers, J., Migoli, J. and Nzomo, J. (2001) Identifying and addressing the causes of declining participation rates in Kenyan Primary Schools. *International Journal of educational development* 21: 361–374.
- Agbeti, A. (2011) Influence of assessment on teaching and learning in junior high School in Ghana. Unpublished doctoral thesis, the University of Sussex, UK
- Aiken, L. (2000) *Psychological Testing and Assessment*, Boston, MA: Allyn and Baccon
- Ajen, L. (1989) Attitude structure and behaviour. In A. R. Practkanis and S. J. Breckler (Eds) *Attitudes structure and function* (pp241-274). Hillsdale, N.J. Erlbourn.
- Akyeampong, A. K. (1997) Continuous Assessment in post-secondary teacher training colleges in Ghana: A case study evaluation. Unpublished doctoral thesis, University of Nottingham, Nottingham
- Akyeampong, A. K., Djangmah, J., Oduro, A. and Seidu, A. (2007) *Access to Basic Education in Ghana: The Evidence and the Issues*. CREATE Country Analytic Report, 2007 University of Sussex, UK.
- Akyeampong, K. and Stephens, D. (2002) [Exploring the Backgrounds and Shaping Factor of Beginning Student Teachers in Ghana: Towards Greater Contextualization of Teacher Education](#). *International Journal of Educational Development*, 22 (3-4). pp. 261-274.
- Alausa, Y.E. (1988) *A formative evaluation of continuous assessment practice in Ijebu North local government area, Ogun State*. Unpublished M.Ed dissertations, University of Ibadan.
- Alderson, P. (2004) Ethics. In: Fraser, S., Lewis, V., Ding, S., Kellett, M. & Robinson, C. (Eds.) *Doing Research with Children and Young People* London: Sage.

Allport, G. (1935) Attitudes. In C. Marchisen (Ed) *The Handbook of Social Psychology* Vol. 2, pp. 798-844.

Amedahe F.K (1998). *Models of combining continuous assessment scores with external examination scores for selection and certification*. Unpublished doctoral dissertation, University of Pittsburgh, Pittsburgh.

Anamuah-Mensah Committee Report (2002) “Meeting the Challenges of the Education in Twenty First Century. Executive Summary” Report of the Committee on Review of Education Reform in Ghana. Adwinsa Publications (Gh) Ltd. Ghana.

Anamuah-Mensah, J., Akwasi-Asabere, A., and Mireku, K. D. (2004) “Ghanaian Junior Secondary School students’ Achievement in mathematics and Science” Results from Ghana’s participation in TIMSS, Ministry of Education, Accra.

Anamuah-Mensah, J., Mireku, K. D., and Ampiah, J. G. (2009) TIMSS 2007 Report: *Findings from IEA’s TIMSS at Eighth Grade*. Accra: Adwinsa Publications (Gh) Ltd.

Anamuah-Mensah, J. (2008) Teacher Education in the Context of Ghana’s 2007 Education Reforms. In PRINCOF. *Developments in Basic Teacher Education in Ghana* (pp. 120-132). Kumasi: Greenland’s Concept

Ary, D., Jacobs, C., and Razavieh, A. (2002) *Introduction to Research in Education* (6th edn). Belmont, CA: Wadsworth Publishing.

Assessment Reform Group (1999) *Assessment for Learning beyond the Black Box*. Cambridge, UK: University of Cambridge School of Education.

Atweh, B., Bleicker, R. E. & Cooper, T. J. (1998) Construction of the social context of the mathematics classroom: A sociolinguistic analysis. *Journal for Research in Mathematics Education* 29(1): 63–82.

- Avalos, B. (1986) Training for better teachers in the third world: lessons from research *Teaching and Teacher Education* 1(4) 289–299
- Atkin, J.M., Black, P. and Coffey, J.E. (Eds.) (2001) *Classroom assessment and the National Science Education Standards*. Washington, D.C.: National Academy Press
- Bachman, L. F. and Palmer, A. S. (1996) *Language testing in practice*. Oxford: Oxford University Press
- Bachman, L. (1990) Fundamental Considerations in Language Testing. Oxford: Oxford University Press.
- Bachman, L. F. (2002) Some reflections on task-based language performance assessment. *Language Testing*, 19(4), 453-476.
- Balacheff, N. (1990) Beyond a psychological approach: the psychology of mathematics education. *For the Learning of Mathematics*, 2 - 8.
- Ball, D. L. (1990) The mathematical understanding that prospective teachers bring to teacher education. *Elementary School Journal* 90: 449 – 466.
- Bandura, A. (2001) Social cognitive theory: An agentic. *Perspective Annual Review of Psychology* 52: 1–26.
- Bangert-Drowns, R. L., Kulik, J. A. & Morgan, M. (1991) The instructional effect of feedback in test-like events. *Review of Educational Research* 61(2): 213–238.
- Berry, R. (2011) Assessment Reforms around the World. In R. Berry and B. Adamson, *Assessment Reform in Education – Policy and Practice* (Pp. 89 -102). Dordrecht, the Netherlands: Springer. Doi: 10.1007/978-94-007-0729-0
- Bezuk, N. S., Cathcart, W.G. Vance, J.H., and Pothier, Y. M. (2001) *Learning Mathematics in Elementary and Middle Schools*. Columbus: Merrill Prentice Hall.

- Biggs, J. B. (1999) *Teaching for Quality Learning at University: What the Student Does*. Buckingham, UK: Open University Press
- Black, P., and Harrison, C. (2001) Feedback in questioning and marking: The science teacher's role in formative assessment. *The School Science Review*, 82(301), 55 - 61.
- Black, P. J. & Wiliam, D. (1998a) Inside the black box: Raising standards through classroom assessment. *Phi Delta Kappan* 80(2): 139–48.
- Black, P. J. & Wiliam, D. (1998b) Assessment and classroom learning. *Assessment in Education* 5(1): 7–73.
- Black, P. J. & Wiliam, D. (1998c) *Inside the Black Box: Raising Standards through Classroom Assessment*. London: Kings College, School of Education.
- Black, P. J. & Wiliam, D. (1999) Assessment for Learning: Beyond the black box. Accessed 12 June 2010 from <http://www.assessment-reform-group.org/publications.html>
- Black, P. J. & Wiliam, D. (2009) Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability* 2 (1): 5–31.
- Bliem, C. and Davinroy, C. (1997) *Teachers' Beliefs about Assessment and Instruction in Literacy*. Accessed 12 June 2010 from www.cse.ucla.edu/Reports/TECH421.PDF
- Bloom, B. S. (1969) Some theoretical issues and educational evaluation. In R.W. Tyler (Ed.), *Education evaluation: New roles, new means* (National Society for the Study of Education Yearbook, Vol. 68, Part 2, pp. 26-50) Chicago, IL: University of Chicago Press.
- Boaler, J. (2002) Exploring the nature of mathematical activity: Using theory, research and 'working hypotheses' to broaden conceptions of mathematics knowing. Invited Paper. *Educational Studies in Mathematics*, 51(1-2), 3-21

