UNIVERSITY OF EDUCATION, WINNEBA

ASSESSMENT LITERACY OF MATHEMATICS TEACHERS AND CHALLENGES IN THE IMPLEMENTATION OF THE SCHOOL-BASED ASSESSMENT IN SENIOR HIGH SCHOOLS OF GHANA

SEYRAM SEWORNOO

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SEYRAM SEWORNOO

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DECLARATION

STUDENTS' DECLARATION

I, SEYRAM SEWORNOO, declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE: ……

DATE: ……

SUPERVISOR'S DECLARATION

I/We hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of Dissertation as laid down by the University of Education, Winneba.

NAME OF PRINCIPAL SUPERVISOR: Dr. M. J. NABIE

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DATE: ……

NAME OF CO-SUPERVISOR: Dr. CHARLES ASSUAH

SIGNATURE……

DATE…….

DEDICATION

This dissertation is dedicated to all my family members and friends for their love and support

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This study investigated the level of assessment literacy of mathematics teachers and the challenges in the implementation of School Based Assessment (SBA) in Senior High Schools of the Central Region of Ghana. Specifically, it explored the level of mathematics teachers‟ knowledge of the purposes of assessment, assessment strategies, interpretation and action-taking on assessment data, and what to assess in mathematics. It also explored the challenges in implementing SBA and the possible ways of addressing the problems of SBA implementation. The study used mixed method design in which 102 mathematics teachers were purposively sampled from 15 randomly selected Senior High Schools. The instrument used was a questionnaire. Major findings of the study were: mathematics teachers tended to have low level of knowledge on the use of assessment to plan their lessons; low level of knowledge on assessing problem-solving; low level of knowledge in the development of project work assessment; low level of knowledge in preparing marking schemes to score subjective tests. Furthermore, the challenges in SBA implementation were overloaded classes, heavy teaching workload, lack of SBA coordination and monitoring mechanism, lack of guideline for preparing/implementing SBA, lack of interest from parents in schoolwork of students, and insufficient time to carry out SBA. Proposed solutions to challenges included: GES should set reasonable and manageable class sizes; and organise in-service training on assessment. Recommendations were made.

CHAPTER 1

INTRODUCTION

1.1 Overview

This study explored the level of assessment literacy of mathematics teachers and the challenges in the implementation of the School-Based Assessment (SBA). Specifically, it explored the level of teachers‟ knowledge of the purposes of assessment, assessment strategies, interpretation and action-taking, and what to assess, challenges in implementing SBA and the possible ways of addressing the problems of SBA implementation in Senior High Schools in the Central Region of Ghana. This chapter presents the background to the study, the statement of the problem, the purpose of the study, the objectives of the study, the research questions, the significance of the study, the delimitation, the limitation and the organization of the study.

1.2 Background to the Study

The quality of the curriculum content, the assessment practices, and the teaching and learning activities are factors that determine the success of the school education system. Assessment, as a determining factor, still remains a powerful educational tool. It is used for monitoring the quality of the school system, evaluating education policies and programmes. It is also used for making important decisions about instruction and placement of students in the curriculum, and for certifying students‟ learning achievement (Bello & Tijani, 2008). Assessment offers the opportunity for teachers to gather, analyse and interpret information in order to tell how well students are doing on a particular subject (Ashie, 2009) and enables the students to see their achievement (McGraw, 2006). The vital role of assessment in schools and the importance placed on mathematics education in Ghana underscore the need for teachers to be assessment literate. The Ministry of Education (MoE) places value on

assessment literacy of teachers, and has made assessment an integral part of the teacher education curriculum. The Ghana Education Service (GES) within the Ministry of Education has also instituted in-service fresher training programmes for teachers to upgrade their knowledge in assessment practices. These interventions are in line with the MoE (2014) recommendation that teachers are to be "assessment literate" (p. 38). Assessment literate teachers "know what they assess, why they assess, how to assess", what the possible problems with assessment are, and how to prevent them from occurring (Nabie, Akayuure, & Sofo, 2013, p. 48). Assessment literacy is important because it helps teachers to

> "perceive, analyse and use data on student performance to improve teaching. Stakeholders are influenced by tests...being assessment literate is more vital for them because assessment illiteracy results in inaccurate assessment and consequently the purposes of assessment could not be fulfilled" (Khadijeh & Amir, 2015, p. 1).

The requirement for assessment literacy was occasioned by the introduction of the School Based Assessment (SBA) system to replace the Continuous Assessment scheme in the 2007 syllabus review (MoE, 2014). Bello and Tijani (2008) recognised that the Continuous Assessment (CA) scheme was generally expected to achieve four major purposes. First, Continuous Assessment was to ensure both the legitimacy and dependability of the results of students" performance in the final certification examination by reflecting the performance of the pupils under normal classroom circumstances in the final grading. Second, Continuous Assessment was most appropriate for and encouraged the assessment of the totality of the student, as it identified with the affective and psychomotor domains of learning. Third, Continuous Assessment bestowed on the classroom teacher a measure of involvement in the

evaluation of his or her students. Fourth, CA helped the student to build a viable and profitable learning habit.

In spite of these four critical purposes outlined above, some weaknesses were identified with the Continuous Assessment scheme. It was noted that even though formative assessment (or assessment for learning) and summative assessment (or assessment of learning) were recommended for schools, summative assessment was largely practised in the Continuous Assessment regime at the expense of formative assessment. The over-dependence on summative assessment only resulted in the evaluation of student accomplishment retrospectively after a unit or course; for instance, allocation to a level or class or allocation of a letter or numerical grade, which might later show up in a report. Attention was driven only to the narrow and measurable but ignoring the important and immeasurable. The CA system was based on frequent paper-and-pencil test-taking which did not really serve the four purposes of the CA. Thus, the CA system placed emphasis on accountability and related issues other than the development of cognition of learners (the habit of the mind to reason and solve problems), a weakness the MoE (2014) report noted.

In order to address these shortcomings in the Continuous Assessment system, the School Based Assessment (SBA) was introduced to emphasise assessment for learning (formative assessment). Assessment for Learning is the process of looking for and interpreting evidence for utilisation by learners and their teachers to decide where the learners are in their learning, where they need to go and how best to arrive there. It helps teachers to monitor their own progress (MoE, 2014). According to the MoE (2014) report, the School Based Assessment (SBA) is a more embracing system that directs attention to the cognitive domain of learning but receives little attention

under the Continuous Assessment period. The report argues that, in the School Based Assessment system, students need to apply the knowledge and skills gained in the school term to carry out bona fide assessment tasks or innovative activities, tackle a genuine issue and write analytic reports and propose a new orientation to project work in pre-tertiary school subjects. Both assessment for and of learning are expected to be given in the course of teaching in all pre-tertiary school subjects to inform students‟ progress and teachers‟ practice, except that, assessment for learning should be largely used in the SBA. Assessment for learning provides a means of testing aspects of achievement which may not be easily or sufficiently tested by timed-tests. Classroom assessment ought to reflect this understanding and employ a diverse array of methods, including those that call for actual performance, using them over time so as to reveal change, growth and an increased degree of integration (Bello & Tijani, 2008). Conducting assessment in this manner provides a precise picture of learning achievement and enhances students‟ educational experience.

The nature of classroom assessment in schools brought about by the new School Based Assessment policy, particularly at the Senior High School level, is such that, unlike the Continuous Assessment where teachers used homework tasks which require a very short duration of time to finish as project, in SBA, projects are expected to take no less than six weeks to complete. After the first 3 or 4 weeks of teaching in a term, the teacher is expected to set and administer a class test covering the topics

(or content) treated and record this as SBA Task 1. Then after the next 3 or 4 weeks in the term, the teacher sets and administers SBA Task 2. Task 4, Task 8 and Task 12 are supposed to be projects to be undertaken throughout the term and submitted at the end of the term; a student is expected to select one project topic for each term; and

projects for the second term would be undertaken by teams of students as group projects. Furthermore, in the Continuous Assessment regime, the aggregate class score was 30% of the final score but in the SBA it is 50% of the final score. Class exercises and homework scores formed part of the Continuous Assessment but not in the SBA, where they serve formative evaluation purposes only. The major changes to classroom assessment, which accompanied the introduction of SBA, are summarised in Table 1.2.

Table 1.2 Major changes to assessment which came with the 2007 syllabus review

	Nature of changes	CA	SBA
Overall changes	i. Use of class exercises and home work	Largely for CA	For formative evaluation only
	ii. % contribution of Class Exercises/ Homework/project work to overall school assessment	30%	-
	iii. % contribution of SBA Tasks to overall school assessment (i.e.	-	50%

	class tests & project)		
iv.	% contribution of end of t erm exams to overall school assessment	70%	50%
v.	% contribution of (I or II and III) to final WASSCE score	30%	30%
vi.	Number of assessments per term	11	4
vii.	Number of assessments per year	33	12
Changes in project	a) Number of project tasks given per term	4	1
	b) Term distribution of project tasks by individual or group	All individual tasks each term	Individual tasks in terms 1 and 3; Group task in term 2
	c) When is project task given and completed?	Any time, i.e. teachers discretion	Beginning of the term and submitted at the end of the term
	d) Written report required?	Optional, largely oral presentation	Yes, with references
	e) Scoring projects	5	20

(Source: MoE, 2014, p. 37)

The Curriculum Research and Development Division of GES (CRDD, 2010) has portrayed the new assessment system, SBA, as one which can lead to very effective teaching and learning if carried out properly. CRDD (2010) stated that the new internal assessment system will help schools to accomplish the following purposes:

- "standardize the practice of internal school-based assessment in the country
- provide reduced assessment tasks for each school subject
- provide teachers with guidelines for constructing assessment items/questions and other assessment tasks
- introduce standards of achievement in each subject and in each class
- provide guidance in marking and grading of test items/questions and other assessment tasks

- introduce a system of moderation that will ensure accuracy and reliability of teachers‟ marks
- provide teachers with advice on how to conduct remedial instruction on difficult areas of the syllabus to improve students‟ performance” (CRDD, 2010 p. xii).

In view of all of the above, assessment is becoming more structured and rigid with the introduction of school based assessment and the use of assessment tasks which have to be administered at regular intervals irrespective of students‟ readiness as stipulated by SBA procedures (Ghartey-Ampiah, 2012). The nagging issue, therefore, is the capability of the teacher, who is at the centre of the education/classroom, to conduct school based assessment to meet the instructional goals and aspirations of the new system. Thus, the teacher should possess a good knowledge of the assessment process, particularly the four areas of knowledge in the assessment process: knowledge of assessment purposes; knowledge of assessment strategies; knowledge of assessment interpretation and action taking; and knowledge of what to assess (Abell & Siegel, 2011). In this regard, schools that are concerned about the implementation of SBA will definitely make sure that their teachers are knowledgeable in all aspects of assessment. Since the most critical implementers of SBA are the teachers, it is imperative that studies are conducted to explore the level of assessment literacy of mathematics teachers in Senior High Schools, from time to time, to ascertain their capability to handle assessment activities, and also the impact that the training programmes are having on them and their work.

1.3 Statement of the Problem

Despite the fact that classroom assessments are controlled by teachers who by their professional training, "know what to teach, how to teach, and how to assess" (Nabie, Akayuure & Sofo, 2013, p. 48), available research reports (MoE, 2014; World Bank, 2013) point to the fact that teachers are still lacking in many aspects of the School Based Assessment (planning, developing and administering assessment methods, as well as scoring, analyzing and reporting assessment data) leading to weak assessment and its attendant poor performance recorded in mathematics over the years.

Students‟ poor performance in mathematics and teachers‟ weakness in their assessment practices have earlier been reported in the Trends in International Mathematics and Science Study reports (Anamuah-Mensah, Mereku & Ghartey-Ampiah, 2008) and the World Bank‟s (2013) Systems Approach for Better Education Results (SABER) study respectively. Mereku and Appiah (2012) had earlier observed the prescriptive and procedural nature of the Ghanaian classroom assessment practices.

The problem of weak assessments and its attendant poor performance of students‟ in mathematics have brought to the fore the need to investigate the issue of teachers‟ assessment literacy levels in SBA and the accompanying challenges of SBA implementation, if the noble aspirations of the Education Ministry to provide quality mathematics education are to be realised. Stiggins (2005) warns that without the ability to effectively assess student attainment of curriculum targets, we will be unable to help students attain higher levels of academic achievement, regardless of the instructional methods we use or, how we organize our schools. This suggests that if teachers‟ knowledge in assessment is inadequate and/or are unable to overcome assessment-related challenges, they may not be able to help improve student learning.

With limited knowledge, they may feel overwhelmed and frustrated and consequently display undesirable work behaviours towards performing school based assessments. As indicated by Fook and Sidhu (2010), finding ways of improving the levels of teachers‟ knowledge in all aspects of SBA should be an important objective in order to improve best practices of teachers in assessment.

1.4 Purpose of the Study

Despite the introduction of the School Based Assessment in 2007, classroom assessment practices in Ghana are still weak as reported by the World Bank‟s (2013) „Systems Approach for Better Education Results (SABER)‟ study. Consequently, students‟ performances in mathematics over the years have not been encouraging. MoE (2014) report states that, the reforms in assessment require that teachers are assessment literate. Therefore, the study explored the level of assessment literacy of mathematics teachers and the challenges in the implementation of the School-Based Assessment (SBA).

1.5 Objectives of the Study

The study was designed to explore:

1. The assessment literacy level of Senior High School Mathematics teachers in school based assessment (SBA) in Ghana.
2. Senior High School Mathematics teachers‟ challenges in implementing school based assessment (SBA).
3. Senior High School Mathematics teachers‟ perspectives on how the challenges of SBA can be addressed.

1.6 Research Questions

The following research questions were formulated to guide the study:

1. What is the level of SHS Mathematics teachers‟ assessment literacy in SBA?
2. What are SHS Mathematics teachers‟ challenges in implementing the SBA?
3. From SHS Mathematics teachers‟ perspective, how can the challenges be addressed?

1.7 Significance of the Study

According to Khadijeh and Amir (2015), assessment literacy is important because it helps teachers to

> “perceive, analyze and use data on student performance to improve teaching. Stakeholders are influenced by tests...being assessment literate is more vital for them because assessment illiteracy results in inaccurate assessment and consequently the purposes of assessment could not be fulfilled” (p. 1).

Knowing mathematics teachers‟ assessment literacy level will enable facilitators of workshops, or the agencies responsible for planning, developing and executing the blueprint in the form of curriculum and assessment for teachers to implement, to develop need-specific professional development and training in assessment. It is also hoped that the results of this study will help mathematics teachers to have improved teaching experience through improved assessment. Furthermore, the study will bring to the fore assessment-related challenges that will enable the Ministry of Education to take steps to mitigate the challenges that confront the administration of school-based assessment in schools. Research work remains an academic exercise in all educational

institutions. The findings could also be the basis for future educational research works into mathematics teachers‟ assessment literacy. The study is deemed timely and crucial as it could provide a relevant picture for scholars, practitioners and policy makers in relation to assessment.

1.8 Delimitation of the Study

The study focused on the assessment literacy of mathematics teachers and some challenges in the implementation of school based assessment system in Senior High Schools in Ghana. The research covered Mathematics teachers from only fifteen (15) Senior High Schools in the Central Region of Ghana. This was because the teachers willing to participate in the study (comprising the sample required) were obtained after visiting the fifteenth school.

Additionally, even though assessment literacy as indicated by Abell and Siegel (2011) consists of three main aspects (view of learning, assessment principles, and domains of knowledge), the study focused only on the knowledge domains: knowledge of the purposes of assessment; knowledge of assessment strategies; knowledge of assessment interpretation and action taking; and knowledge of what to assess. This was because the study was designed to measure the level of constructs in the knowledge domains.

1.9 Limitation of the Study

As purposive sampling technique was employed to ensure that experienced teachers are selected for the study, the researcher did not involve all the teachers in the schools. As a result, there was bias as some teachers were deliberately left out. Also,

the study depended on teachers‟ self-perceived knowledge to evaluate their assessment literacy. Consequently, teachers‟ responses were not verified to ascertain their actual level of knowledge.

2.0 Organisation of the Study

The report is organised into five chapters. The first chapter comprises the background to the study, the statement of the problem, the purpose of the study, the research questions, the significance of the study, the delimitation of the study and the limitation of the study. Chapter two is a review of carefully selected literature relevant to the problem investigated. It reflected the conceptual framework within which the study is grounded and interpreted. The research methodology, chapter three, covers the research design, population, sample and sampling techniques, instrument for data collection, the validity and reliability of the instrument, data collection procedure, data analysis procedure and ethical issues. Results of the study and its findings are presented in the fourth chapter. The fifth chapter presents summary of findings, conclusion and recommendations to the study.

CHAPTER 2

LITERATURE REVIEW

The problem necessitating the study was the weakness in classroom assessments and its attendant poor performance of students‟ in mathematics. Therefore, the study was designed to explore the assessment literacy of mathematics teachers, the challenges of School-Based Assessment (SBA) implementation and its solutions in Senior High Schools in the Central Region of Ghana. Specifically, it explores the level of teachers‟ knowledge of the purposes of assessment, assessment strategies, interpretation and action-taking on assessment data, and what to assess, challenges in implementing SBA and the possible ways of addressing the problems of SBA implementation in Senior High Schools in the Central Region of Ghana. In order to achieve these objectives, literature relevant to the study was reviewed.

Stake (2008) stated that it is a prerequisite of all research works to review work done by other researchers in the area of study. The review is to ensure that the primary goal of research is met, which is to contribute to knowledge in the area of study. Researcher Chumun (2002) has stated that literature review serves three main purposes: First, to synthesise knowledge which has been researched and published in the area of study; Second, to present the present situation in the topic of interest and how the current study improves or revises what is known; Third, to provide a foundation for a problem being investigated or formulate a problem, select a research

methodology and interpret research results. This chapter reviews literature relevant to the study.

The literature is reviewed in the following areas: concept of assessment literacy; assessment purposes, what to assess in SBA, assessment strategies in SBA, assessment interpretation and action-taking on SBA data, and challenges in the implementation of classroom assessment/SBA.

2.1 Concept of Assessment literacy

Assessment is a comprehensive term as it deals with a wide range of processes (Stiggins, 2005). The processes range from formal examinations, with academic achievement as the foremost concern, to on-going events of the classroom which are related to instruction. Underlying these processes is the competence of the teacher, in terms of assessment literacy, to manage the processes. Popham (2009) argues that, up until recent times, the teacher knew so little about educational assessment because educational assessment was not incorporated in their training programme. In Ghana, training modules in assessment that teacher-trainees are offered emphasize measurement and statistics, and focus on the technicalities of assessment, rather than innovative use of assessment for improvement of learning (Amedahe, 2000). Thus, teacher education (undergraduate and graduate) programmes do not provide adequate training in assessment as part of teacher certification to ensure teachers are assessment literate (MoE, 2014).

Assessment literacy is defined as the ability of teachers to develop assessments that relates learning objectives to assessment activities for students to understand and achieve what is expected in the syllabus (Gottheiner & Siegel, 2012). Thus, assessment literates "know what they assess, why they assess, how to assess, what the

possible problems with assessment are, and how to prevent them from occurring" (Khadijeh & Amir, 2015, p. 140).

According to the MoE (2014) report, assessment literate teachers, apart from knowing basic principles of sound classroom testing procedures, must have clear vision of the meaning of academic success, and translate that vision into high-quality assessments in the classroom. Assessment literate teachers also understand how to produce high-quality achievement data and use assessment data to evaluate and improve their practice. These conceptions of assesment literacy in the School Based Assessment system is represented in a model by Abell and Siegel (2011).

Abell and Siegel (2011) described assessment literacy as composing three main aspects: view of learning; assessment principles; and four areas of knowledge (knowledge of assessment purposes, knowledge of assessment strategies, knowledge of assessment interpretation and action taking, and knowledge of what to assess). The study is grounded on Abell and Siegel"s conceptions of assessment literacy with focus on the four areas of knowledge. In Abell and Siegel (2011), a model of assessment literacy is described based on research literature (see Figure 1).

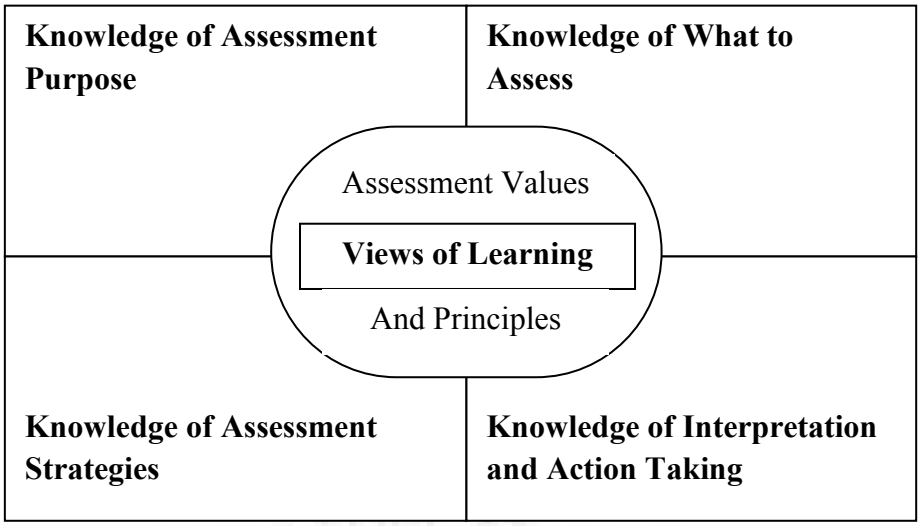

Figure 1 A model for teacher literacy from Abell and Siegel (2011, p. 534)

From Abell and Siegel (2011) model, there are four core principles at the heart of teacher assessment literacy: First, assessment as a process by which teachers can learn about their classroom practices and how to improve them in order to better support student learning. Second, assessment as a process from which students should learn. Testing students in ways that requires higher levels of thinking enables students to learn from the process. Third, assessment should help students to develop their own knowledge and skills in order to self-regulate their learning. To help students develop their learning, it is important to consider how assessment tasks are introduced to and used by students, how assessment data are interpreted by teachers, and how instruction is adapted in response to assessment data. Fourth, assessment tasks need to be equitable for all learners. Tasks should be designed to minimize the bias for all students.

The four principles of assessment literacy have four corresponding knowledge domains, namely: assessment purposes; what to assess; assessment strategies; and assessment data interpretation and action taking.

2.1.1 Purposes of Assessment

In Ghana, the recommended assessment types for schools under the SBA system are formative and summative assessments, so as to draw on the benefits of both assessments. Consequently, teachers‟ reasons for conducting SBA must reflect these benefits. According to Abell and Siegel (2011), assessment purposes involve teachers‟ reasons for assessing students. They observe that the common reasons for assessment include assessing "to diagnose students‟ prior knowledge, to assess students‟ knowledge during instruction, to document learning at the end of a unit, and to help students diagnose their own learning" (p. 210).

Teachers‟ reasons for conducting assessment have been identified variously in the literature. Through assessment, teachers are able to collect information, make interpretations and decisions on the basis of the information gathered on a daily basis in the classroom for improved teaching and learning (Airasian, 1997; Dix, 2010) and monitor students‟ learning progress towards learning goals (Linn & Miller, 2005). Researchers like Black and Wiliam (1998); Stiggins (2005); Wiliam and Thompson (2008) and McGraw (2006) have stated that the assessment serves the purposes of evaluating students, teachers, curriculum and resources; providing certificates; predicting, controlling, and maintaining standards; giving grades; and fostering communication and accountability.

According to Jabbarifar (2009), assessment as a process includes four basic functions: First, measuring improvement over time; Second, motivating students to study; Third,

evaluating the teaching methods; and Fourth, ranking the students' capabilities in relation to the whole group evaluation. He further states that the purpose of classroom assessment and evaluation is to give students the opportunity to show what they have learned rather than catching them out or to show what they have not learned. The fourth function of assessment, in ranking the students‟ capabilities in relation to the whole group evaluation as indicated by Jabbarifar (2009), takes two forms: Norm-referenced and Criterion-referenced assessments. According to Harlen (2005), the purpose of assessment is to determine the student‟s overall achievement in a specific area of learning at a particular time. Teachers use the evidence gathered through assessment to do more careful planning for the next teaching cycle (Sethusha, 2014).

According to MoE (2014) and Bello and Tijani (2008), School Based Assessment (SBA) serves three purposes, namely: first, to discover the progress, strengths and weaknesses of students from the perspective of performance; Second, to inform teachers‟ decision about what needs to be taught, how effective teaching has been and class performance in comparison with other teachers and schools; Third, to make important grading, selection and placement decisions about students on a grade based on merits, certify students learning achievement and provide feedback to stakeholders on the quality of an educational institution. On its grading function, they state that assessment produces certificates of competence at a particular stage of learning and provides basis for graduating a learner from one level to the next. SBA scores generated by teachers through classroom assessments were incorporated in the final grading of students at a ratio of 70:30 (External: SBA), which ultimately certifies students‟ learning and achievement. SBA helps in placing students at the different levels of the school curriculum to ensure the development of their potential, which is

the selection function of assessment. Additionally, SBA scores have a predictive function as it provides information on the likely performance of students.

Educational policy formulators are particularly interested in ensuring best practices by reviewing the status of curriculum standards for best practices to be maintained through instruction and assessment. In Ghana, external assessment by the West African Examination Council (WAEC) is used nationally by policymakers for this purpose - improvements in educational outcomes (MoE, 2014). Additionally, Akunu (2012) observes that external assessment impacts what and how teachers teach and assess in the classroom.

Some studies, that explored assessment practices of teachers, have reported on some purposes of assessment as indicated by teachers. Philippou and Christou (1997) conducted a study into the role of assessment, grading criteria, most common item format and objectives tested, and alignment of assessment and instruction. They investigated Greek and Cypriot teachers‟ assessment practices and found that teachers thought that the main purposes of assessment were to determine students‟ difficulties and to assess the effectiveness of instruction.

Delandshere and Jones (1999) examined the assessment conceptions of elementary teachers. They found out that teachers viewed assessment as having three main purposes: for placing students in the appropriate curriculum stage; for describing student achievement and defending their grading system; and, for preparing students for large-scale standardised tests.

In Ghana, a study on the training needs of teachers in School Based Assessment (SBA) by Bello and Tijani (2008) showed that teachers carry out assessment

purposely to determine students‟ learning progress, to ascertain the impact of instructional method on students‟ understanding and for accountability.

2.1.2 What we Assess in Learning Mathematics

According to Abell and Siegel (2011), what to assess is tied to the curricular and learning goals. The importance of defining what to assess adds meaning to the exercise of meeting curriculum goals and distinguishes between "assessment of attainment or effort or ability or improvement or deterioration" (Chumun, 2002, p. 105). Teachers assess both cognitive and non-cognitive characteristic such as attitudes and behaviours. Teachers lookout for affective characteristics - interest, quietness, confidence and behaviour as well as mathematical ability, anytime they take a class to teach (Black & Broadfoot, 1982). These characteristics are generally termed as cognitive, affective and recreational behaviours. According to De Lange (1999), attributes of the affective domain such as attitudes and interest do not constitute mathematical competence but are nonetheless important pre-requisites for the attainment of mathematical competence. De Lange (1999) argues that for mathematical competence to be achieved, teachers must design test items that examines skills which he organised in three levels. He states that the first level comprises reproduction, definition and computation; second level comprises connections and integration for problem solving, and the third level comprises mathematisation, mathematical thinking, generalisation and insight.

De Lange (1999) explains the three levels as follows: level one is about the performance expectation aspects of „"knowing" and using "routine procedures" used in TIMSS study (p. 14). Level one deals with "knowledge of facts,… recalling mathematical objects and properties, performing routine procedures…, and dealing

with statements and expressions that contain symbols and formulas" (p. 14). The second level is somewhat related to the TIMSS "investigating and problem solving category" which included "formulating and classifying problems and situations, developing strategy, solving, predicting, and verifying" (p. 14). Level three relates to "mathematical reasoning" (p. 15) and performance expectation which include developing notation and vocabulary, developing algorithms, generalising and conjecturing. He acknowledges that level three, which goes to the heart of mathematics and mathematical literacy, is difficult to test. He states that level three goes with three dimensions, namely: the "content or domains of mathematics ... mathematical thinking and understanding, and ...difficulty of questions posed from simple to complex" (p. 15).

The assessment framework for TIMSS-2007 was covered by two organising dimensions: a content dimension which specifies the domains or subject matter to be assessed within each subject; and a cognitive dimension which specifies the domains or thinking processes to be assessed. In each subject, there were three cognitive domains – Knowing, Applying and Reasoning (Anamuah-Mensah, Mereku & Ghartey-Ampiah, 2008).

In Ghana, the official curriculum for mathematics instruction and assessment at the senior high school level is the mathematics syllabus. The syllabus noted that in developing assessment procedures, teachers should first select specific objectives in such a way that they would be able to assess a representative sample of the syllabus objectives (CRDD, 2010). The Ghanaian School Based Assessment (SBA) is structured to direct attention to cognitive areas of learning, which are knowing, application and reasoning (Anamuah-Mensah, Mereku & Ghartey-Ampiah, 2008). In

line with the objective of directing attention to the cognitive areas of learning, curriculum developers designed the mathematics syllabus to ensure most importantly that both instruction and assessment are based on the specified profile dimensions - Knowledge and Understanding, and Application of Knowledge - and the seven areas of subject matter - Number and Numeration, Plane Geometry, Mensuration, Algebra, Statistics and Probability, Trigonometry, and Vectors and Transformation in a Plane (CRDD, 2010). It is instructive to note that these dimensions are consistent with the Knowledge and Cognitive Process dimensions of the revised Taxonomy (Krathwohl, 2002) and what constitutes mathematical competence as described by De Lange (1999). The diagram below shows the proportion of the profile dimensions recommended for SBA and end of term examination in Senior High Schools.

Table 2.1.2 Proportion of the Profile Dimensions for SBA and Exam Paper

Dimensions	Paper 1	Paper 2	SBA	Total Marks	Total Marks Scaled to 100
Knowledge and Understanding	30	20	10	60	30
Application of Knowledge	10	80	50	140	70
Total	40	100	60	200	
% Contribution of Exam Papers	20	50	30		100

It is clear from the mathematics syllabus, SBA policy and from De Lange (1999) that mathematics assessment assesses or should assess both the product and process of learning. Assessment today places more emphasis on acquisition of skills and abilities rather than just knowledge. Therefore, it is important for teachers to consider whether to assess the product of student learning or the process of learning or both. The

concern expressed however is that teachers may focus too much on grading the finished activity after considering the finished outcome, instead of focusing more on the way it was produced, the way the students set out organising knowledge and interpreting information. This is because their preoccupation is finishing the syllabus (MoE, 2014). In product of work, attention is paid to the ideas presented, the quality and quantity of work, its relevance to the subject set and to evidence of originality. In process, the attention is on how the work was carried out, planned, executed and demonstrated. It must be noted that process and product are intimately related and that process leads to product.