- Boaler, J. (2008) Promoting 'Relational Equity' and High Mathematics Achievement through an Innovative Mixed Ability Approach. *British Educational Research Journal*. 34(2), 167-194
- Bogdan, R. C. and Taylor, S. J. (1975) *Introduction to Qualitative Research Methods: A phenomenological Approach to the Social Sciences*. New York: John Wiley and Sons.
- Bolhuis, S. and Voeten, M. J. M. (2004) Teachers' conceptions of student learning and own learning. *Teachers and Teaching: Theory and Practice* 10(1): 77–98.
- Bond, L.A., Herman, J., and Arter, J. (1994) Rethinking Assessment and its role in Supporting Educational Reform. In Laboratory Network Program, *A Tool Kit for Professional Developers: Alternative assessment*. Portland, or: Northwest Regional Educational Laboratory
- Borko, H., Davenroy, K.H., Bliem, C. L. and Cumbo, K. B. (2000) Exploring and supporting teacher change: two third-grade teachers' experiences in a mathematics and literacy staff development project, *Elementary School Journal*, 100 (4), 273-306.
- Boud, D. (2000). Sustainable Assessment: Rethinking Assessment for the Learning Society. *Studies in Continuing Education* 22(2)151–167.
- Boulton-Lewis, G. M., Smith, D. J. H., McCrindle, A. R. Burnett, P. C. and Campbell, K. J. (2001) Secondary Teachers' Conceptions of Teaching and Learning. *Learning and Instruction* 11: 35–51.
- Bransford, J. Brown, A. L. and Cocking, R. R. (2007) *How People Learn: Brain, Experience and School* (expanded edn) Board on Behavioural Cognitive and Sensory Sciences. Washington DC: The National Academy Press.
- Broadfoot, P., and Black, P. (2004) Redefining assessment? The first ten years of assessment in education. *Assessment in Education*, 11(1), 7-27.

- Brookhart, S. M. (2004) Classroom assessment: tensions and intersections in theory and practice. *Teachers College Record*, Vol. 106, (3), 429-458.
- Brookhart, S. M., Moss, C. M., and Long, B. A. (2010) Teacher inquiry into formative Assessment practices in remedial reading classrooms. *Assessment in Education: Principles, Policy and Practice*, 17(1), 41–58
- Brown, G. T. L. (2004) Teachers' conceptions of assessment: Implications for policy and professional development. *Assessment in Education*, 11(3), 301–318.
- Brown, G.T.L. (2006). Teachers' conceptions of assessment: Validation of an abridged version. *Psychological Reports*, 99, 166-170
- Brown, G. T. L. (2008). Conceptions of Assessment: Understanding what Assessment Means to Teachers and Pupils. *Language Testing Journal* 21(3): 305–34.
- Brown, G. T. L. (2009). Teachers' Self-Reported Assessment Practices and Conceptions: Using Structural Equation Modelling to Examine Measurement and Structural Models. In T. Teo and M. S. Khine (eds) *Structural Equation Modelling in Educational Research: Concepts and Applications*. Rotterdam, Netherlands: Sense Publishers, 213–266.
- Brown, G. T. L. (2011). Teachers' Conceptions of Assessment: Comparing Primary and Secondary Teachers in New Zealand. *Assessment Matters*, 3, 45–70.
- Brown, G. T. L. and Harris, L. R. (2009) Unintended consequences of using tests to improve learning: How Improvement-Oriented Resources Engender Heightened Conceptions of Assessment as School Accountability. *Journal of Multidisciplinary Evaluation* 6(12): 68–91.

- Brown, G. T. L., Irving, S. E. and Peterson, E. R. (2008) Beliefs that Makes a Difference: Pupils' Conceptions of Assessment and Academic Performance. Paper Presented at the Biannual Conference of the International Test Commission, Liverpool, UK.
- Brown, G. T. L., Irving, S. E., Peterson, E. R. and Hirschfield, G. H. F. (2009) Use of interactive-informal assessment Practices: New Zealand secondary pupils' conceptions of assessment. *Learning and Instruction* 19(2): 97–111.
- Brown, G. T. L., Lake, R. and Matters, G. (2011) Queensland Teachers' conceptions of assessment: The Impact of Policy Priorities on Teacher Attitudes. *Teaching and Teacher Education*, 27(1): 210–220. DOI: 10.1016/j.tate.2010.08.003. Date accessed, 8th May, 2011.
- Brown, G. T. L., and Remesal, A. (2012) Prospective teachers' conceptions of assessment: A cross-cultural comparison. *The Spanish Journal of Psychology* 15(1): 75–89.
- Burrell, G. and Morgan, G. (1985) *Sociological Paradigms and Organisational Analysis*: London: Heinemann Educational Publishers.
- Carpenter, T. P. and Fennema, E. (1992) Cognitively guided instruction: Building on the Knowledge of Pupils and Teachers. *International Journal of Research in Education*, 21, 281-286.
- Carless, D. (2005) Prospects for the implementation of assessment for learning, *Assessment in Education*, 12(1), 39–54.
- Chappuis, J. (2005) Helping pupils to understand assessment. *Educational Leadership* 63(3): 39–43.
- Chester, C. and Quilter, S. M. (1998) In-service teachers' perceptions of educational assessment. *Journal of Research in Mathematics Education* 33(2): 210–236.
- Cheung, D. (2002) Refining a stage model for studying teacher concerns about educational innovations, *Australian Journal of Education*, 46(3), 305–322

- Chin, C. and Teou L.Y. (2010) Formative assessment: using concept cartoons, pupils' drawings and group discussions to tackle children's ideas about biological inheritance. *Journal of Biological Education*, 44, 3
- Chitsonga, S. S. (2010) *Assessment practices of mathematics teachers who also teach AP statistics* (Doctoral dissertation, University of Georgia).
- Clark, C. & Peterson, P. (1986) Teachers' thought processes. In M. Wittrock (ed) *Handbook of Research on Teaching* (3rd edn). New York: MacMillan, 255–296
- Clark, I. (2012) Formative assessment: Assessment is for self-regulated learning. *Educational Psychology Review*, 24(2), 205-249.
- Coffey, J. E. (2003) Making Connections: Pupils Engaging in and with Assessment, *Digital Dissertations* (UMI No. AAT3085273).
- Cohen, L., Manion, L. and Morrison, K. (2007) *Research Methods in Education* (6th edn). London: Routledge.
- Cohen, D. K. and Hill, H. C. (2000) Instructional Policy and Classroom Performance: The Mathematics Reform in CA. *Teachers College Record* 102:294–343.
- Cohen, D. K. & Ball, B. D. L. (1990) Policy and practice: an overview. *Educational Evaluation and Policy Analysis* 12(3): 347–353.
- Coomber, R. (2002) Signing your life away? Why research ethics committees (REC) shouldn't always require written confirmation that participants in research have been informed of the aims of a study and their rights – the case of criminal populations. *Sociological Research Online* 7(1). Accessed 4 November 2010 from <http://www.socresonline.org.uk/7/1/coomber.html>
- Cooney, T (1985) A beginning teacher's view of problem solving. *Journal for Research in Mathematics Education*, 16,324-336.