Some studies have shown what most teachers assess in their assessment of students. In Delandshere and Jones‟ (1999) study which examined the assessment conceptions of elementary teachers, they found out that teachers distinguished between formal assessment which resulted in grades, and informal assessment that were not used for grading. As a result, teachers adhered to testing skills and procedures. Their assessment practices where primarily summative similar to the mandated state assessments. They reported that teachers‟ assessments were aligned with their instruction since both were skill and procedure based. Cooney and Shealy (1995) also hold similar views to that of Delanshere and Jones (1999). Cooney and Shealy (1995) report that teachers had assessment conceptions and practices that were aligned with their mathematics and learning conceptions. Majority of the teachers in their study believed that mathematics is basically computation, problem skills and concepts. As a result, their tests were primarily computational in nature. Other teachers in their study, viewed mathematics as a puzzle which consisted of challenging and analytical patterns and so engaged students regularly in projects and activities that focussed on process than procedure (product). According to Brown (2003), teachers who used

computational tests used assessment as a tool to measure surface learning since they only assessed skills and concepts. On the other hand, teachers who focussed on process and used open-ended projects, viewed assessment as a means to influence learning and improve the education of students.

2.1.3 Mathematics Assessment Strategies

An assessment strategy involves "knowledge of assessment formats, understanding of assessment types and specific instruments" (Abell & Siegell, 2011, p. 534). Assessment Strategies refers to how a teacher assesses students on particular concepts, both formatively and summatively (Abell & Siegel, 2011). NCTM (2000) states that "because different students show what they know and can do in different ways, assessments should allow for multiple approaches, thus giving a well-rounded picture and allowing each student to show his or her best strengths" (p. 23).

2.1.3.1 Formative and Summative Assessment Strategies

Formative assessment strategies involve ways of gathering, interpreting, and acting on information about students‟ learning so that it may be improved. According to Bell and Cowie (2001), formative assessment strategies may be formal or informal, and take place in the course of instruction. Formal formative assessment strategies take the form of curriculum-embedded assessment that focus on some specific aspect of learning, but they can also be direct questioning, quizzes, brainstorming, generation of questions, and many more. Conversely, informal formative assessment strategies are improvised and can take place in any student-teacher interaction at whole class, small group, or one-on-one levels. It can arise out of any teaching/learning activity at hand, and it is embedded in and strongly linked to learning and teaching activities (Bell & Cowie, 2001).

Formative assessment incorporates alternative assessment techniques into teaching and learning. The need to provide a holistic and comprehensive learning experience geared towards realising the goals of education has led to the proposal to incorporate alternative, and not just the traditional, strategies of assessment in the teaching and learning process (Wiliam & Thompson, 2008). This proposal allows for the adoption and inclusion of wide-ranging teaching and assessment methods to elicit information to guide instruction. Alternative assessments are developed from classroom instruction and activities which involve real-world problems or tasks that cannot be measured by the traditional assessments. Alternative assessment uses measurements and evaluation strategies relevant to both the teacher and the students (Herrera, Murry & Cabral, 2007). In alternative assessment strategies, students have the opportunity to demonstrate what they learned. This assessment strategy focuses on the growth and the performance of the student. That is, if a student fails to perform a given task at a particular time, she or he still has the opportunity to demonstrate his or her ability at a different time and different situation. Since alternative assessment, as a strategy, is developed in context and over time, the teacher has a chance to measure the strengths and weaknesses of the student in a variety of areas and situations (Atsu, 2011). Therefore, the teacher has a better understanding of student learning by looking at the student product rather than scores for further insights regarding students‟ knowledge and skills (Atsu, 2011).

Summative assessment strategies, on the other hand, are administered periodically to determine at a particular point in time what students know and do not know. Summative assessment strategies point out the result of an assessment on what has been achieved at a particular stage of the curriculum. These strategies cannot provide immediate feedback because the results are known too late and information is not

available to the pupils about the strengths or weaknesses of their work (Stiggins, 2005). Summative assessment, as a strategy, concerns itself with summing up or summarising achievement of students, which is usually reported at the end of a term or for purposes of certification at the completion of a course of study (Bello & Tijani, 2008). That is, summative assessment strategies are limited to administrative decisions and assigning grades to the tests (Wiliam & Thompson, 2008).

2.1.3.2 Mathematics Assessment Tools

Available literature have identified and reported on some specific instruments/tools used formatively and summatively in assessments.

Some formative assessment tools used in assessments and their descriptions are:

Observations of students during in-class activities: Observation is a "process of systematically viewing and recording students while they work, for the purpose of making programming and instruction decisions… it provides information on students' strengths and weaknesses, learning styles, interests, and attitudes" (Ontario, 2005, p. 1).

Interviews: An interview is a face-to-face conversation in which teacher and student use "inquiry to share their knowledge and understanding of a topic or problem… used by the teacher to explore the student‟s thinking; assess the student‟s level of understanding of a concept or procedure; gather information or obtain clarification" (Ontario, 2005, p. 1). Interviews provide immediate feedback.

Questions and Answers (Oral Discussion): In the question-and-answer strategy, "the teacher poses a question and the student answers verbally, rather than in writing… this strategy helps the teacher to determine whether students understand what is being,

or has been, presented, and helps students to extend their thinking". This could be both formal (planned) and informal (spontaneous). Homework exercises could be used as review for class discussions. (Ontario, 2005, p. 2).

Performance Tasks/Projects: During a performance task, students "create, produce, perform, or present works on real world issues. The performance task may be used to assess a skill or proficiency, and provides useful information on the process as well as the product" (Ontario, 2005, p. 2). Projects are example of performance tasks. Projects encourage time on academics outside of class, and can be used to assess transfer of skills and integration of content (Hanna & Dettmer, 2004). Projects involve tasks or a series of tasks for students to carry out using one or more of the following processes: gathering data, observing, looking for references, identifying, measuring, analyzing, determining patterns and or relationships, graphing and communicating. In the SBA, project work has been restructured and its focus is now to encourage students to apply knowledge and skills acquired in the school term to carry out authentic assessment tasks and write analytic reports or use mathematics to solve real life problems (problem-solving) (MoE, 2014).

Classroom Presentation: In-class activities where students informally present their results. A classroom presentation requires students to "verbalize their knowledge, select and present samples of finished work, and organize their thoughts about a topic in order to present a summary of their learning…this could provide the basis for assessment after completion of a student"s project" (Ontario, 2005, p. 1). As part of project-based learning in the SBA, the teacher is expected to give the students the opportunity periodically to present progress reports to the class for colleagues" feedback and suggestions (MoE, 2014).

Some summative assessment tools used in assessments and their descriptions are:

Quizzes, Tests, Examinations: A quiz, test, or examination requires "students to respond to prompts in order to demonstrate their knowledge in writing or their skills (e.g., through performance). Quizzes are usually short; examinations are usually longer… quizzes, tests, or examinations can be adapted for re-teaching" (Ontario, 2005, p. 2). Quizzes, Tests or Examinations could be objective (multiple choice questions) or subjective (essays). These assessment tools can be tailored to match instructional objective and are known to yield results quickly. However, weaknesses identified with tests or examinations are: they are vulnerable to student theft and distribution; they tend to dominate the syllabus rather than reflect them; and learning in the classrooms is restricted to examinable activities only (Dery & Addy-Lamptey, 2010).

Multiple Choice Questions or Selected Responses are a part of quizzes, tests, and examinations. Selected responses require students to "identify the one correct answer. The strategy can take the form of multiple-choice or true/false formats…selected response is a commonly used formal procedure for gathering objective evidence about student learning, specifically in memory, recall, and comprehension" (Ontario, 2005, p. 2). Its disadvantage is that students‟ success is largely determined by a great element of chance (Dery & Addy-Lamptey, 2010).

Essays: An essay is a "writing sample in which a student constructs a response to a question, topic, or brief statement, and supplies supporting details or arguments…the essay allows the teacher to assess the student's understanding and/or ability to analyse and synthesize information" (Ontario, 2005, p. 1).

Philippou and Christou (1997) researched into the role of assessment, grading criteria, most common item format and objectives tested, and alignment of assessment and instruction. They investigated Greek and Cypriot teachers‟ assessment practices. They reported that teachers used a variety of strategies to determine students‟ mathematics grades including class participation, performance on class work, test scores and student effort. Teachers reported using a variety of test items formats including but not limited to items for understanding novel problems and items requiring applying to concepts to novel situations.

The Ghanaian mathematics syllabus recommends that teachers use class tests, homework, projects, quizzes, oral questions, group exercise, end-of-term tests etc developed in such a way that will challenge students to apply their knowledge to issues, and develop observational and investigative skills (CRDD, 2010). Nabie, Akayuure and Sofo (2008) investigated Ghanaian teachers‟ assessment practices and challenges of integrating problem solving and investigations in teaching mathematics. Their results show that many practising teachers integrated and used multiple assessment techniques in their problem solving and investigation lessons. They report that majority of teachers used traditional rather than alternative assessment strategies which included class exercise, tests, homework, discussion, observation, project work and group work as recommended by the syllabus.

Abell and Siegel (2011) states that assessment literate use strategies beyond the traditional multiple choice and true/false type of formats. Familiarity with a variety of assessment tools helps teachers to select the most relevant and powerful instruments for particular learning goals. According to Lowery (2003), traditional tools are indispensable as their role in assessments in measuring some aspects of achievement

such as factual recall cannot be determined any other way. He suggests that alternative assessments help in directing attention away from the computational, speed and accuracy of mathematics, which characterises traditional assessments, to strategies that encourage mathematical thinking. This develops understanding rather than developing a student‟s memory. He further states that alternative assessment strategies like portfolios, open-ended questions, focused observations and performance tasks offer more opportunities to students mastery of subject matter by asking them to create, perform, or produce; tap higher-level thinking; and involve problem-solving skills.

2.1.4 Interpretation and Action-Taking on Assessment Data

The third core principle of assessment states that assessment should help students to self-regulate their learning. To help students develop their learning, it is important to consider how assessment tasks are introduced to and used by students, how assessment data are interpreted by teachers, and how instruction is adapted in response to assessment data. Thus, Assessment Interpretation and Action-Taking pertains to what teachers believe about how students would respond to assessment tasks and how they interpret and adjust their instruction in response to this. For instance, teachers routinely use assessment data to assign grades, but more knowledgeable teachers are able to analyse and report assessment data to stakeholders for purposes such as to adjust lessons and student tasks (Abell & Siegel, 2011).

According to Abell and Siegel (2011), an important aspect of assessment literacy is the teacher understanding for interpreting and acting on assessment information. They state that “teachers need to know not only what, when, how and why to assess, but also what to do with the assessment data” (p. 534). Interpretation is often overlooked

in assessment, but researchers stress that once teachers successfully interpret assessment results, developing an instructional strategy to address the findings is necessary to enhance the learning experiences of students (Stiggins, 2005; Abell & Siegel, 2011).

2.1.4.1 Interpreting Assessment Responses

Grading is the "process of judging the finality of a student‟s work or performance in which scores and descriptive evidence are converted into marks or letters (grades), which indicate how well each child has learned" (Airasian, 1997). Grades are traditional and universal means of documenting students‟ learning performance. Although students and other stakeholders place such importance on grades, few teaches have had formal training for it. Only teachers on marking duties for the West African Examination Council‟s conducted exams are taking through the process of marking and scoring, while the majority of teachers do not have this training. Ekwueme and Meremitwu (2013) observed that students taught by teachers with WAEC marking experience committed fewer errors than their counterparts taught by teachers without WAEC marking experience. Grades are formal and important element of students‟ record. Grading is a difficult task for teachers because teachers tend to be bias instead of being objective. In grading students‟ end-of-term test, SBA scores account for 30% of the final score as shown in Table 2.1.2.

In Ghana, investigations carried out on SBA by the Curriculum and Research Development Division of the Ghana Education Service show that significant differences existed in teachers scoring of test. The findings also show that marking schemes were not used to score students responses to tests (Dery & Addy-Lamptey, 2010). The West African Examination Council (1996) study reported that some

teachers scored school based subjective tests without marking schemes, a situation it described as worrying (Bello & Tijani, 2008). This is worrying as it could lead to wrong analysis and reporting of assessment data. School Based Assessment data is analysed quantitatively and qualitatively to determine students‟ performances for continuous assessment purposes.

2.1.4.2 Action-Taking on Assessment Results

This important phase is characterised by communicating assessment results to various stakeholders. Teachers are the main users of the evidence gathered. They use assessment to check the effectiveness of instruction (Sethusha, 2012). According to Sethusha (2012), teachers use assessment data to make decisions about students‟ needs in the next term, to tell how well their students reached well-defined goals and achieved outcomes. Thus, they evaluate students‟ progress or achievement. Moreover, teachers use the evidence gathered to do more careful planning for the next teaching cycle.

Reporting assessment data to students provides them with clear feedback as to their progress and makes them more accountable for their own learning. Students are able to reflect on what they have learned. As a result, students can take more active roles in making decisions about what their needs are for the next lessons.

Parents also play a prominent role in classroom assessment. Assessment results communicated to parents provide them with concise feedback and explicit evidence of their children‟s progress so that they can monitor and supervise their children‟s work. They are also able to assist the teacher in internal decision-making. Finally, school administrators need reports to make a variety of decisions about assessment-related issues such as curriculum planning and assessment policy (Sethusa, 2012).

2.2 Challenges in Implementing School Based Assessment

Webb (2005) highlighted factors such as school organisation, traditions and routine, the length of the class periods, class sizes and the system‟s expectations for grade-level content as contributing to teachers‟ classroom practices. In his arguments, Webb (2005) is of the opinion that short duration class periods often curtail sustained student engagement, classroom discussion and opportunities for reflection. Additionally, a large class size in a class can pose a challenge for offering prompt and constructive feedback to open-ended questions and students‟ projects.

Henderson and Mapp (2002) found that "students with involved parents, no matter what their income or background, were more likely to earn higher grades and test scores and enrol in higher-level programs, be promoted, pass their classes, attend school regularly, have better social skills, show improved behaviour, adapt well to school and graduate and go on to further education" (p.7). It was recommended that school authorities, in drawing school achievement plans, must endeavour to involve parents.

According to Airasian (1997), some of the difficulties teachers face in implementing good school based assessment include the plenty of interactions which take place in the classroom, questions of subjectivity and reliability of classroom assessment, the lack of systematic recording approaches to keep the information, and the need to control the class while all these are being done. Chumun (2002) also points out problems faced in implementing school based assessment apart from the nature and range of the assessments teachers are being required to make, also include the time, energy and the skills needed to carry out the assessments effectively.

Byabato and Kisamo (2014) investigated the implementation of school based continuous assessment in Tanzania and its implications on the quality of education. In their study, five hundred and forty six (546) secondary school teachers from Dar es Salaam, Arusha and Zanzibar were involved. Their study revealed that the implementation of school based assessment is fraught with a number of serious problems such as lack of teachers‟ integrity, favouritism and marks inflation, lack of uniformity in the assessment tools, varying procedures for recording and reporting as many of the teachers who generate these problems lack professional training on assessment practice.

Fabunmi and Adewale (2002) ackowledged a report on the relationship between certain school-related factors and secondary school internal efficiency in Ogun State between 1992 and 1997. Results of findings revealed a positive and significant relationship between school size and internal efficiency. The report established that school size made a significant contribution to the efficiency of schools as it predicted the performance of a school,and impacted administrative supervision and control at both class and school levels. Fabunmi and Adewale (2002) recommended that adequate quantity and quality of teachers should be posted to schools to deal with the problem of increasing school and class sizes.

Kapambwe (2010) in his study which investigated the implementation of school based continuous assessment in Zambia reports that teachers indicated that large class size, staffing, student absenteeism, inadequate teaching and learning resources, lack of teacher networking, inadequate monitoring and feedback were the challenges they faced to effectively carry out school based assessment. According to Siaw and Nortey (2011), Ghanaian schools are characterised by large class sizes of up to 70 students

per class in urban and peri-urban areas and 30 or less in rural schools. MoE‟s (2013) report states that student-classroom ratio at the SHS level is 56.0, as of 2012/13 academic year, having increased from 50.4 the previous year. Ghana Education Service policy states that an ideal class size should have been twenty-five and thirty-five students (Mintah, 2014). According to Mintah (2014), when the number of students in a class is more than thirty-five such a class is said to be large. He noted that the number of students in a class in most Ghanaian Senior High Schools on average is sixty-five.

Akyeampong, Pryor and Ampiah (2006) reported on inadequate monitoring where circuit supervisors visited schools they only looked at registers and lesson notes, or marked work and continuous assessment records. Any systematic formative assessment during teaching and learning in the classroom was neither monitored nor encouraged. Baku (1991) reports that, teachers were generally generous in the award of marks to candidates, and concluded that poor assessment skills and poor monitoring mechanism have contributed to that.

Asare-Inkoom‟s (2001) study was designed to investigate whether the intended time of 160 min per week for 96 weeks was adequate for the treatment of the Senior Secondary School Core Mathematics in the Cape Coast Education District of the Central Region of Ghana. The data were analysed by means of simple proportion, t-statistics and one-way analysis of variance. The results showed that the intended time of 160 min per week for 96 weeks for the SHS core mathematics programme was inadequate.

2.3 Summary

The literature review was grounded on Abell and Siegel‟s (2011) conceptual model of teachers‟ assessment literacy and situated in the Ghanaian context. Literature showed that teachers‟ purposes of assessments are generally to place students in the appropriate curriculum stage, to describe student achievement, prepare students for large-scale examinations (e.g. WAEC examinations), to meet continuous assessment requirements of the SBA, and to measure the effectiveness of instruction for improved learning. To achieve these purposes, teachers‟ utilise both formative and summative assessment tools (e.g. group work, class tests, class exercises, homework and projects) and assessment formats (objective and subjective items) to assess the necessary mathematical values. These mathematical values include knowledge and understanding, mathematical reasoning and problem-solving competencies. Data obtained from assessments are interpreted quantitatively and qualitatively for use by the teachers, and are communicated to other stakeholders. Marking schemes are necessary aids in the interpretation of assessment data for objectivity and accurate action-taking. The Ghanaian School Based Assessments cover seven subject areas namely: number and numeration; plane geometry; algebra, mensuration; statistics and probability; trigonometry; vectors and transformation in a plane.

Literature on challenges in assessment in schools showed that challenges ranged from large class sizes, inadequate instructional time, lack of proper monitoring and control, lack of teachers‟ integrity, to lack of systematic recording approaches. Solutions to challenges in assessment ranged from provision of infrastructure, adequate teacher recruitment, proper monitoring and coordination of assessment, provision of SBA guideline, to proper training in assessment.

CHAPTER 3

METHODOLOGY

3.1 Overview

This chapter presents the research design, population, sample and sampling procedure, instrument for data collection, validity and reliability, ethics, field work and data analysis as applied in this study.

3.2 Research Design

According to Babbie and Mouton (2001), a research design is a set of guidelines and instructions that are followed in conducting research. The purpose of the research design is to achieve greater control of the study (Burns & Grove, 2001). The study was designed to explore the assessment literacy of mathematics teachers in Senior High Schools in the Central Region of Ghana. A study on mathematics teachers‟ assessment literacy requires the collection of both quantitative and qualitative data. According to Cresswell and Plano-Clark (2007), mixed method design allows the use of both quantitative and qualitative data collection techniques. The mixed method, as a research design with methods of inquiry, focuses on collecting, analyzing and mixing both quantitative and qualitative data in a single study in which the data are collected concurrently, or in a series of study in which the data are collected sequentially (Cresswell & Plano-Clark, 2007). According to Tashakkori and Teddlie (2003), the mixed method design provides better opportunities for the researcher

to answer research questions. Consequently, a mixed method design was used for the study.

3.3 Population

According to Ary, Jacobs and Rezavieh (2002), population refers to the entire group of individuals to whom the findings of a study apply. It is the group the researcher wishes to explore about. In this study, the primary aim was to explore the level of assessment literacy in Senior High Schools in the Central Region of Ghana. The targeted group or population was the mathematics teachers in the Senior High Schools in the Central Region. Schools in the Central Region were chosen for convenience since the researcher hails from the region and he is very familiar with academic activities in the region. Also, teachers of the schools in the region are comparable to teachers across the country in terms of teaching qualification and experience. These characteristics are very important for generalisation.

3.4 Sample and Sampling Techniques

The sample of mathematics teachers for the study was drawn using purposive sampling from fifteen Senior High Schools in the Central Region. This method of sampling was chosen in order to compose a sample of mathematics teachers with at least four years‟ experience with classroom assessment/SBA. This is because, by virtue of their experience, they are likely to be knowledgeable about School Based Assessment and the challenges confronting its implementation. Creswell (2002) stated that, in purposive sampling, researchers intentionally select individuals and sites to learn or understand a phenomenon. The sample consisted of one hundred and two (102) teachers from the 15 schools. Simple random sampling was used to select the

fifteen schools. The schools selected and the numbers of teachers chosen are as shown in Table 3.1.

Table 3.1 Number of Participants in the sampled Schools

NAME OF SCHOOL	NUMBER OF MATHEMATICS TEACHERS
First School	10
Second School	8
Third School	7
Fourth School	6
Fifth School	8
Sixth School	6
Seven School	10
Eighth School	5
Ninth School	10
Tenth School	6
Eleventh School	5
Twelfth School	5
thirteenth School	3
Fourteenth School	5
Fifteenth School	8

The variation in the number of teachers was because the teachers willing to participate varied from school to school.

3.5 Instrument for Data Collection

Instrumentation refers to the tools or means by which a researcher attempts to measure variables or items of interest in the data-collection process. It is related not only to instrument design, selection, construction and measurement, but also the conditions under which the designated instruments are administered (Salkind, 2010). The instrument is the device used by the researcher for collecting data.

The questionnaire was the data collection instrument used for the study. The questionnaire was adapted from Fook and Sidhu (2010) because its questions related to the primary aim of the study or the research questions. Fook and Sidhu (2010) questionnaire consists of both close and open-ended questions that were used to obtain quantitative and qualitative data on the level of knowledge and best practices of Malaysian ESL (English as a Second Language) teachers in SBA. The close-ended questions collected data on the following constructs: knowledge in planning the SBA; knowledge in developing the SBA; knowledge in scoring, analysing and reporting the SBA. The open-ended questions dealt with respondents‟ demographic variables of gender, ethnic and academic qualification. The close-ended items had two types of 4-point Likert scale as shown in Tables 3.5a and 3.5b.

Table 3.5a The categories and coding of the 4-point Likert scale

Daily/Weekly (D/W)	Monthly (M)	Termly (T)	Never Used (NU)
1	2	3	4

The scales in Table 3.5a increased from Daily/Weekly (D/W) to Monthly (M) to Termly (T) to Never Used (NU).

Table 3.5b The categories and coding of the 4-point Likert scale

Very Limited (VL)	Limited (L)	Sufficient (S)	Very Sufficient (VS)
1	2	3	4

The adapted questionnaire was modified. First, the study did not use the open-ended questions in the adapted questionnaire because it dealt with the demographic issues. Second, the close-ended questions in the adapted questionnaire were used but modified in these areas: the content areas were changed to reflect the seven content areas of the core mathematics in the Ghanaian SHS syllabus; items on assessment strategies and purposes of assessment, as well as some challenges in SBA implementation were included. However, the 4-point Likert scale used in the adapted questionnaire was kept for comparability of results with previous study. The resulting questionnaire helped the researcher in collecting reliable data within a relative short space of time.

3.6 Description of the Questionnaire

The questionnaire consisted of items grouped in three sections, namely: A, B and C. The items in section A and B were close-ended and Likert-Scaled type items while section C consisted of a close-ended item and an open-ended item.

Items in sections A and B elicited responses‟ on mathematics teachers‟ assessment literacy and challenges respectively. Nine major questionnaire items numbering 1 to 9 with sub-questionnaire items were provided for respondents to tick or circle (Refer to Questionnaire in Appendix A). The purpose of these questionnaire items was to elicit information from respondents on their knowledge of assessment purpose, assessment

strategies, interpretation and action taking, what to assess, and challenges that impede SBA implementation. Knowledge of assessment purposes and mathematical values assessed were dichotomous variables while knowledge of assessment strategies, what to assess, and interpretation and action taking were Likert scaled. The categories on the Likert scale, as used in the adapted questionnaire, were kept for comparability of results with previous studies. The researcher, however, used a 3-point Likert scale to measure the challenges of SBA implementation (item 8). A 3-point Likert scale was chosen for item 8 to give direction, i.e. to indicate the prevalence of the challenges among respondents (Table 3.6).

Table 3.6 The categories and coding of the 3-point Likert scale

Not true of me (NT)	Somewhat true of me (ST)	Very true of me (VT)
1	2	3

The final section being section C involved a close-ended question that required teachers to state their most pressing challenge from the given list of challenges. An open-ended question, which was a follow-up, allowed the respondents to express their personal perspectives on how their stated challenges can be addressed. Questionnaire item 10 was the close-ended item which demanded that respondents identify one of the challenges, as stated in items 8 and 9, they consider most pressing. Questionnaire item 11 was the open-ended item which requested respondents to propose what in their view should be done to address the stated challenges. The purpose of these open-ended items was to bring to the attention of authorities the most pressing challenges and solutions from the teachers‟ perspective geared towards addressing them.

3.7 Validity and Reliability

Pallant (2001) described validity as a term describing a measure that accurately reflects the concept it is intended to measure. In this regard, validity simply refers to how accurately the questionnaire was able to collect the responses from the respondents as intended by the researcher. Validity also refers to the degree to which the study accurately answers the questions it was intended to answer. It examines the truthfulness or the quality of the research process and the accuracy of the results.

The questionnaire was given to the researcher‟s supervisor to review and make comment, with the view to ensure validity. The supervisor‟s comments were accepted and unclear items were modified and all items were evaluated to ensure they belonged to the subsets they have been assigned. For example, it was suggested that, item 1e of Section A be included for respondents to indicate any other reason for conducting classroom assessment. This item was made optional (Refer to Questionnaire in Appendix A).

Reliability is the degree of stability or consistency of measurement (Gravetter & Forzano, 2006). In finding the reliability of the instrument, it was pre-tested and re-tested on a sample of 10 respondents (mathematics teachers) of Archbishop Porter Girls‟ School in the Western Region. Mathematics teachers of Archbishop Porter Girls‟ School were chosen because they share similar characteristics as those in other schools in the Central Region. The number of respondents that was used for the pilot study was sufficient to include any major variations in the population. According to Cornelly (2008), extant literature suggests that a pilot study sample should be ten (10) per cent of the sample size projected for the larger parent study. Hill (1998) suggested 10 to 30 participants for pilots in survey research. Correlation, between test and retest

responses, was then computed using Statistical Package for the Social Science (SPSS) software Version 16.0. The sample correlation coefficient obtained was 0.912. The Coefficient of Determination was 83%. Thus, 83% of the variation in Re-test was due to a linear relationship with Test. Based on the responses given during the pilot study, the researcher was satisfied and proceeded to conduct the main survey.

3.8 Data Collection Procedure

The researcher obtained a covering letter from the Department of Mathematics Education, UEW, to the administrators of the schools to obtain permission to collect data (Refer to Covering Letter in Appendix B). The respondents were contacted through visit at their various duty posts and classrooms and were briefed on how to respond to the items and given the opportunity to ask the researcher questions to clarify issues respondents did not understand in relation to difficulties in responding to the items. The questionnaire was responded to almost immediately and was taken from them.

3.9 Data Analysis Procedure

Bogdan and Biklen (1982) defined data analysis as the process of "working with data, organising it, breaking it into manageable units, synthesising it, searching for patterns, discovering what is important and what is to be learned, and deciding what you will tell others" (p. 62). In this study, two types of analytical tools were employed; one for the quantitative data and the other for the qualitative data. The quantitative data were analysed using descriptive statistics using the Statistical Package for the Social Sciences (SPSS) software Version 16.0 to calculate measures of central tendency (mean and mode) and dispersion (standard deviation), frequencies and percentages. The means and standard deviations, and frequencies and percentages of the variables

were presented in tables and reported in Chapter 4. The mode, frequencies and percentages of the categories on the Likert scale were also presented in Appendix C.

The determination of level of knowledge on an item was measured using mean of the coded categories on the Likert scales used for the study as cut-off points. For instance, in the 4-point Likert scale (refer to Table 3.5b) a mean score of 2.5 was used as a cut-off point to re-code the literacy level into high, moderate or low. As a rule, if the mean score is in the range 2.0 and 2.5, the literacy level is moderate. If the mean score is greater than 2.5, the literacy level is high while a mean score less than 2.0 indicate that the literacy level is low. The declarative statements under assessment literacy construct were coded with Yes (1) and No (2). These statements were on purposes of assessment and mathematical values assessed constructs, and so the frequency of Yes (1) of more than 50% was used as a measure of teachers‟ knowledge. In the 3-point Likert scales, a mean score of 2.0 was used as a cut-off point to show the prevalence of teachers‟ challenges.

According to Cohen, Manion and Morrison (2007), qualitative data analysis involves the procedure of categorising, structuring and putting meaning to the mass of collected data. That is, analysis of qualitative data involved stages of categorising and filtering the data in order to identify the exact dominant themes that were common in respondents‟ responses. The researcher coded the data, found themes, and the data were organised and defined according to the codes and themes. Based on the themes, the researcher then analysed the ideas that emerged from their responses while taking notice of the patterns and variations in their responses. The responses presented as quotes were representative of the groups they belonged, and express the general views.

3.10 Ethical Issues

The principle of voluntary participation requires that people should not to be coerced into participating in the research. Closely related to the notion of voluntary participation is the requirement of informed consent. Essentially, this means that prospective research participants must be fully informed about the procedures and risks involved in research and must give their consent to participate. Ethical standards also require that researcher would not put participants in a situation where they might be at risk of harm as a result of their participation (Kumar, 2005).