- Corbin, J., and Strauss, A. L. (2008) *Basics of Qualitative Research. Techniques and Procedures for developing grounded theory*. Sage Publications, Inc.
- Cowie, B. & Bell, B. (1999) A model of formative assessment in science education. *Assessment in Education: Principles, Policy & Practice* 6(1): 101–116.
- Creemers, B. P. M., Kyriakides, L., and Antoniou, P. (2013) *Teacher Professional Development for Improving Quality of Teaching*. Dordrecht, The Netherlands: Springer.
- Creswell, J. W. (1998) *Qualitative Inquiry and Research Design: Choosing Among Five Traditions*. Thousand Oaks, CA: Sage.
- Creswell, J. W. (2003) *Research Design: Qualitative, Quantitative, and Mixed Methods Approach* (2nd ed.) Thousand Oaks, CA: Sage Publications.
- Crisp, G. T. (2012) Integrative Assessment: Reframing Assessment Practice for Current and Future Learning. *Assessment and Evaluation in Higher Education*, 37, 33-43
- Croft, A. (2002) Pedagogy in the school context: An intercultural Study of The Quality of Learning, teaching and teachers' education in lower primary classes in southern Malawi. Unpublished doctoral thesis, University of Sussex, UK.
- Crosswhite, F J., Dossey, A., Cooney, T J., Downs, F L., Grouws, D. A., McKnight, C. Swafford, J. O., and Weinzweig, A. 1. (1986). *Second international mathematics study detailed report for the United States*. Champaign, IL: Stipes.
- Darlington, Y. and Scott, D. (2002) *Qualitative Research in Practice: Stories from the Field*. Buckingham, UK: Open University Press.
- Davis, P. J. and Hersh, R. (1980) *The Mathematical Experience*. Harmondsworth, UK: Penguin.
- Davis, P, and Hersh, R. (1986) *Descartes' dream: The world according to mathematics*. San Diego: Harcourt Brace Jovanovich.

- Davies, J., and Ecclestone, K. (2009) 'Straitjacket' or 'springboard for sustainable learning'? The implications of formative assessment practices in vocational learning cultures. *The Curriculum Journal*, 19(2), 71-86.
- Dei, G. J. S. (2005), 'Social Difference and the Politics of Schooling in Africa: a Ghanaian Case Study', *Compare: A Journal of Comparative Education*, 35, 3, pp. 227 – 245.
- Delandshare, G. & Jones, J. H. (1999) Elementary teachers' beliefs about assessment in mathematics: A case of assessment paralysis. *Journal of Curriculum and Supervision* 14(3): 216–240.
- De Lange, J. (2007) Large scale assessment and mathematics education. In F. K. Lester Jr. (ed) *Second Handbook of Research on Mathematics Teaching and Learning: A Project of the International Council of Teachers of Mathematics* Vol 2. Charlotte, NC: Information Age, 1111–11420.
- Demetrio, H. (2006) Learning to conduct educational research in teacher education: A Turkish perspective. *Australian Journal of Teacher Education* 33(1): 1–17.
- Denzin, N. K. and Lincoln, Y. S. (2005) *A Handbook of Qualitative Research* (3rd edn). Thousand Oaks, CA: Sage Publications.
- Dickson, K. B. and Benneh, G. (2000) *A Geography of Ghana*. London: Longman
- Dixon, H. R., Hawe, E., and Parr, J. (2011) Enacting assessment for learning: the beliefs practice Nexus. *Assessment in Education: Principles, Policy, and Practice*, 18(4), 365-379.
- Dori, Y. J. (2003) From nationwide standardized testing to school-based alternative embedded assessment in Israel: students' performance in the Matriculation 2000 project, *Journal of Research in Science Teaching*, 40(1), 34–52.
- Drake, P. & Heath, L. (2008) Researching in schools and universities: Insiders and professional doctorates. *Higher Education Review* 41(1): 21–35.
- Drake, C., Spillane, J., and Hufferd-Ackles, K. (2001) Storied Identities: Teacher Learning and Subject-Matter Context. *Journal of Curriculum Studies*, 33(1), 1–23.

- Dunne M., Pryor, J. and Yates, P. (2005) *Becoming a Researcher: A Research Companion for the Social Sciences*. Maidenhead, UK: Open University Press.
- Durrani, N. and Dunne, M. (2010) Curriculum and national identity: exploring the links between religion and nation Pakistan. *Journal of Curriculum Studies*, 42(2).pp.215-240
- Ecclestone, K. (2004) Learning in a comfort zone: Cultural and social capital in outcome-based assessment regimes. *Assessment in Education* 11(1): 30–47.
- Eisner, E. W. and Peshkin, A. (Eds) (1991) *Qualitative Inquiry in Education: The Continuing Debate*. New York: Teachers' College Press.
- ELRC (Educator Labour Relations Council) 2005, *Educator workload in South Africa*. HSCR Press
- Emeke, E.A. (1996) *Psychological dimensions of continuous assessment implementation on teachers and pupils in secondary schools in Oyo State*. A paper presented at the WAEC monthly seminar series.
- Emmanuel, E.E. (1990) *Evaluation of continuous assessment practice in Cross River State*. Unpublished M.Ed. dissertation, University of Ibadan.
- Ernest, P. (1996). Popularization: myths, mass media and modernism. In A. 1. Bishop, (Ed.), *The International Handbook of Mathematics Education*, Dordrecht: Kluwer Academic, Vol. 2, pp.785-817.
- Ernest, P. (1989) The knowledge, belief and attitudes of the mathematics teacher: a model. *Journal of Education for Teaching*, Vol. 15, (1) pp 13-33.
- Ernest, P. (1991) *Philosophy of Mathematics Education* London: Falmer Press.
- Ezzy, D. (2002) *Qualitative Analysis: Practice and Innovation*. London: Routledge.

- Firestone, W.A., Schorr, R.Y. and Monfils, L.A. (Eds.). (2004) *The Ambiguity of Teaching to the Test: Standards, Assessment, and Educational Reform*. Mahwah: Lawrence Erlbaum Associates
- Fobih, D., Akyeampong, K and Koomson, A. (1999) *Ghana Primary School Development Project (GPSDP): Final Evaluation of Project Performance*, (Accra, Ministry of Education)
- Fraenkel, R. F. and Wallen, N. E. (2008) *How to Design and Evaluate Research in Education* (7th edn). McGraw-Hill Companies, Inc.
- Furtak, E. (2003) *Formative assessment in K-8 science education: A conceptual Review*. Retrieved Feb. 15, 2013, from http://www7.nationalacademies.org/bose/Furtak_Commissioned_Paper.pdf.
- Gareis, C. (2007) Reclaiming an important teacher competency: The lost art of formative assessment. *J. Pers Eval Educ*, 20,17-20.
- Gebril, A., and Brown, G. T. L. (2014) The Effect of High-Stakes Examination Systems on Teacher Beliefs: Egyptian Teachers' Conceptions of Assessment, *Assessment in Education: Principles, Policy and Practice*, 21:1, 16-33, DOI: 10.1080/0969594X.2013.831030 .Date accessed: 15th February, 2014.
- Ghana Statistical Service (GSS) (2010) *National Population and Housing Census*, Accra, Ghana Statistical Service.
- Gipps, C., McCallum, B. and Hargreaves, E. (2001) *What Makes a Good Primary School Teacher? Expert Classroom Methods*. London: Falmer Press.
- Gipps, C. (1994) *Beyond Testing: Towards a Theory of Educational Assessment*. London: Falmer Press.
- Gipps, C. and Murphy, P. (1994) *Fair Test? Assessment, Achievement and Quality*. Buckingham, UK: Open University Press.

- Gipps, C. (1990) *Assessment: A Teachers' Guide to the Issues*. London: Hodder and Stoughton.
- Guba, E. G. and Lincoln, Y. S. (1989) *Fourth Generation Evaluation*. Beverley Hills, CA: Sage Publications.
- Gipps, C., McCallum, B., Hargreaves, E., Pickering, A. (2005) 'From TA to Assessment for Learning: the impact of assessment policy on teachers' assessment practice'. Paper presented at the British Educational Research Association Annual Conference, University of Glamorgan
- Good, T., Grouws, D., & Ebmeier, H. (1983) *Active mathematics teaching*. New York: Longman.
- Greaney V. & Hasan, P. (1998) 'Public Examinations in Pakistan: A system in need of reform' in Hoodbhoy, P. *Education and the State: Fifty years of Pakistan*, Karachi: Oxford University Press.
- Hamersley, M. (1992) *What's Wrong with Ethnography? Methodological Explanation*. London: Routledge.
- Hammond, M. and Collins, R. (1991) Self-Directed Learning: Critical practice. *Higher Education* 24(3), 301–314.
- Hamp-Lyons, L. (1997) Wash back, Impact and Validity: Ethical Concerns. *Language Testing* 14(3), 295–303.
- Hargreaves, A., Earl, L, and Schmidt, M. (2002) Perspectives on alternative assessment reform, *American Educational Research Journal*, 39(1), 69–95.
- Hattie, J. and Timperley, H. (2007) The power of feedback. *Review of Educational Research* 77(1), 81–112.

- Hattori, K. and Saba A. N. (2008) Comparison of classroom assessment practices: A case of Selected Ghanaian and Japanese mathematics lessons. *Journal of Educational Comparison* 3: 95–105.
- Hodgson, C. and Pyle, K. (2010) A literature review of assessment for learning in science. Slough, UK: National Foundation for Educational Research
- Joint Committee on Standards for Educational Evaluation. (2003) The Student Evaluation Standards: How to Improve Evaluations of Students. Newbury Park, CA: Corwin Press
- Kane, J. S. and Lawler, E. E. (1978) Methods of peer assessment. *Studies in Higher Education* 18(3): 555–586.
- Kanu, Y. (2005) ‘Tensions and dilemmas of cross-cultural transfer of knowledge: post-structural/postcolonial reflections on an innovative teacher education in Pakistan’, *International Journal of Educational Development*, 25, pp. 493 – 513
- Keeley, P., and Tobey, C. R. (2011) *Mathematics formative assessment: 75 practical Strategies for Linking Assessment, Instruction, and Learning*. Thousand Oaks, CA: Corwin
- Kellaghan, T., and Greaney, V. (1992) *Using examinations to improve education. A study in fourteen African countries*. Washington DC: World Bank.
- Kellaghan, T., and Greaney, V. (2001) *Using assessment to improve the quality of education*. Paris: UNESCO: International Institute for Educational Planning.
- Kember, D. and Kwan, K. P. (2000) Lecturers’ Approaches to Teaching and Their Relationship to Conceptions of Good Teaching. *Instructional Science* 28: 469–490.
- Kesler, R. (1985). Teachers' instructional behavior related to their conceptions of teaching and mathematics and their level of dogmatism: Four case studies

(Doctoral dissertation, University of Georgia, 1985). *Dissertation Abstracts International*, 46, 2606A

- King, B. (2006) Elementary teachers' attitude towards mathematics and their preparation to teach mathematics. From ProQuest Dissertation and Theses. <http://proquest.umi.com/ezp01.libray.qut.edu.au/pqdweb?did=12221708831&Fmt=7&clientId=14394&RQT=309&VName=PQD> Date accesses, 10th May 2011.
- Kirton, A., Hallam, S., Peffers, J., Robertson, P., Stobart, G. (2007) 'Revolution, evolution or a Trojan horse? Piloting assessment for learning in some Scottish primary schools'. *British educational research journal*, 33(4), 605-627
- Kitcher, P. and Aspray, W. (1988) An Opinionated Introduction. In W. Aspray and P. Kitcher (eds) *History and Philosophy of Modern Mathematics*. Minneapolis, MN: University of Minnesota Press, 3–57.
- Ko, J. and Sammons, P. with Bakkum, L. (2013) *Effective Teaching: a Review of Research and evidence*. Reading: CfBT Education Trust.
- Kuhs, T. M. & Ball, D. L. (1986) *Approaches to Mathematics: Mapping the Domains of Knowledge, Skills and Dispositions*. East Lansing, MI: Michigan State University, Department of Teacher Education.
- Kvale, S. (1996) *An introduction to Qualitative Research Interviewing*. Thousand Oaks, CA: Sage Publications.
- Laberee, R. V. (2002) The Risk of 'Going Observationlist': Negotiating the Hidden Dilemmas of Being an Insider Participant Observer. *Qualitative Research* 2(1): 97–122.
- Lakatos, I. (1978) *Philosophical Papers* Vol. 2. Cambridge, UK: Cambridge University Press.