According to Adusah-Karikari (2008), harm can be defined as both physical and psychological. Indeed, human beings have rights of privacy, and these rights must be respected. The teachers were informed of the purpose, confidentiality and processes of the research and their consent was obtained. All participants were informed of the purpose of the research topic, and also informed about their right to withdraw from the study at any time they wished. Participants expressed their willingness to participate so far as their identities are protected.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Overview

The study was designed to measure and describe mathematics teachers‟ assessment literacy levels by applying Abell and Siegel‟s (2011) conceptual model of assessment literacy, explore the challenges they face in implementing the SBA and their perceived solutions to these challenges. A set of questionnaire were used to gather data from mathematics teachers on assessment literacy, SBA implementation challenges and solutions to the challenges. This chapter presents and discusses the results of the study.

4.2 Mathematics Teachers' Assessment Literacy in SBA

To answer the research question on the level of mathematics teachers‟ assessment literacy, seven questions were posed that sought to find:

1. the reasons for conducting school based assessment in order to determine their knowledge on assessment purposes;
2. the frequency of use of assessment tools, and the level of knowledge in developing assessment tools in order to determine their knowledge on assessment strategies;

3. the mathematical value(s) assessed, mathematics teachers‟ ability to specify learning objectives, and the level of knowledge in question construction in order to determine their knowledge on what to assess in mathematics;
4. and the level of knowledge in scoring, reporting and analysing SBA data in order to determine their knowledge on assessment interpretation and action-taking. Teachers‟ responses are presented in Tables 4.1 to 4.7.

4.2.1 Mathematics Teachers' Reasons for Conducting School Based Assessment

Frequencies of teachers‟ responses to mathematics teachers‟ reasons for conducting school based assessment were computed and converted into percentages to summarize the data. The results are presented in Table 4.1.

Table 4.1. Mathematics teachers' reasons for conducting SBA (n = 102)

ITEM	Valid Yes f (%)	Valid No f (%)
To find out if students are adequately learning	102 (100%)	0 (0.0%)
To find out if students properly understand the lessons	102 (100%)	0 (0.0%)
To inform the planning of the next batch of lessons	47 (46.1%)	55 (53.9%)
To satisfy continuous assessment requirement	102 (100%)	0 (0.0%)

From Table 4.1, all teachers in the schools, representing 100%, contended that they conducted school based assessments to determine if students were learning, if students understood the lessons and to satisfy continuous assessment requirement. However, more than half of the teachers tend to have low level of knowledge on assessment purposes as they did not conduct school based assessment to inform the planning of the next batch of lessons.

4.2.2. Frequency of Use of Assessment Tools for SBA

Means of the frequency of use of assessment types were computed to summarize the data. Standard deviations of the observed values were computed to measure how well the mean represents the data. Small standard deviations relative to the mean indicate that the observed values are close to the mean. A large standard deviation indicates that the mean is not an accurate representation of the data. Table 4.2 shows the results of the computed means and standard deviations. Tables 2a to 2i show the modes, frequencies and percentages (Refer to Appendix C).

Table 4.2 The means of frequency of use of the various assessment tools (n = 102)

Assessment Tools/types	Mean	Std. Deviation
Class test	1.39	0.18
Class Exercise	1.00	0.00
Assignment	1.00	0.00
Project Work/ Practical Skills Test	3.82	0.08
Discussion	1.00	0.00

Oral Presentation	3.39	0.25
Group Work	2.70	0.21
Interview	2.04	0.28
Observation	3.07	0.26

From Table 4.2 and Tables 2a to 2i, teachers‟ responses indicated that various assessment tools were used in the schools but to a varying degree of frequency. The means of the frequency of use of class exercise, class tests, assignments, discussion and interview were lesser than the average 2.5 ($M < 2.5$). These indicated that class exercise, class tests, assignments, discussion and interview were more frequently used whereas observation, project work, group work and oral presentation were less frequently used ($M > 2.5$). Overall, mathematics teachers selected and used various assessment tools, but they often used the summative tools at the expense of the alternative formative tools.

4.2.3 Level of Knowledge in the Development of Assessment Tools for SBA

Means of teachers‟ level of knowledge in the development of assessment tools were computed to summarize the data. Standard deviations of the observed values were computed to measure how well the mean represents the data. Small standard deviations relative to the mean indicate that the observed values are close to the mean.

A large standard deviation indicates that the mean is not an accurate representation of the data. Table 4.3 shows the results of the computed means and standard deviations. Tables 3a to 3h show the modes, frequencies and percentages (Refer to Appendix C).

Table 4.3 Level of Knowledge in the Development of Assessment Tools (n = 102)

ITEM	Mean	Std. Deviation
Class test	3.56	0.16
Assignment	3.65	0.17
Project Work/ Practical Skills Test	1.71	0.20
Discussion	3.46	0.19
Oral Presentation	3.47	0.20
Group Work	2.84	0.22
Interview	3.48	0.23
Observation	3.12	0.21

From Table 4.3, most teachers in the schools indicated that they had no difficulty developing class tests/ end-of-term tests items, assignments, discussion, oral

presentation, group work, interview and observation, as the means were greater than the average 2.5 ($M > 2.5$). Tables 3a to 3h show that the modal category was mostly the Very Sufficient category, except for the Project Work/Practical Skills Test item where more than two-third of the teachers were found in either Very Limited or Limited categories. Thus, majority of teachers in the schools rated their level of knowledge in project/practical skills assessment as low ($M = 1.71$, $SD = 0.20$).

4.2.4 Mathematical Value(s) Assessed in SBA

Frequencies of teachers‟ responses to mathematics teachers‟ reasons for conducting school based assessment were computed and converted into percentages to summarize the data. The results are presented in Table 4.4.

Table 4.4 Mathematical Value(s) that is/are Assessed in Mathematics (n = 102)

Item	Valid Yes f (%)	Valid No f (%)
Product : Knowledge or Mastery of Basic Concepts	102 (100%)	0 (0.0%)
Product : Routine procedures	102 (100%)	0 (0.0%)
Process : Problem-solving or investigation	36 (35.3%)	66 (64.7%)
Process : Mathematical reasoning or understanding in essay test	102 (100%)	0 (0.0%)

From Table 4.4, all teachers (100%) indicated that they often assessed knowledge or mastery of basic concepts and routine procedures, emphasising concentration on

product of student learning. On process-driven assessments, all of the teachers (100%) again indicated assessing mathematical reasoning or understanding in essay test. However, more than half of the teachers indicated that they did not assess problem-solving or investigation. Thus, more than half of the teachers tend to have low level of knowledge on assessing problem-solving or investigation - a critical mathematical value recommended by the mathematics syllabus.

4.2.5 Level of Knowledge or Ability to Specify Learning Objectives for SBA

Means of teachers‟ level of knowledge or ability to specify learning objectives for SBA were computed to summarize the data. Standard deviations of the observed values were computed to measure how well the mean represents the data. Small standard deviations relative to the mean indicate that the observed values are close to the mean. A large standard deviation indicates that the mean is not an accurate representation of the data. Table 4.5 shows the results of the computed means and standard deviations. Tables 5a to 5e show the modes, frequencies and percentages (Refer to Appendix C).

Table 4.5 Level of Knowledge or Ability to Specify Learning Objectives for SBA (n = 102)

ITEM	Mean	Std. Deviation
Taxonomy of educational objective: cognitive.	2.86	0.25
Interpreting Core Mathematics syllabus: content, teaching &learning activities.	3.29	0.28
Writing specific objective for lesson plan.	3.04	0.21

Outlining instructional content for the test.	3.48	0.30
Listing instructional objectives for the test.	3.45	0.29

Table 4.5 reveals that teachers tend to have high level of knowledge in specifying learning objectives for SBA. Teachers did not have problems in specifying learning objectives for their lesson plans and tests. From Table 4.5, the mean scores for the teachers‟ ability to specify the learning objectives (specific and instructional) were 3.04 and 3.45 respectively. In relation to their ability to interpret the mathematics syllabus, the teachers also indicated that they did not have problems in interpreting the core mathematics syllabus in terms of content, teaching and learning activities. The mean score (M = 3.29, SD = 0.28) was above the average 2.5. This was consistent with their ability in outlining instructional content of tests (M = 3.48, SD = 0.30). The results also show that teachers‟ knowledge in assessment in the cognitive domain is high (M = 2.86, SD = 0.25).

4.2.6 Level of Knowledge in Question Construction for SBA

Means of teachers‟ level of knowledge in question construction were computed to summarize the data. Standard deviations of the observed values were computed to measure how well the mean represents the data. Small standard deviations relative to the mean indicate that the observed values are close to the mean. A large standard deviation indicates that the mean is not an accurate representation of the data. Table 4.6 shows the results of the computed means and standard deviations. Tables 6a to 6j show the modes, frequencies and percentages (Refer to Appendix C).

Table 4.6 Level of Knowledge in Question Construction (n = 102)

ITEM	Mean	Std. Deviation
Constructing MCQ in Number and Numeration	3.41	0.19
Constructing MCQ in Plane Geometry.	3.42	0.13
Constructing MCQ in Mensuration	3.38	0.18
Constructing MCQ in Algebra.	3.35	0.15
Constructing MCQ in Statistics and Probability.	3.24	0.20
Constructing MCQ in Trigonometry.	3.37	0.22
Constructing MCQ in Vectors and Transformation in a Plane.	3.17	0.20
Constructing application of knowledge or word problem (subjective) questions.	3.08	0.19

Constructing subjective questions that require an understanding of mathematical principles	3.35	0.21
Constructing questions for Practical and Investigational works (problem solving)	1.76	0.08

Results from questionnaire survey (Table 4.6) show that mathematics teachers rated themselves as knowledgeable with regards to the construction of MCQ (multiple choice questions) items on the seven areas of teaching and learning in the core mathematics syllabus, namely; in number and numeration (M = 3.41, SD = 0.19), plane geometry (M = 3.42, SD = 0.13), mensuration (M = 3.38, SD = 0.18) and algebra (M = 3.35, SD = 0.15). Besides that, most of the teachers also indicated that they had sufficient knowledge in constructing MCQs based on statistics and probability (M = 3.24, SD = 0.20), trigonometry (M = 3.37, SD = 0.22), and vectors and transformation in a plane (M = 3.17, SD = 0.20). The responses have high mean scores of 3 and above. Tables 6a to 6g reveal that more than two-third of the teachers belongs to the categories of Sufficient and Very Sufficient. The modes for the respective variables were 50 (Very Sufficient category), 51 (Very Sufficient category), 51 (Sufficient category), 62 (Sufficient category), 42 (Sufficient and Very Sufficient categories), 50 (Sufficient category) and 42 (Sufficient category).These indicate that their level of knowledge in constructing MCQ items on the listed subject areas tends to be high.

In addition, teachers tend not to have problems in constructing subjective questions on application of knowledge or word problem questions (M = 3.08, SD = 0.19). The corresponding mode is 42, belonging to the Sufficient category (Table 6h). Again, a

high mean score of 3.35, a mode of 45 and a narrow standard deviation 0.21 reveal that teachers‟ knowledge in constructing subjective questions that require an understanding of mathematical principles is high. However, their knowledge on constructing questions for practical and investigational works (problem-solving) is rather limited (M = 1.76, SD = 0.08) indicating teachers having problems, with a mode of 48 for the Very Limited category (Table 6j).

Hence, teachers tend to have high level of knowledge in constructing both objective (MCQ items) and subjective questions on the syllabus and lessons they had taught, except for questions on problem solving where teachers‟ knowledge tend to be low.

4.2.7 Level of Knowledge in Scoring, Analysing and Reporting SBA Data

Means of teachers‟ level of knowledge in scoring, reporting and analysing SBA data were computed to summarize the data. Standard deviations of the observed values were computed to measure how well the mean represents the data. Small standard deviations relative to the mean indicate that the observed values are close to the mean. A large standard deviation indicates that the mean is not an accurate representation of the data. Table 4.7 shows the results of the computed means and standard deviations. Tables 7a to 7g show the modes, frequencies and percentages (Refer to Appendix C).

Table 4.7 Level of Knowledge in Scoring, Analysing and Reporting SBA Data (n = 102)

ITEM	Mean	Std. Deviation
Preparing answer keys for MCQs	3.57	0.19
Scoring the MCQs	3.57	0.22
Developing marking scheme for subjective questions before scoring	2.41	0.20
Providing students frequent feedback on their scripts after scoring	3.46	0.18
Analysing students achievement data (quantitative & qualitative)	2.69	0.21
Plan remedial teaching based on information got from assessment	3.37	0.15
Reporting score on students‟ performance	3.51	0.20

The results from Table 4.7 show that teachers tend to have high level of knowledge in analysing assessment data on students‟ performance. Teachers‟ knowledge in analysing and interpreting the scores reflected that they used quantitative and qualitative methods (M = 2.69, SD = 0.21) in determining students‟ performance. Table 7e shows that, more than half of the teachers belong to the Sufficient and Very Sufficient Categories. The modal category was Sufficient, with a frequency of 37. Teachers also showed sufficient knowledge (M = 3.37, SD = 0.15) on using the results of their analysis to plan remedial teaching. Table 7f shows the results were skewed with more than two-third of the teachers (90.2%) in the Sufficient and Very Sufficient

categories. The mode was 48 for the Very Sufficient category. It can be deduced that the teachers, most probably, make a practice of analysing the scores and taking action on them, and so rated their level of knowledge in these aspects as "sufficient". This level of knowledge in interpreting the scores in the form of basic statistics resulted in good reporting of test scores (M = 3.51, SD = 0.20). All the teachers (100%) belonged to either the Sufficient category or the Very Sufficient category (Table 7g).

The teachers did not have problems in preparing answer keys for MCQs (M = 3.57, SD = 0.19) and scoring MCQs (M = 3.57, SD = 0.22). All teachers (100%) rated their knowledge in preparing answer keys for MCQs and scoring MCQs as either Sufficient or Very Sufficient (Tables 7a and 7b) However, they rated their knowledge in the aspect of developing marking scheme before scoring subjective questions as "limited" (M = 2.41, SD = 0.20), with the modal category being the Limited category. Mode was 48. Teachers were however prompt (M = 3.46, SD = 0.18) in providing feedback on students" scripts after scoring their papers.

Therefore, overall, teachers rated their knowledge in scoring, reporting and analysing SBA data as high, except for the aspect of developing marking scheme for subjective questions where they rated their knowledge as low.

4.3 Mathematics Teachers' Challenges in Implementing the SBA

To answer the research question on the mathematics teachers" challenges in implementing the SBA, the researcher posed two investigating questions for the mathematics teachers that sought to find: the challenge(s) faced in implementing SBA; and any prior training in assessment. The construct, challenge(s) faced in SBA implementation, was Likert scaled to have three categories as shown below to indicate the prevalence of the challenge among teachers.

Table 3.6 The categories and coding of the 3-point Likert scale

Not true of me (NT)	Somewhat true of me (ST)	Very true of me (VT)
1	2	3

4.3.1 SBA Implementation Challenges

Means of teachers‟ challenges in SBA implementation data were computed to summarize the data. Standard deviations of the observed values were computed to measure how well the mean represents the data. Small standard deviations relative to the mean indicate that the observed values are close to the mean. A large standard deviation indicates that the mean is not an accurate representation of the data. Table 4.8 shows the results of the computed means and standard deviations. Tables 8a to 8h show the modes, frequencies and percentages (Refer to Appendix C).