- Lerman, S. (1983) Problem solving or knowledge centred: The influence of Philosophy on Mathematics Teaching. *International Journal of Mathematical Education in Science and Technology* 14: 59–66.
- Lerman, S. (1989) Constructivism, Mathematics and Mathematics Education. *Educational Studies in Mathematics* 20: 211–223.
- Leung, C., and Mohan, B. (2004) Teacher formative assessment and talk in Classroom contexts: Assessment as discourse and assessment of discourse. *Language Testing*, 21, 335-359
- Lewin, K. M and Dunne M. 2000. “Policy and Practice in Assessment in Anglophone Africa: Does Globalisation Explain Convergence?” In *Assessment in Education: Principles, Policy and Practice. Special Issue: Globalisation, Qualifications and Livelihoods*.
- Lincoln, Y. S. and Guba E. G. (1985) *Naturalistic Inquiry*. Newbury Park, CA: Sage Publications.
- Lissitz, R. and Schafer, W. (2002) *Assessment in Educational Reform: Both Means and Ends*. Boston, MA: Allyn and Bacon.
- Lockheed, M. E. and Verspoor, A. M. (1991) *Improving Primary Education in Developing Countries*. New York: Oxford University Press
- Ma, L. (1999) *Knowing and Teaching Elementary Mathematics: Teachers’ Understanding of Fundamental Mathematics in China and the United States*. Mahwah, NJ: Erlbaum Associates.
- Madaus, G.F., and Kellaghan, T. (1992) Curriculum evaluation and assessment. P.W.Jackson (Ed.), *Handbook of research on curriculum* (pp. 119- 154). New York: Macmillan.

- Mabry, L., Poole, J., Redmond, L., and Schultz, A. (2003) Local impact of state testing in Southwest Washington, *Education Policy Analysis Archives*, 11(22). Available online at: <http://epaa.asu.edu/epaa/v11n22/> Date accessed 20th June, 2012.
- Marsh, C.J. (2004) *Key Concepts for Understanding Curriculum*. Oxon: Routledge Falmer
- Marshall, B. and Drummond, and M. (2006) How Teachers Engage with Assessment for Learning: Lessons from the Classroom. *Research Papers in Education* 21(2): 133–49.
- McAlpine, M. (2002) *Principles of Assessment*. Blue paper No.1, CAAA Centre. Luton: University of Luton.
- McNeill, P. & Chapman, S. (2005), *Research Methods*, (3rd edition), New York, Routledge.
- McGalliard, W. J. (1983) Selected factors in the conceptual systems of geometry teachers: Four case studies (Doctoral dissertation, University of Georgia). *Dissertation Abstracts International*, 44A, 1364.
- McMillan, J. H. (2001) *Essential Assessment Concepts for Teachers and Administrators*. Thousand Oaks, CA: Corwin Publishing Company.
- McKnight, D.H., Choudbury, V. and Kacmar, C. (2002) Developing and validating trust measures for e-commerce: an integrative typology. *Information Systems Research*, 13 (3), 334-61
- McNair, S., Bhargava, A., Adams, L., Edgerton, S. and Kypos, B. (2003) Teachers Speak out on Assessment Practices, *Early Childhood Education Journal*, 31(1), 23–31.
- McWilliams, H. O. A. and Kwamena-Poh, M. A. (1975) *The Development of Education in Ghana*. London: Longman Group Ltd.

- Merriam, S. B. (1998) *Qualitative Research and Case Study Applications in Education* (2nd edn). San Francisco, CA: Jossey-Bass Publishers.
- Miles, M. and Huberman, A. M. (1994) *Qualitative Data Analysis*. London: Sage Publications
- Ministry of Education (2010) Education Sector Report. Accra, Ghana, MOE, 2010
- Ministry of Education (2008) Education Strategic Plan (ESP). Accra, Ghana: Ministry of Education.
- Ministry of Education (2013) *Basic School Syllabus*. Accra, Ghana: Ministry of Education.
- Ministry of Education, Curriculum, Research and Development Division (2010) Ghana National Educational Assessment (NEA) report 2007–13. Accra, Ghana: Ministry of Education.
- Ministry of Education, Science and Sports (2011) *Education Sector Report 2008–11*. Accra, Ghana: Ministry of Education.
- Morgan, C. and Watson, A. (2002) The Interpretative Nature of Teachers' Assessment of Pupils' Mathematics: Issues for Equity. *Journal for Research in Mathematics Education* 33(2): 78–110.
- Morse, J. (1994) *Critical Issues in Qualitative Research*. Thousand Oaks, CA: Sage Publications.
- Morris, P., and Adamson, B. (2010) Curriculum, schooling and society in Hong Kong. Hong Kong: Hong Kong University Press.
- Mpeirwe, J. (2007) Management of instructional materials and performance of Teachers in Primary Schools in Kampala. Unpublished master's dissertation, Makerere University, Kampala, Uganda.

- Myers, M. D. and Huberman, A. M. (1994) *Qualitative Data Analysis: An Expanded Sourcebook* (2nd edn). Thousand Oaks, CA: Sage Publications.
- National Centre for Education Statistics (2001) *ECLS-K Base Year Restricted-Use Salary and Benefits File 2001–14*. Washington, DC: U.S. Government Printing Office.
- National Council of Teachers of Mathematics (2005, 2006a) *Curriculum Focal Points for Pre-Kindergarten through Grade 8 Mathematics*. Reston, VA: NCTM.
- National Council of Teachers of Mathematics (2006b) *NCTM releases curriculum Focal Points to Focus Math Curricula*. Accessed 27 September 2007 from www.nctm.org/standards/focalpoints.aspx?id=7760
- National Council of Teachers of Mathematics (NCTE) (2006c) All Eyes are on NCTM's Curriculum Focal Points. *NCTM News Bulletin* 43(4): 1–6.
- National Council of Teachers of Mathematics (1995) *Assessment Standards for School Mathematics*. Reston, VA: NCTM.
- NCTM (1989) *Curriculum and Evaluation Standards for School Mathematics* (Reston, VA, NCTM).
- NDPC, (2009) 2008 Annual Report on the Implementation of the Growth and Poverty Reduction Strategy (GPRS).
- NEIDA (1992) (Network of Educational Innovation for Development in Africa). *The Situation of Educational Materials in Africa*. Dakar, UNESCO.
- NESAR, (2013) MOE, Ghana: “Report on the National Education Sector Review”, 2011-2013
- Ngaaso, C., Abato, J. A., Owereko, M. Henny, I. (2011) *Social Studies Atlas for Basic Schools*. Adwensa Publications. (Gh). Ltd
- Nickson, M. (1981) *Social Foundations of The Mathematics Curriculum*, Unpublished Doctoral Dissertation, University of London Institute of Education.