Table 4.8 SBA Implementation Challenges (n = 102)

ITEM	Mean	Std. Deviation
Heavy teaching workload (above 24 periods per week).	1.75	0.13
Overloaded classes (a class of above 50 students).	2.02	0.14
Lack of SBA coordination and monitoring mechanism.	3.00	0.00
Poor recording and reporting on students‟ school based assessment.	2.42	0.15
Lack of guideline for preparing/implementing SBA.	3.00	0.00

Lack of interest from parents in schoolwork of students.	1.70	0.12
Insufficient time to carry out SBA.	2.43	0.16
Absenteeism of learners.	1.72	0.13

The results in Table 4.8 show a real picture of the challenges teachers encounter in the course of implementation of school based assessment. Most of the means are above the average mean of 2.00, with the most reported challenges being overloaded classes (M = 2.02, SD = 0.14), heavy teaching workload (M =1.75, SD = 0.13), insufficient time to carry out SBA (M = 2.43, SD = 0.16), lack of SBA coordination and monitoring mechanism (M = 3.00, SD = 0.00), lack of guideline for preparing/implementing SBA (M = 3.00, SD = 0.00), poor recording and reporting on students" school based assessment (M = 2.42, SD = 0.15), absenteeism of learners (M = 1.72, SD = 0.13) and lack of interest from parents in schoolwork of students (M = 1.70, SD = 0.12).

Furthermore, Tables 8a to 8h show that, more than half of the teachers were either in the Somewhat True of Me category or Very True of Me category for the variables under consideration, except for the variables "lack of interest from parents in the schoolwork of students" and "absenteeism of learners" where half or more than half of the teachers were in the Not True of Me category.

From Tables 8a to 8h, the modes for heavy teaching workload, lack of interest from parents in schoolwork of students and absenteeism of learners were 48, 52 and 51 respectively, all in the Not True of Me category. However, for the variables namely: insufficient time to carry out SBA; lack of SBA coordination and monitoring

mechanism; lack of guideline for preparing/implementing SBA and poor recording; and reporting on students‟ school based assessment, the results were skewed for the Very True of Me category. Their respective modes were 52, 102, 102 and 60. Overloaded classes showed a mode of 36 for the Somewhat True of Me category.

4.3.2 Training in School Based Assessment

The teachers were required to indicate whether they had had any form of training in assessment at pre-service training or during service. Two items were presented to teachers to which they were to indicate Yes (1), No (2) or Not Sure (3). The results are presented in figure 2 below.

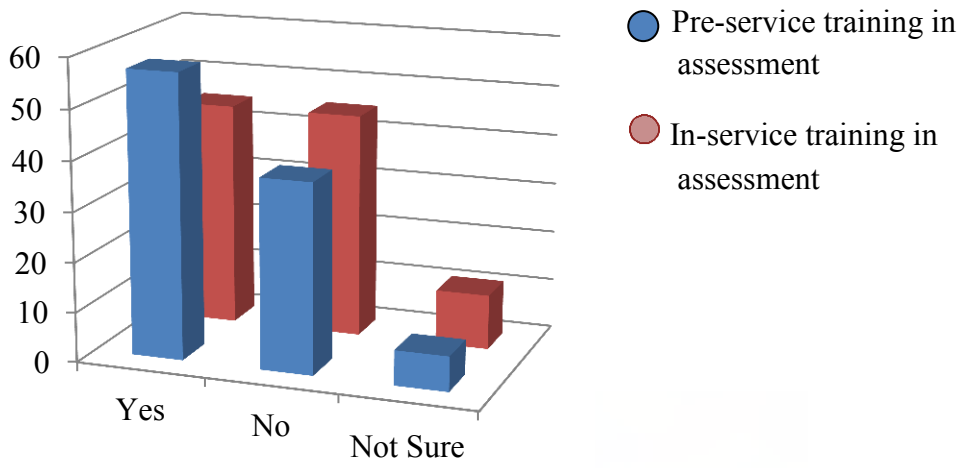

Figure 2. A Chart of Teachers' Pre-service and In-service Training in School Based Assessment

Majority of teachers, 55.9% (n= 57), had had training in assessment during their pre-service years, and most of the teachers, 44.1% (n = 45), also indicated they have participated in in-service training programme during service. However, a very significant number of teachers, 37.3% (n = 38) and 44.1% (n = 45), claimed not to have had any training in assessment in pre-service and in-service respectively. Again, some teachers, less than 10%, were not sure of having any training programme on assessment.

4.4 Mathematics Teachers' Perspective on Addressing SBA Implementation Challenges

To answer the research question on the mathematics teachers‟ perspective on addressing SBA implementation challenge, the researcher posed two questions for mathematics teachers that sought to find: teachers‟ most pressing challenges; and solutions to the challenges. The question on teachers‟ most pressing challenges was close-ended while the second follow-up question on solutions to the challenges was open-ended.

4.4.1 Mathematics Teachers' Most Pressing Challenges

Teachers‟ fore-most challenges were sorted out, the frequency counts were determined and converted into percentages. The results are presented in Table 4.9

Table 4.9 Teachers' fore-most challenges

Challenge	Frequency (f)	Percentage (%)
Overloaded classes.	41	40.2
Heavy teaching workload.	28	27.5
Lack of guideline for preparing/implementing SBA.	25	24.5
Lack of SBA coordination and monitoring mechanism.	8	7.8

Majority of teachers, n = 41, representing 40.2%, indicated overloaded classes as their fore-most SBA implementation challenge. This was followed by heavy teaching workload, with 27.5% of teachers (n = 28) indicating that as their most pressing challenge. Lack of guideline for preparing/implementing SBA was indicated by 24.5% of teachers (n = 25) as most pressing challenge. Lastly, lack of SBA coordination and monitoring mechanism had 7.8% of teachers (n = 8) indicating it as their fore-most challenge.

4.4.2 Mathematics Teachers' Solutions to SBA Implementation Challenges

When teachers were requested in item 11 to suggest a way of addressing the challenges, a careful study of their responses brought to the fore their varied standpoints on solutions to the particular issue of concern. Thus, whereas one group of teachers shared one another"s views of solution on an issue, others held contrary views to those teachers.

On the challenge of overloaded classes, two groups of suggestions were identified. One group of teachers requested a reduction in the current class sizes they have. Stating their positions, Teacher A, Teacher B and Teacher C, all have this to say in writing:

Teacher A wrote, "*it would be better, in terms of students getting the needed attention, for GES to revert to its own policy on ideal class size if possible; I know that to be around 35*". He added, "*…so that teachers can adequately cater for the needs of students through instruction and assessment*".

Teacher B wrote, "*GES should make a normal class size to be 50 students; nothing more, nothing less. Because, I consider that to be manageable, and not the 58 or 60 as I have in my classes*".

Teacher C also wrote, "*I would suggest that the current class sizes be reduced. This is because, in the first place, the size of the classrooms in this school was not designed to handle the student numbers we have now. This makes it difficult for me to navigate through the classes to interact well with my students*". He added, "*During exams, students are made to sit outside the classrooms to write their papers, which is not good*", but failed to give a class size he would consider as right. Some teachers, belonging to this group, expressed similar views to that of Teacher A, Teacher B and Teacher C. However, the second group of teachers, writing on the same issue of overloaded classes, held contrary views. Teacher D, Teacher E and Teacher F had these to say:

Teacher D wrote, "*I wish I could suggest something practicable on this matter, and so I will leave it to GES, within whose purview it lies, to decide what will be in the best interest of both the teachers and the students*". She added, "*If they decide well, then so much the better*".

Teacher E wrote, "*I don't think anything can be done about it, and so GES should just maintain the current size…as difficult as the current size of 60 students is for me, I think it's OK*".

Teacher F also wrote, "*GES should put a ceiling on the class sizes of schools, so that GES and Parent-Teacher Association would build more infrastructures to accommodate the excess numbers of students*".

Many other teachers, belonging to this group, held similar views to that of Teacher F. They wrote about infrastructural developments by Government and PTA to address the incidence of overpopulated classes.

Teachers‟ positions on addressing heavy teaching workload were also expressed in various ways. The researcher noted in the responses of teachers that, even though CRDD has been able to reduce the number of assessments per term required in the school based assessment, the incidence of heavy teaching workload still persists. For instance, some teachers had these to say in writing:

Teacher G wrote, "*I do thirty periods per week. Frankly, this is a marathon for me. Meanwhile, I have other duties as teacher, such as marking assessments, and house master. So, I suggest, GES should recruit more teachers to take some burdens off our shoulders*". Majority of teachers were of the view that teacher recruitment should be done so that teaching periods can be reduced for other equally important teaching and learning duties of the teacher to be done effectively.

On the challenge of lack of SBA coordination and monitoring mechanism, teachers suggested that the Ghana Education Service and the Schools should put in place mechanisms that would monitor assessments in schools and enforce mathematics teachers to assess students based on set guidelines. This will ensure that teachers are inspected to do what they are expected to do. Teacher H and Teacher I had these to say in writing:

Teacher H wrote, "*What stops GES, in conjunction the schools, from instituting coordination and monitoring mechanism? Teachers will always do what they are inspected to do, not what they are expected to do, which is what GES seems to be doing. That is why some teachers are pretending to be doing what they are expected*

to do". Teacher I, on the hand, wrote, "*GES should redefine the role of the Heads of Department to be purely an administrative role, purposely assigned with duties of ensuring better instructional and assessment strategies of teachers in schools…This will ensure that instruction and assessment are aligned with curriculum objectives, and designed to cater to students*"

Teachers" views on the lack of guideline for preparing/implementing SBA was strongly expressed, writing to the effect that, the schools should organise in-service training to enrich teachers" methodology in assessment, particularly in preparing and implementing the SBA. One teacher, Teacher J, had this to say in writing:

"I know we are the implementers, but how can we implement this new policy without anyone telling us or giving us guidelines on how it should be done as the mathematics syllabus requires?…we need training, that's all". Another teacher, Teacher K, also wrote, "*school based assessment, as I understand it, is not an event; it is a process. It is methodological. Therefore, GES should ensure that teachers are taken through proper training to make them well-equipped*". Teacher L bemoaned the lack of proper content in one GES sponsored in-service training programme he attended. He wrote "*I would suggest that teachers be trained in assessment from time to time to sharpen their skills. GES should make sure the training programme delivers proper content. This is because my experience in one such programme, sponsored by GES, leaves much to be desired. I would say some of the content weren't needful*". Teacher M, the other hand, called for SBA manual to be made available to teachers. He wrote, "*GES should provide us with the manual which, I understand, was to accompany the school based assessment policy…this will go a long way to help us do the class assessment tasks well*".

4.5 Discussion of Results

The research was conducted to find out the level of SHS mathematics teachers‟ assessment literacy in the four areas, namely, assessment purposes, assessment strategies, assessment interpretation and action taking, what to assess, based on Abell and Siegel‟s (2011) model of assessment literacy. The research was also conducted to find out some of the teachers challenges in implementing school based assessment and the solutions to address some of these challenges.

This section discusses the findings, as presented in sections 4.2, 4.3 and 4.4, relative to the research literature described in chapter 2. Thus, the findings are discussed under the following themes:

1. Mathematics Teachers‟ knowledge of the purposes of assessment
2. Mathematics Teachers‟ knowledge of what to assess in mathematics
3. Mathematics Teachers‟ knowledge of assessment strategies
4. Mathematics Teachers‟ Knowledge of assessment interpretation and action-taking
5. Mathematics Teachers‟ Challenges in School Based Assessment implementation
6. Mathematics Teachers‟ Solutions to SBA implementation challenges

4.5.1 Mathematics Teachers' Knowledge of the Purposes of School Based Assessment

According to Abell and Siegel (2011), the common purposes for assessment include assessing: "to diagnose students‟ prior knowledge; to assess student‟s knowledge

during instruction; to document learning at the end of a unit; and to help students diagnose their own learning" (p. 210).

In this study, teachers were required to indicate the reasons for which they conducted classroom assessment. All the teachers contended that they conducted classroom assessments to determine if students were learning, if students understood the lessons and to satisfy continuous assessment requirement. This implies that, teachers are fixated on and agree to the summative use of assessment. According to Harlen (2005), the summative purpose of assessment is to determine the student‟s overall achievement in a specific area of learning at a particular time - a purpose that distinguishes it from all other forms of assessment. Teachers‟ responses in this study agree with Abell and Siegel (2011) and Bello and Tijani (2008) that teachers‟ purposes for conducting assessment are mainly: to discover the progress, strengths and weaknesses of students from the perspective of performance, and to quantify students learning achievement in order to provide feedback to stakeholders on the progress of teaching and learning. According to Bell and Cowie (2003) and Harlen (2005), teachers believe that classroom assessment makes explicit what students know and can do and so choose the summative way, even though both teachers and students are keenly aware that the narrow test results do not accurately represent what they understand or can do. Teachers‟ responses also agree with the findings on assessment conceptions of elementary teachers by Delanshere and Jones (1999) who found out that teachers viewed assessment purposely to describe student achievement.

However, mathematics teachers are split on the purpose of using assessment to inform the planning of the next batch of lessons. Majority of teachers‟ responses tend not to agree with Boston (2002) and Sethusha (2012) on the formative aspect of assessment where it is used to plan instruction or next teaching cycle. While 46.1% of teachers‟

responses agree to using assessment for this purpose, 53.9% of teachers claim they do not. Thus, majority of teachers overlooked the formative use of assessment where information gathered is used to make beneficial changes in instruction, as indicated by Stiggins (2005). According to MoE (2014), most teachers are in a hurry to complete the syllabus so that they do not let assessment data influence the planning of lessons. This situation, in the view of the researcher, do not inure to the benefit of learners as they may be denied of having better learning experience in the classroom. It is however gratifying to note that most of the teachers in the study have demonstrated knowledge of tangible educational reasons for assessing their students.

4.5.2 Mathematics Teachers' Knowledge of What to Assess in Mathematics

The official intended curriculum for the teaching and learning of core mathematics at the Senior High School level is the SHS core mathematics syllabus (MoE, 2014). The syllabus is designed to ensure that both instruction and assessment are based on the knowledge and understanding (AU) and application of knowledge (AK) dimensions, with focus on both products and processes of learning. The results of this study show that teachers lay more emphasis on the products of learning (i.e. knowing basic facts and routine procedures) than the processes of learning which involve higher cognitive competencies such as applying and reasoning critically. According to De Lange (1999), mathematics assessment should be more process-driven than product-driven if the cognitive areas of learning need to be developed. Particularly on the aspect of mathematical reasoning, the results of this study show that teachers (100%) claim they assessed that competence, even though, according to De Lange (1999), mathematical reasoning is difficult to test. This perhaps could be due to the fact that teachers do not know what constitutes mathematical reasoning. Cooney and Shealy

(1995) posit that majority of teachers believe that mathematics is basically computational, problem skills and concepts and so their tests were primarily computational in nature, as this research has confirmed. They however state that only few teachers viewed mathematics as a puzzle consisting of challenging and analytical patterns and so engaged students regularly in projects and activities that focussed on process than product. Again, this research finding was consistent with this finding of Cooley and Shealy (1995). Anamuah-Mensah, Mereku and Ghartey-Ampiah (2008) observed that the mathematics curriculum itself places a great deal of "emphasis on mastering basic skills and procedures and understanding mathematical concepts and principles but gives little emphasis on communicating mathematically, reasoning mathematically, and deriving formal proofs" (p. 19). As a result, teachers‟ assessment practices focus on mastering basic skills and procedures and understanding mathematical concepts and principles.