- No Child Left Behind (2007) *Building on Results: A Blueprint for Strengthening NCBL*. Washington, DC: US Department of Education.
- Oaks, J. (1985) *Keeping Track: How Schools Structure Inequality*. New Haven, CT: Yale University Press.
- Oduro, E. O. (2009) Classroom Assessment Practices. Unpublished paper, University of Sussex, UK.
- OECD (2005) *Formative Assessment: Improving Learning in Secondary Classrooms*. Centre for Educational Research and Innovation (CERI).
- Organisation for Economic Cooperation and Development OECD (2010) *PISA 2009 Results: Learning to Learn – Student Engagement, Strategies and Practices (Volume III)* <http://dx.doi.org/10.1787/9789264083943-en>. Date accessed, 2nd March 2010.
- Organisation for Economic Cooperation and Development (OECD) (2011) Review of Evaluation and Assessment in Education. OECD Publishing.
- Organisation for Economic Cooperation and Development, and Centre for Educational Research and Innovation (OECD/CERI)(2005) International conference. Learning in the 21st Century: *Research, innovation and policy*.
- O-saki, K. M. and Agu, A. O. (2002) Study of Classroom Interaction in Primary in the United Republic of Tanzania. *Prospects* 32: 103–116.
- O’Sullivan M., (2001) “The Inset Strategies Model: An Effective Inset Model for Unqualified and Under Qualified Primary Teachers in Namibia *International Journal of Educational Development* 21, pp. 93-117
- Owens, J. (1987). A study of four pre-service secondary mathematics teachers' constructs of mathematics and mathematics teaching (Doctoral dissertation, University of Georgia). *Dissertation Abstracts International*, 48A, 588.
- Padgett, D.K. (1998) Qualitative Methods in Social Work Research: Challenges and

Rewards. Thousand Oaks, CA: Sage.

Patton, M. Q. (2002) *Qualitative Research and Evaluation Methods* (3rd edn). Thousand Oaks, CA: Sage Publications.

Pennycuik, D. (1990) 'The introduction of continuous assessment systems at secondary level in developing countries' in Broadfoot, P., Murphy, R. and Torrance, H. (eds.) *Changing educational assessment: International perspectives and trends*. London: Routledge

Pimm, D. (1987) *Speaking Mathematically: Communication in Mathematics Classrooms*. London: Routledge and Kegan.

Pishghadam, R. and Shayesteh, S. (2012) Conceptions of assessment among Iranian EFL Teachers, EN, *Iranian EFL Journal*, Volume (8) 2012-6 pp. 9-23

Popham, W. (2008) *Transformative assessment*. Alexandria, VA: Association for Supervision and Curriculum Development.

Pryor, J. and Lubisi, C. (2002) Reconceptualising education assessment in South Africa. *Journal of Educational Development* 22: 673–686.

Ragin, C. C. (1992) 'Casing' and the process of social inquiry. In C. C. Ragin and H. S. Becker (eds) *What is a Case? Exploring the Foundations of Social Inquiry*. Cambridge, UK: Cambridge University Press.

Ramaprasad, A. (1983) On the definition of feedback. *Behavioural Science* 28: 4–13.

Remesal, A. (2011) Primary and secondary teachers' conceptions of assessment: A qualitative study. *Journal of Teaching and Teacher Education*. 27(2): 472–482.

Quansah K.B (2005) *Continuous assessment handbook*. Ghana education service publication. (BECAS project document).

- Ransuran, A. (2006) 'How are teachers' understandings and practices positioned in discourses of assessment?' paper presented at the 4th sub-regional conference on Assessment in Education. Johannesburg, South Africa, 26th to 30th June 2006.
- Reynolds, A., Reagin, M. and Rein shuttle, K. (2001) Less is More: What teachers Say About Decreasing Class Size and Increasing Learning. *American School Board Journal* 199(9): 30–32.
- Rolleston, C. (2009) The Determination of Exclusion: Evidence From The Ghana Living Standards Surveys 1991–2006. *Comparative Education* 45(2): 197–218.
- Romberg, T. A. (ed) (2004) *Standards-Based Mathematics Assessment in Middle School: Rethinking Classroom Practice*. New York: Teachers College Press.
- Romberg, T. A. and Kaput, J. (1999) Mathematics Worth Teaching, Mathematics Worth Understanding. In E. Fennema and T. A. Romberg (eds) *Mathematics Classrooms that Promote Understanding*. Mahwah, NJ: Lawrence Erlbaum Associates, 3–18.
- Rust, C. (2002) Learning and Teaching briefing papers.
www.brookes.ac.uk/services/ocsld/resources/assessment/purposes.html Date accessed; 10th December, 2012.
- Sach, E. (2012) Teachers and testing: An investigation into teachers' perceptions of formative assessment. *Educational Studies*, 38(2), 261–276
- Sadler, R. (1989) Formative Assessment and the Design of Instructional Systems. *Instructional Science* 18: 119–144.
- Schafer, W. D. (1991) Essential Assessment Skills in Professional Education of Teachers. *Educational Measurement: Issues and Practice* 10(1): 3–6.

- Sebba, J., Crick, R. D., Yu, G. Lawson, H., Harlen, W., and Duruant, K. (2008) Systematic review of research evidence of the impact on students in secondary schools of self and peer assessment. EPPI –Centre report no 1614, October, 2008.
- Senk, S. L., Beckmann, C. E., and Thompson, D. R. (1997) Assessment and grading in high school mathematics classrooms. *Journal for Research in Mathematics Education*, 28(2), 187-215
- Senk, S. L. and Thompson, D. R. (eds) (2003) *Standards-Based School Mathematics Curricula: What are They? What do Pupils Learn?* Hillsdale NJ: Erlbaum Associates.
- Sharkey, J. (2005) OK, But It's Not Our Reality: Teachers' Negotiating Their Political Contexts. In M. Bigelow and C. Walker (eds) *Creating Teacher Community: Selected Papers From the Third International Conference on Language Teacher Education*. Minneapolis, MN: Centre for Advanced Research on Language Acquisition, 165–186.
- Shepard, L. A. (2005) Linking Formative Assessment to Scaffolding. *Educational Researcher* 63(3): 66–70.
- Shepard, L.A. (2006) Classroom Assessment. In *Educational measurement*, 4th ed., ed. R.L. Brennan, 623–46. Westport, CT: American Council on Education/Praeger.
- Shepard, L.A. 2008. Formative assessment: Caveat Emptor. In *The future of assessment: Shaping teaching and learning*, ed. C.A. Dwyer, 279–303. New York: Erlbaum.
- Shulman, L. (1986) Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review* 57: 1–22.
- Skovsmose, O. (2006) Research, Practice, Uncertainty and Responsibility. *Journal of Mathematical Behaviour*, 25(4), 267-284.