Assessment requires planning and developing and so the syllabus is the reference point of what objectives and content it considers necessary and needs to be assessed. The syllabus notes that in developing assessment, teachers must select objectives in such a way that they will be able to assess a representative sample of the syllabus objectives. Each specific objective in the syllabus is considered a criterion to be mastered by the students. The study revealed that teachers had sufficient knowledge on many aspects of planning the SBA as shown by the results. Teachers did not have problems in specifying learning objectives for their lesson plans and tests. The mean scores for the teachers‟ ability to specify the learning objectives were 3.04 and 3.45 respectively. In relation to the ability to specify learning objectives, the teachers also indicated that they did not have problems in interpreting the core mathematics syllabus. The mean score was above average which was 3.29. This is consistent with

their ability to write or specify good learning objectives. The results also show that the teachers did not have problems in outlining instructional content of tests (M = 3.48). Thus, most of the teachers in schools tend to have high level of knowledge in identifying instructional objectives and content for SBA as they were very conversant with the mathematics syllabus. Additionally, teachers were able to rate their knowledge of the taxonomy of educational objectives of the cognitive domain. This domain consists of a six-level hierarchy of dimensions, on which the mathematics syllabus operates. These dimensions, in order of complexity, are remember, understand, apply, analyse, evaluate and create (CRDD, 2010). It is necessary teachers become conversant with these dimensions so that they could effectively assess student learning, if we must realise the objective of the SBA to direct attention to the cognitive areas of learning. Teachers determined their level of difficulty of assessment with respect to the cognitive domains. The results show that teachers‟ level of knowledge in the cognitive domain of learning (M = 2.86, SD = 0.25) is at high but a significant one-third indicated a limited knowledge.

Linn and Miller (2005) define test as “an instrument for measuring a sample of behaviour” (p. 26). The most common assessment tools used in schools are the ones that present students with a series of questions or prompts and use their written responses as evidence of knowledge. This is the usual paper and pencil tests (summative or traditional tools). In this testing culture, questions can be multiple-choice or Likert-style questionnaires, true-false, close items and essay (subjective) questions. Answer formats can be close responses, essays, short answer or long answer (demonstrating procedure). Results show that mathematics teachers rated themselves as knowledgeable with regards to the construction of multiple choice question (MCQ) items on the seven areas of teaching and learning in the core

mathematics syllabus, namely; in number and numeration (M = 3.41), plane geometry (M = 3.42), mensuration (M = 3.38) and algebra (M = 3.35). Most of the teachers also indicated that they had sufficient knowledge in constructing MCQs on statistics and probability (M = 3.24), trigonometry (M = 3.37), and vectors and transformation in a plane (M = 3.17). Since all the responses have high mean scores of 3 and above, it indicates that their level of knowledge in constructing MCQ items on the listed areas is high. The teachers tend not have problems in constructing subjective questions on application of knowledge or word problem questions (M = 3.08) as more than two-third of the teachers indicated so. Again, a high mean score of 3.35, with more than two-third teachers indicating to having either sufficient or very sufficient knowledge, reveals that teachers do not have problem in constructing subjective questions that require an understanding of mathematical principles. However, their knowledge on constructing questions for practical and investigational works (problem-solving) is rather limited (M = 1.76), with more than two-third teachers rating their knowledge as either limited or very limited. This indicates that teachers are having problems. Hence, it can be deduced that, the teachers have high level of knowledge in constructing both objective (MCQ items) and subjective questions based on the syllabus and lessons they had taught, except for the area of problem-solving where the rated their level of knowledge to be low.

4.5.3 Mathematics Teachers' Knowledge of Assessment Strategies

The investigation of teachers‟ assessment strategies involved collecting data on teachers‟ assessment tools for assessing concepts in mathematics. According to the CRDD (2010) and Bello and Tijani (2008), assessment tasks can be in the form of oral questions, quizzes, assignments, essays, project work etc, and that, teachers

should use these to ensure that students have mastered the instruction and behaviours implied in the specific objectives of each unit. The data revealed that teachers in the study engaged their students using various assessment tools/strategies in schools but to a varying degree of frequency. They used a wide variety of traditional and alternative assessment tools identified in the Ghanaian core mathematics syllabus. However, many teachers tended to use traditional rather than alternative assessment strategies**.** Majority of teachers in the schools indicated that class tests (M = 1.39), class exercise (M = 1.00), assignments (M = 1.00), discussion (M = 1.00) and interview (M = 2.04) were done daily or weekly and so recorded means below the expected average of 2.50. The assessment types that were less frequently used or never used at all were group work (M = 2.70), project work (M = 3.82), oral presentation (M = 3.39) and observation (M = 3.07). This finding tends to be as a result of teachers‟ levels of difficulty in developing the assessment tools in school based assessment. Most teachers in the schools indicated that they had no difficulty developing class tests items, assignments, discussion, oral presentation, group work, interview and observation, as the means were greater than the average 2.5 (M > 2.5). Tables 3a to 3h show that the modal category was mostly the Very Sufficient category, except for the Project Work/Practical Skills Test variable where almost all teachers were found in Very Limited or Limited Categories. Thus, majority of teachers in the schools rated their level of knowledge in project/practical skills assessment as low (M = 1.71, SD = 0.20). The minimal use of project work (M = 3.82) tend to be as a result of the teachers‟ incompetence in designing project work. This finding agree with existing evidence which indicate that teachers have difficulty in developing and using assessment instruments, especially instruments other than testing (Bello & Tijani, 2008). As indicated by Bello and Tijani (2008), regardless of

teachers‟ claims, most of them often adapted WAEC past questions for class tests, assignments and end-of-term tests. Even though teachers can use traditional assessment tools to establish the state of the actual knowledge of the student (Nabie, Akayuure, & Sofo, 2013), the tools are limited in their capability to respond to learners‟ active construction of knowledge.

4.5.4 Mathematics Teachers' Knowledge of Assessment Interpretation and Action-Taking

Teachers‟ knowledge of interpretation and action taking relates to what teachers believe about how students would respond to assessment tasks and how they modify their instruction in response to this knowledge. For instance, teachers routinely use assessment data to assign grades, but more knowledgeable teachers are able to use assessment data to adjust lessons and student tasks (Abell & Siegel, 2011).

The results in Table 4.7 show that teachers tend to have high level of knowledge in scoring reporting, and analysing assessment data on students‟ performance. Teachers‟ knowledge in analysing and interpreting the scores reflected that they were familiar with using quantitative and qualitative methods (M = 2.69) in determining students‟ performance. They also showed sufficient knowledge (M = 3.37) on using the results of their analysis to plan remedial teaching. According to Stiggins (2005), remediation is a necessary use of assessment. He stressed that assessment affords teacher the opportunity to tell where further instruction is needed for remediation and mastery of the subject matter. It can be deduced that the teachers, most probably, make a practice of analysing the scores and taking action on them, and so rated their level of knowledge in these aspects as "sufficient". This level of knowledge in interpreting the

scores quantitatively and qualitatively resulted in good reporting of test scores (*M* = 3.51).

The teachers tend not to have problems in preparing answer keys for multiple choice questions (MCQs) (*M* = 3.57) and scoring MCQs (*M* = 3.57). However, they rated their knowledge in the aspect of developing marking scheme before scoring subjective questions as "limited" (*M* = 2.41). This finding agrees with investigations carried out on SBA by the Curriculum and Research Development Division (CRDD) of the Ghana Education Service (GES) which revealed that significant differences existed in teachers scoring of tests, and that marking schemes were not used (Dery & Addy-Lamptey, 2010). According to Bello and Tijani (2008), evidence exists, citing WAEC (1996), to the effect that some teachers scored school-based subjective tests without marking schemes. Teachers were however prompt (*M* = 3.46) in providing feedback on students‟ scripts after scoring their papers. However, according to Bello and Tijani (2008), evidence exists, citing WAEC (1996) that, some teachers were unable to mark various essay tests they gave their students for well over three months of the students having submitted their scripts, and so teachers were unable to promptly provide feedback.

4.5.5 Mathematics Teachers' Challenges in School Based Assessment Implementation

This study has revealed that currently the implementation of school based assessment is fraught with a number of serious problems such as teachers‟ heavy teaching workload, overloaded classes, lack of SBA coordination and monitoring mechanism, lack of guideline for preparing/implementing SBA, lack of interest from parents in schoolwork of students, and insufficient time to carry out SBA.

According to Byabato and Kisamo (2014), the problem of lack of SBA coordination and monitoring mechanism fosters inflation of SBA scores and favouritism. This finding is further corroborated by a study carried out by Baku (1991), which reported that teachers were generally generous in the award of marks to candidates. Among the factors proposed to have contributed to this behaviour included poor assessment skills and poor monitoring mechanism. Dery and Addy-Lamptey (2010) have attributed the high SBA scores (inflation of SBA scores) to insufficient time to carry out SBA in the classroom. They have also blamed the incidence of inflation of scores on the differences in the skills being assessed due to lack of guideline for preparing SBA.

The Research Department of the West African Examinations Council have conducted a number of studies on SBA scores and its relationship with the external scores and have come out with findings which pointed out that teachers‟ scores were erratic and unsystematic mainly due to lack of experience in assessment. Coupled with this, investigations carried out on SBA by the Curriculum and Research Development Division (CRDD) of the Ghana education service (GES) revealed that record keeping by teachers was poor (Dery & Addy-Lamptey, 2010). According to Byabato and Kisamo (2014), the missing link between what teachers think they know and what they can do in practice is likely to be resulting from the lack of training on assessment practices for teachers. They add that this might also be caused by the reported heavy teaching workload and overpopulated classes. In Kapambwe‟s (2010) study of the implementation of school based assessment in Zambia, it was found that teachers indicated among others that large class size, student absenteeism, inadequate monitoring as the challenges they faced to effectively carry out school based assessment.

Involving parents in the teaching and learning of Mathematics could as well improve students‟ mathematics achievement. This is true because parents have a major role to play as stakeholders in student learning. Parents are expected to complement teachers‟ effort by providing learning material for their wards, checking their wards‟ academic progress and serving as source of encouragement to their wards. A review of a wide range of studies by Henderson and Mapp (2002) on parents involvement also found that "students with involved parents, no matter what their income or background, were more likely to earn higher grades and test scores and enrol in higher-level programs, be promoted, pass their classes, attend school regularly, have better social skills, show improved behaviour, adapt well to school and graduate and go on to further education" (p.7). It was recommended that school authorities, in drawing school achievement plans, must endeavour to involve parents. At the moment, very little of this is seen at the SHS level in Ghana because most of the SHSs are boarding schools and school authorities lack the needed communication tools to engage parents regularly.

The obvious lack of guideline on preparing SBA is expected to hamper the development of authentic teacher-made assessment tests, according to the MoE (2014). Though the introduction of the SBA is an attempt to emphasise assessment for learning in teachers‟ classroom practice as well as reduce teachers‟ workload in assessment, the MoE (2014) notes that its implementation in schools faces a major challenge for the fact that the guidelines for preparing class assessment tasks (CATs), a major ingredient of the change, is not available to teachers. Without the CATs, it will be difficult for teachers to understand these and implement these changes in assessment. Incidentally, nearly half, (44.1%), of the teachers in the schools participated in in-service training programme on assessment. Again, 55.9% of

teachers claimed to have had pre-service training on assessment. These rather low percentages give an indication of the need for more training in assessment. MoE (2014) reports that "in-service training appears to be poorly targeted as most of the programmes are generalized" (p. 25). This is not good news because mathematics is now moving with the pace of technology and if mathematics teachers should keep to this pace, they need regular professional development. Teacher education should not end with obtaining a degree or diploma.

4.5.6 Mathematics Teachers' Solutions to SBA implementation Challenges

School size at the SHS level has been observed to increase year to year. This is because of the increasing number of JHS graduates that are placed in the Senior High Schools by the Computerised School Selection and Placement System. However, teacher recruitment most often does not correspond to the increase in class and school size. According to Fabunmi and Adewale (2002), school size can predict the performance of a school and also supervision and control can only be effective when the class population is minimal. Fabunmi and Adewale (2002) recommend that adequate quantity of teachers should be posted to schools, and that the number of available classes should be used to determine the number of teachers to be posted to schools.

Byabato and Kisamo (2014) report that the missing link between what teachers think they know and what they can do in practice is likely to be resulting from the lack of training on assessment practices for teachers. Therefore, they suggested that schools should organise in-service training to enrich teachers" methodology in assessment and particularly preparing and implementing the SBA.

Over reliance on WAEC questions, which may result in the neglect of portions of the curricula which do not lend themselves easily to paper or pencil tests (Bello & Tijani, 2008) and the reported incidence of inflation of SBA scores and favouritism (Byabato & Kisamo, 2014), have resulted in calls for institutionalisation of mechanism for SBA coordination and monitoring by the teachers.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Overview

The purpose of this study was to measure and describe mathematics teachers‟ SBA literacy levels, SBA implementation challenges and perceived solutions to these challenges at the SHS level. Research questions were posed to find; the level of mathematics teachers‟ assessment literacy, the challenges they face in the implementation of the school based assessment, and how they perceive these challenges can be addressed. In order to answer the research questions, a mixed methodology involving both quantitative and qualitative methods was employed for data collection and analysis. This chapter being the final chapter for this study is a summary of the findings and conclusions drawn, and the recommendations for future consideration.

5.2 Summary of Findings

The presentation of the summary is based on each research question.

5.2.1 Findings on Mathematics Teachers' Assessment Literacy in SBA

Teachers‟ responses indicate the following:

On the purpose of conducting school based assessment,

- Mathematics teachers‟ responses showed that more than half (53.9%) of the teachers conduct classroom assessment for these reasons: to find out if students were learning; if students understood the lessons; and to satisfy continuous assessment requirements. However, nearly half (46.1%) of mathematics teachers‟ indicated conducting classroom assessment for a fourth reason in addition to the three reasons, which is to plan the next batch of lessons. Thus, most mathematics teachers tended to have low level of knowledge of using assessment to plan their lessons.

On what to assess,

- Mathematics teachers‟ responses showed that teachers assessed students on values of both product and process of learning in mathematics, which comprises: knowledge or mastery of basic concepts (product), Routine procedures (product), problem solving or investigation (process), and mathematical reasoning or understanding (process). However, majority (64.7%) of mathematics teachers did not assess problem-solving while 35.3% of them claimed to assess problem-solving, which value the mathematics syllabus strongly recommends. Thus, mathematics teachers tended to have low level of knowledge on assessing problem-solving in mathematics.
- Mathematics teachers tended to have high level of knowledge in constructing multiple-choice questions (MCQ) and subjective/essay test to reflect the instructional objectives and content areas of the core mathematics syllabus, and to assess the cognitive domain of learning.

On assessment strategies,

- Mathematics teachers had knowledge of and used wide-ranging assessment types recommended by the CRDD (2010) at varying frequencies. Assessment types such as class exercise, class tests, assignments, discussion and interview were frequently used, whereas observation, project work, group work and oral presentation were less frequently used.
- Mathematics teachers tended to have high level of knowledge in developing class tests, assignments, discussion, oral presentation, group work, interview and observation for assessment. However, majority of teachers (n = 81) rated their knowledge in project work assessment tool as Limited or Very Limited. This indicates a low level of knowledge in the development of project work assessment.