- Smith, M. L. L. and Rotenberg, C. (1991) Unintended Consequences of External Testing in Elementary Schools. *Educational Measurement: Issues and Practice*, 10(4), 7-11.
- Susuwele-Banda, W. J. (2005) Classroom assessment in Malawi: Teachers' perceptions and practices in mathematics (Doctoral dissertation, Virginia Polytechnic Institute, 2005). *Dissertation Abstracts International*, 66, 12.
- Sutton, R. (1992) *Assessment: A Framework for Teachers*. London: Routledge.
- Stake, R. (1999) *The Art of Case Study Research*. Thousand Oaks, CA: Sage Publications.
- Stiggins, R. J. (1997) *Student-Centred Classroom Assessment* (2nd edn). Upper Saddle River, NJ: Merrill.
- Stiggins, R. and Arter, J. (2002) 'Assessment for Learning: International Perspectives'. Proceedings of an International Conference, Chester, UK, September, 2001. Corporate source: Assessment Training Inst. Inc., Portland.
- Stiggins, R. J. (1999) Evaluating Classroom Assessment Training in Teacher Education Programs. *Educational Measurement: Issues and Practice*, 18(10), 23-27.
- Stiggins, R. J. (2002) Assessment crisis: The absence of assessment for learning. *Phi Delta Kappan* 83 (10): 758-765.
- Stiggins, R., Chappuis, J. (2005). Using student involved classroom assessment to close achievement gaps. Theory into Practice. Retrieved on July, 2013 http://findarticles.com/p/articles/mi_MONQM/is_1_44/ai_n13807464?tag=content:coll
- Stobart, G. (2008) *Testing Times: The Uses and Abuses of Assessment*. London: Routledge.

- Stobart, G. (2010) Assessment fit-for-the-future. A paper presented at IAEA Annual Conference. Accessed from www.iaea.info/documents/paper_4d520c71.pdf. on February 12th 2014.
- Strauss, A. and Corbin, J. (1990) *Basics of Qualitative Research*. Newbury Park, CA: Sage Publications.
- Suurtamm, C., Koch, M., Arden, A. (2010), “Teachers’ Assessment Practices in Mathematics: Classrooms in the Context of Reform”, *Assessment in Education: Principles, Policy and Practice*, 17 (4), 399-417. Doi: 10.1080/0969594X.2010.497469.
- Tabulawa R. (1997) “Pedagogical Classroom Practice and the Social Context: The Case of Botswana” *International Journal of Educational Development*, Vol. 17(2): pp. *Primary Education. Basic Education Studies*, 2000-2001. Dhaka: UNESCO Office Dhaka. Histories. In R. Hunting, G. Fitzsimons, P. Clarkson and A. Bishop (Eds) *Regional Collaboration in Mathematics Education*, 695–701.
- Tan, K. (2011) ‘Assessment for learning reform in Singapore – quality, sustainable or threshold?’ In: R. Berry and B. Adamson (eds) *Assessment reform in education: policy and practice*. London: Springer, 75-87.
- Taylor S. J. and Bogdan R. (1984) *Introduction to Qualitative Research Methods*. New York: Wiley Inter-science
- Thines, G. (1972) *Phenomenology and the Science of Behaviour: An Historical and Epistemological Approach*. London: George Allen and Unwin.
- Thompson, M. and Wiliam, D. (2008) ‘Tight but loose: a conceptual framework for scaling up School Reforms’. In: C. Wylie (ed) *Tight but Loose: Scaling Up Teacher Professional Development in Diverse Contexts*. Princeton, NJ: Educational Testing Service (ETS).

- Thompson, A. G. (1992) Teachers' beliefs and conceptions: A synthesis of the research. In D. A. Grouws (ed) *Handbook of Research on Mathematics Teaching and Learning*. New York: MacMillan, 127–46.
- Thompson, P. (1989) Artificial intelligence, advanced technology, and learning and teaching algebra. In S. Wagner & c. Kieran (Eds.), *Research issues in the learning and teaching of algebra* (pp. 135-161). Reston, VA: National Council of Teachers of Mathematics.
- Torrance, H. (2007) Assessment as learning? How The Use of Explicit Learning Objectives, Assessment Criteria, And Feedback in Post-Secondary Education and Training Can Come to Dominate Learning. *Assessment In Education: Principles, Policy And Practice* 14(3): 281–95.
- Torrance, H. and Pryor, J. (1998) *Investigating Formative Assessment: Teaching Learning and Assessment in the Classroom*. Buckingham, UK: Open University Press.
- Trends in International Mathematics and Science Study (TIMSS) (2010) Accessed 20 June 2010 <http://nces.ed.gov/timss/>
- Trochim, M. K (2008) Research Method Knowledge Base. Accessed from www.socialmethods.net/kb/qualval.php. Date accessed, 20th June, 2011
- Uchiyama, M. K. (2004) Teachers' use of formative assessment in middle school Reform-Based Mathematics Classrooms, *Digital Dissertations* (UMI No. AAT 3123299).
- UNESCO (2006) *Global Education Digest, 2006: Comparing Education Statistics Across the World*. Montreal, Canada: UNESCO Institute of Statistics.
- UNESCO, (2013/14) EFA Global Monitoring Report: Teaching and Learning. Quality for all. 2013/14 Paris, UNESCO

- USAID (2009) *The Review of Basic Education Quality in Ghana: Basic Education in Ghana Progress and Problems*. Washington, DC: The Mitchell Group.
- Van de Walle, (2001) *Elementary and Middle School Mathematics*: New York: Longman.
- WAEC (1990) *A research report on "the relationship between school estimates and ordinary level examination results: Science and mathematics*. WAEC publication. Accra department of WAEC research division.
- WAEC (1993) *A research report on "Ghana basic education certificate examination (BECE): Relationship between Internal and external assessments*. WAEC publications. Accra department of WAEC research division.
- Walsham, G. (2005) Learning about being critical. *Information Systems Journal* 15(2) 111–117.
- Webb, M. and Jones, J. (2009) 'Exploring tensions in developing assessment for Learning'. *Assessment in education*, 16(2), 165-184.
- Wiliam, D. (2011) What is assessment for learning? *Studies in Educational Evaluation*, 37, 3-14. doi:10.1016/j.stueduc.2011.03.001
- Wiliam, D. (2009) 'Assessment for learning: why, what and how?' Inaugural professorial lecture, London: Institute of Education, University of London.
- Wiliam, D. (2006) Assessment: Learning communities can use it to engineer a Bridge Connecting Teaching and Learning. *Journal of Staff Development* 27(1): 16–20.
- Wiliam, D. (2009) An integrative summary of the Research Literature and Implications for a New Theory of Formative Assessment. In H. L. Andrade and G. J. Cizek (eds) *Handbook of Formative Assessment*. New York, NY: Taylor and Francis.

- Wilson, S. M., Shulman, L. S. and Richert, A. (1987) 150 different ways of Knowing: Representations of knowledge in teaching. In J. Calderhead (ed) *Exploring Teachers' Thinking*. Sussex, UK: Holt, Rinehart and Winston, 104–124.
- Wolf, D., Bixby, H., Glenn, J. H. and Gardner, H. (1991) To use their minds well: Investigating new forms of student assessment. *Review of Research in Education*, 17, 31-74.
- World Bank, (2014) Basic Education beyond Millennium Development Goals in Ghana: How *Equity in service delivery affects educational and learning outcomes*, Washington, U.S.A
- World Bank, (2011) World Bank EdStats database, (2011)
<http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTEDUCATION/EXTDATASTATISTICS/EXTEDSTATS/0..menuPK:3232818~pagePK:64168427~piPK:64168435~theSitePK:3232764,00.html>
- Yorke, M. (2003) Formative assessment in higher education: Moves Towards Theory and the Enhancement of Pedagogic Practice. *Higher Education*, 45(4): 477-501.
- Yin, R. K. (2003) Applications of case study research (applied social research Methods). *Series, 4th edn. Thousand Oaks: Sage Publications*.
- Zajda, J. (2004) The role of the state in education. *International Review of Education*, 50(3/4), 199-221.

APPENDICES

Appendix 1

Lesson Observation Protocol

Section A

Date..... Name of School.....
 Time of observation.....
 Start
 End.....
 Grade level.....
 Teacher's gender.....
 Number of pupils

Boys	Girls	Total

Absent

Section B

Teacher's bio-data

Qualifications...
 Trained..... Untrained.....
 Teaching Experience.....
 Number of years with present class.....
 Number of INSET courses attended.....

Section C

Lesson plan

Topic.....
 Objective(s).....Smart or not
 Core points stated to achieve objective(s)
 Teacher learner activities –adequate or not stated
 Comments.....

Section D

Classroom context

1. Adequacy of physical environment:
 Classroom resources:
 Sparsely equipped... rich in resources...
 Comments.....

2. Classroom space:

Crowded or adequate room?

Comments.....

3. Classroom arrangement:

.....

 Comments

4. Interaction among pupils:

Comments.....

E. Description of lesson delivery**General Comments**

.....

F. Major way(s) in which pupil activities were structured

As whole class in small groups, in pairs or as individuals

Comments (estimate time spent on each)

.....

G. Major way(s) in which pupils engaged in class activities

Entire class was engaged in the same activities at the same time

Groups of pupils were engaged in different activities at the same time

Comments.....

H. Major activities of pupils

1. Listened to a presentation:

a. By teacher (including demonstration, lecture, extensive procedural instruction)

b. By pupils (including informal or presentation of their work)

Comments.....

2. Engaged in discussion:

a. whole class.

b. small groups/pairs.

Comments.....

3. Questioning and feedback:

- a. Engaged in fact-eliciting (closed) questions
- b. Engaged in higher level (open) questions
- c. Mixed question types
- d. Pupils allowed to ask questions
- e. Reflected on questions and pupils' answers
- f. Prompted feedback

Comments

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4. Engaged in problem solving/investigation:

- a. Played a game to build or review knowledge
- b. Followed specific instructions in an investigation
- c. Had some latitude in designing an investigation
- d. Recorded, represented and/or analysed data
- e. Recognised patterns or trends
- f. Evaluated the validity of arguments or claims

Comments

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4. Engaged in reading/reflection/written communication about mathematics:

- a. Read about mathematics
- b. Answered textbook/worksheet questions
- c. Reflected on reading activities or problems individually or in groups
- d. Prepared a written report
- e. Wrote a description of a plan, procedure or problem-solving process.
- f. Wrote a reflection in a notebook.

Comments

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5. Used any audio and/ or visual teaching and/or learning resource:

- a. To develop conceptual understanding
- b. To learn or practice a skill.
- c. To collect data
- d. As a problem-solving tool (e.g. data analysis)
- e. As a presentation tool
- f. As a communication tool

Comments

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6. Other activities

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I. Comments

Any additional information necessary to capture lesson activities or context, including comments on any feature of the class.

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Appendix 2

Interview Schedule for Teachers

Mathematics teaching and learning have remained problematic in basic schools in Ghana. Various reasons have been attributed to the low pupils' performance in mathematics. New assessment procedures replacing the continuous assessment – the School-Based Assessment (SBA) have been introduced intended to influence the ways in which teachers assess pupils formatively. The study seeks to explore the teachers' classroom assessment practices in view of the current changes.

Teachers are assured of anonymity and confidentiality.

The main research question: 'What are teachers' assessment practices in mathematics classrooms in Ghana?' has the following sub-questions as follows:

Interview questions

1. What is your understanding of assessment?
2. How has assessment benefited your teaching: Has it been useful to you?
3. How has assessment made a difference to your classroom practices, how you teach, and how pupils respond in class?
4. On average over the year, how many times do you assess the pupils in your class?
Do you do this at any particular time(s) and why?
5. How have your pupils embraced the type of assessment you conduct?
6. What are some of the types of assessments you use in your classroom?
7. To what extent has assessment influenced teaching and learning?
8. What lessons have you learnt in your assessment practices?
9. How does assessment relate to your classroom work?

10. How do the conditions under which teachers teach influence their classroom assessment in mathematics?
 11. How have you been monitoring pupils' progress during lesson delivery?
 12. How has the classroom arrangement helped you in your teaching?
 13. What challenges do you face in conducting your classroom assessment?
 14. What policies and institutional factors influence teachers' classroom assessment practices in mathematics classrooms?
 15. What policies exist that influence your assessment practices?
- How has the community embraced assessment results in your school?

Appendix 3

Data for NEA Results by Region

	Primary 3		Primary 6	
	MC (%)	Prof (%)	MC (%)	Prof (%)
Greater Accra	74	40	81	38
Ashanti	55	22	62	20
Western	53	17	59	16
Eastern	52	16	59	14
Central	51	16	51	11
Brong Ahafo	51	13	52	10
Volta	44	10	51	12
North	41	11	36	4
Upper West	41	9	48	8
Upper East	46	13	50	9

Source: NEA, 2011p.xv

Appendix 4



University of Sussex

CONSENT FORM FOR PROJECT PARTICIPANTS

PROJECT TITLE:

**ASSESSMENT IN THE MATHEMATICS
CLASSROOM IN GHANA: A STUDY OF
TEACHERS' PRACTICES IN TWO BASIC SCHOOLS**

Project Approval:

Reference:

I agree to take part in the above study, which is being conducted by Ms Evelyn Owusu Oduro, a student of the University of Sussex, UK. I have had the project explained to me, and I have read and understood the Explanatory Statement, which I may keep for my records. I understand that agreeing to take part means that I am willing to:

- Allow the researcher to observe my lessons
- Be interviewed by the researcher
- Allow the interview to be audiotaped
- Make myself available for a further interview should the need arise

I understand that any information I provide is confidential, and that no information I disclose will lead to the identification of any individual in the project report, either by the researcher or by any other party.

I understand that my participation is voluntary, that I can choose not to participate in part or all of the project, and that I can withdraw at any stage without being penalised or disadvantaged in any way.

If the data collected need to be stored for future use, I would like the researcher to negotiate with me again for my consent.

Name: _____

Signature: _____

Date: _____

Independent witness to participant's voluntary and informed consent (if necessary e.g. where there is a relationship between the participant and the researcher which might be deemed to unduly influence the participant's voluntary consent).

I believe that _____ (name) understands the above project and gives his/her consent voluntarily.

Name: _____

Signature: _____

Address: _____

Date: _____