On interpreting and action-taking on students‟ work,

- Mathematics teachers indicated high level of knowledge in preparing answer keys for Multiple Choice Questions and scoring Multiple Choice Questions. However, their level of knowledge in preparing marking schemes to score subjective tests was found to be low.
- Mathematics teachers‟ responses show that they determine students‟ collective performance quantitatively and qualitatively. Their level of knowledge was found to be high.
- Mathematics teachers‟ responses indicate that they provide prompt feedback and plan remedial instruction on students‟ performance. Their level of knowledge was found to be high.

5.2.2 Findings on Mathematics Teachers' Challenges in Implementing SBA

The findings of the research reveal mathematics teachers‟ challenges to be overloaded classes, heavy teaching workload, lack of SBA coordination and monitoring mechanism, lack of guideline for preparing/implementing the SBA, lack of interest from parents in schoolwork of students, and insufficient time to carry out SBA, but at different percentage of indication.

The study specifies overloaded classes to be a class of 50 students and above which was the student-classroom ratio at the SHS level as of 2011/2012 academic year (MoE, 2013); even though, according to Mintah (2014), any figure above 35 is said to be large as per the GES policy. Mathematics teachers‟ responses show that, majority (40.2%) of teachers indicated overloaded classes as their fore-most challenge in the implementation of the SBA.

Heavy teaching workload, in the study, was specified to be teaching periods of above 24 periods per week. Mathematics teachers‟ responses show that 27.5% of teachers indicated heavy teaching workload as their most pressing challenge.

Lack of SBA coordination and monitoring mechanism arises where there is no structure or supervision in place to ensure that teachers integrated systematic formative assessment (formal and informal assessment) to better effect of teaching and learning (Akyeampong, Pryor & Ampiah, 2006). Mathematics teachers‟ responses show that 100% of teachers indicated the lack of SBA coordination and monitoring mechanism as "Very True" in their case. Also, 7.8% of teachers indicated it as being their fore-most challenge in implementing the school based assessment.

Lack of guideline for preparing/implementing the SBA is the situation where the SBA policy was not accompanied by the SBA how-to manual on preparation or implementation of the SBA, i.e Class Assessment Tasks (CATs) not available to teachers (CRDD, 2010; MoE, 2014). Mathematics teachers‟ responses show that 24.5% of teachers indicated lack of guideline for preparing/implementing SBA as their most pressing challenge in implementing the SBA.

Lack of interest from parents in schoolwork of students implies that parents as stakeholders in education do little or nothing at all to complement the efforts of teachers in the learning process. Mathematics teachers‟ responses show that more than half (51.0%) of the teachers indicated lack of interest from parents in schoolwork of students as “Not True” in their case.

Insufficient time to carry out SBA arises when relatively short duration class periods often curtail sustained student engagement, classroom discussion and opportunities for reflection (Webb, 2005). Mathematics teachers‟ responses show that more than two-third of teachers indicated insufficient time to carry out SBA as either “Somewhat True” or “Very True” in their case.

Poor recording and reporting on students‟ SBA is a situation where systematic record-keeping is not done well, and the incidence of unmarked scripts. Mathematics teachers‟ responses show that more than two-third of teachers indicated poor recording and reporting on students‟ SBA as either “Somewhat True” or “Very True” in their case.

Absenteeism of learners arises when a significant number of students miss out on regular assessments as a result of being irregular to school or unavailable in class.

Mathematics teachers‟ responses show that exactly half of the teachers indicated absenteeism of learners as “Not True” in their case.

5.2.3 Findings on Mathematics Teachers' Perspective on Addressing the Challenges

Mathematics teachers‟ responses show that their foremost challenge in the order of most indicated to least indicated are as follows: Majority of teachers, n = 41, representing 40.2%, indicated overloaded classes as their fore-most SBA implementation challenge. This was followed by heavy teaching workload, with 27.5% of teachers (n = 28) indicating that as their most pressing challenge. Lack of guideline for preparing/implementing SBA was indicated by 24.5% of teachers (n = 25) as most pressing challenge. Lastly, lack of SBA coordination and monitoring mechanism had 7.8% of teachers (n = 8) indicating it as their fore-most challenge.

Teachers propose the following;

- GES should set reasonable and manageable class-sizes that will inure to the benefit of both teachers and students.
- MoE and PTA should build more infrastructures to deal with the incidence of overpopulated classes.
- GES should recruit adequate teachers to deal with the problem of increasing school and class sizes, and its attendant heavy teaching workload.
- GES should organise proper, need-specific in-service training on assessment for teachers.
- GES should put in place mechanisms to monitor school based assessments in order to realize the good aspiration of the SBA policy. For example, GES should

redefine the role of Heads of Department, properly trained to design and supervise all assessment activities.

- GES should make available the SBA how-to manual to make the implementation of classroom assessment tasks easier for teachers.

5.3 Conclusion

The requirement from the MoE (2014) report for teachers to be assessment literate for the effective implementation of the school based assessment policy in Ghanaian schools cannot be underestimated. Abell and Siegel‟s (2011) assessment literacy model was applied to the Ghanaian context in the study to determine mathematics teachers‟ level of assessment literacy at the Senior High School level. The study also delved into School Based Assessment implementation challenges and teachers‟ solutions to addressing them. The study reviewed related literature, and employed both quantitative and qualitative methods to collect data for analysis. Based on the results obtained from the study, the following conclusions have been reached:

First, the study revealed that mathematics teachers‟ level of assessment literacy in the four areas: assessment purposes; what to assess; assessment strategies; and interpretation and action taking; on the average is sufficient. Mathematics teachers know the purposes of school based assessment, but have to utilize school based assessment more, for example, to plan lessons in advance. Teachers assessed values ranging from knowledge or mastery of basic concepts, routine procedures, to mathematical reasoning or understanding, but rarely assessed problem solving – a very crucial aspect in the school based assessment policy. Teachers‟ level of knowledge in using formative assessment strategies was moderate while indicating a high level of knowledge in the use of summative assessment strategies. In addition,

teachers have high level of knowledge in the use of different test formats. However, teachers have problems developing standard marking scheme for scoring subjective questions. On determine students‟ collective performance quantitatively and qualitatively, teachers‟ level of knowledge was found to be high. It was also found that, mathematics teachers‟ level of knowledge in providing prompt feedback and plan remedial instruction on students‟ performance was high. In spite of these findings, the variability of teachers‟ responses in most cases indicates that some teachers have problems on the four areas of knowledge, and so need assistance.

Second, the study revealed that mathematics teachers‟ challenges in the implementation of the school based assessment were: heavy teaching workload; overloaded classes; lack of SBA coordination and monitoring mechanism; poor recording and reporting on students‟ school based assessment; lack of guideline for preparing/implementing SBA; lack of interest from parents in school work of students; insufficient time to carry out SBA; and absenteeism of learners. However, the most indicated challenges being heavy teaching workload; overloaded classes; lack of SBA coordination and monitoring mechanism; and lack of guideline for preparing/implementing SBA. Even though, the researcher did not consider all challenges in SBA implementation known in literature, the few indicated by teachers are none-the-less important. The solutions teachers proposed are placed at the door step of GES, PTA and the Ministry of Education. Therefore, the stated stakeholders must respond to the challenges so identified, and factor teachers‟ proposed solutions in their deliberations to address these challenges. Thus, for Ghana to achieve the expected success in mathematics education at the SHS level through an effective school based assessment system, all stakeholders should play their respective roles to realize the desired aspiration.

5.4 Recommendations

Based on the findings of this study, the researcher would like to make the following recommendations for consideration:

- It was found that more than half of mathematics teachers did not conduct assessment for the purpose of using it to plan the next batch of lesson or teaching cycle. Therefore, mathematics teachers should be trained on planning lessons through information from assessments.
- It was found that mathematics teachers used summative assessment tools more frequently as oppose to the formative assessment tools. Majority of teachers (n = 81) rated their knowledge in developing project work assessment as Limited or Very Limited. This indicates a low level of knowledge in the development project work assessment. Therefore, teachers should be given refresher courses in the development of various assessment tools. The refresher course should focus on the formative assessment strategies; particularly, project work assessment.
- It was found that majority (64.7%) of mathematics teachers do not assess problem solving, which mathematical value the core mathematics syllabus strongly recommends. Therefore, it is recommended that Ghana Education Service should seek the assistance of corporate bodies to sponsor training programmes in ways of assessing the mathematical values, particularly problem-solving.
- It was found that teachers rated their level of knowledge in preparing marking schemes to score subjective tests as low. It is recommended that Ghana

Education Service in Collaboration with the West African Examination Council train teachers in developing marking scheme for subjective tests.

- Teachers‟ proposed solutions to addressing the challenges of SBA implementation are recommended. These are:

- GES should set reasonable and manageable class-sizes that will inure to the benefit of both teachers and students.
- MoE and PTA should build more infrastructures to deal with the incidence of overpopulated classes.
- GES should recruit adequate teachers to deal with the problem of increasing school and class sizes, and its attendant heavy teaching workload.
- GES should put in place mechanisms to monitor school based assessments in order to realize the good aspiration of the SBA policy. For example, GES should redefine the role of Heads of Department, properly trained, to design and supervise all assessment activities.
- GES should make available the SBA how-to manual to make the implementation of classroom assessment tasks easier for teachers.

5.5 Suggestion for Further Studies

The study of teachers‟ assessment literacy depended on teachers‟ self-perceived knowledge. As a result, it is suggested that the study be replicated where teachers‟ assessment literacy would be determined by actual examination of their knowledge, or observation of their assessment practices.

REFERENCES

Abell, S. K. & Siegel, M. A., (2011). Assessment literacy: What science teachers need to know and be able to do? In D. Corrigan, J. Dillon, & R. Gunstone (Eds.), *The professional knowledge base of science teaching*, 205–221. http://dx.doi.org/10.1007/s10972-012-9278-z

Adusah-Karikari, A. (2008). *Experiences of Women in Higher Education: A Study of Women Faculty and Administrators in Selected Public Universities in Ghana*. Electronic thesis. Retrieved May 4, 2015, from https://etd.ohiolink.edu.

Airasian, P. W. (1997). *Classroom assessment,* (3rd ed) New York: McGraw- Hill Companies, Inc.

Akunu, A. (2012, October). *University of Sussex.* Retrieved April 20, 2015, from University of Sussex website: http://sro.sussex.ac.uk/

Akyeampong, K., Pryor, J. & Ampiah, J.G. (2006). A vision of successful schooling: Ghanian teachers‟ understanding of learning, teaching and assessment. *Comparative Education*, 42 (2): 155-176.

Amedahe, F. (2000). *Continuous Assessment. Tutor Handbook.* University of Cape Coast, Ghana.

Anamuah-Mensah, J., Mereku, D. K., & Ghartey-Ampiah, J. (2008). *TIMSS 2007 Ghana Report.* Accra: Ministry of Education, Science and Sports.

Ary, D., Jacobs, L. C., & Razavieh, A. (2002). *Introduction to Research in Education (6th ed.).* Belmont: Wadsworth/Thomson Learning.

Asare-Inkoom, A. (2001). *Treatment Duration of some Selected Topics in the Senior Secondary School Core mathematics syllabus*. A Thesis presented to the Department of Science Education, Faculty of Education, UCC.

Ashie, J. (2009, october 26). *Modern Ghana.* Retrieved march 1, 2015, from Modern Ghana website: m.modernghana.com/news/245678/1/jss-exams-and-assessment-in-ghanaian-schools.html

Atsu, M. A. (2011, September 6). *University of Education,Winneba.* Retrieved March 20, 2015, from University of Education, Winneba, website: ir.uew.edu.gh:8080

Babbie, E., & Mouton, J. (2001). *The Practice of Social Research.* Capa Town: Oxford University Press Southern Africa.

Baku, J. (1991). *Implementation of Continuous Assessment in Schools: Minority Report.* Accra: CRDD.

Bell, B., & Cowie, B. (2001). *Formative Assessment and Science Education*. Dordrecht, Netherlands: Kluwer Academic Publishers.

Bello, M. A., & Tijani, A. (2008). *iaea organisation.* Retrieved April 22, 2015, from iaea.info: www.ieae.info/paper_2fb24ab5.pdf

Black, H. D., & Broadfoot, P. (1982). *Keeping track of teaching: Assessment in the modern classroom.* London: Routledge & Kegan Paul.

Black, P., & Wiliam, D. (1998). *Assessment and Classroom Learning*. *Assessment in Education, 5*(1), 7-74.

Bogdan, R. C., & Biklen, S. K. (1982). *Qualitative Research for Education: An Introduction to Theory and Methods*. Boston: Allyn and Bacon, Inc.

Brown, G. T. L. (2003). *Teacher's instructional conceptions: Assessment's relationship to learning, teaching, curriculum, and teacher efficacy*. Paper presented to the Joint Conference of the Australian and New Zealand Associations for Research in Education (AARE/NZARE), Auckland, NZ, November, 28-December 3, 2003.

Burns, N. & Grove, S. (2001). *The practice of nursing research: conduct, critique and utilization (4th ed)*. W. B. Saunders: Philadelphia, Pennsylvania, USA.

Byabato, S., & Kisamo, K. (2014). Implementation of School Based Continuous Assessment (CA) in Tanzania Ordinary Secondary Schools and its Implications on the Quality of Education. *Developing Country Studies*, 55-62.

Chumun, S. (2002). *Classroom Assessment in Mauritian Primary Schools*. Retrieved September 21, 2015, from bura.brunel.ac.uk/handle/2438/5154

Churchill, G., Jr. (1979). A Paradigm for Developing Better Measures of Marketing Constructs, *Journal of Marketing Research,* 64-73.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research Methods in Education* (6th ed.). 270 Madison Avenue, New York, NY: Routledge.

Cooney, T. J. & Shealy, B. E. (1995). *Teachers thinking and rethinking assessment practices.* Paper presented at the Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (Columbus, OH, October 21-24, 1995).

Cornelly, L. M. (2008). Pilot Studies. *Medsurg Nursing* , 411-412.

CRDD. (2010). *Mathematics Syllabus for Senior High School.* Accra: Ghana Publishing Corporation.

Creswell, J. W. (2002). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*. Upper Saddle River, N. J: Merrill.

Cresswell, J. W. & Plano-Clark, V.L. (2007), *Designing and Conducting Mixed Methods Research,* (London, Sage Publications).

Delandshere, G. & Jones, J. H. (1999). *Elementary teachers' beliefs about assessment in mathematics: A case of assessment paralysis*. Journal of Curriculum and Supervision, *14*(3), 216-40.

De Lange, J. (1999). *Ohio Resource Centre.* Retrieved September 26, 2015, from www.fi.uu.nl/catch/products/framework/de_lange_framework.doc

Dery, R. G., & Addy-Lamptey, W. (2010, March 20). *The International Association for Educational Assessment.* Retrieved March 1, 2015, from The International Association for Educational Assessment website: www.iaea.info/documents/paper_4d53997.pdf.

Dix (2010). *The Essential Guide to Classroom Assessment*. Great Britian, United Kingdom: Pearson Education Limited.

Ekwueme, C. O., & Meremikwu, A. N. (2013). Teacher's Characteristics and Students' Degree of Errors in Different Content Areas in Senior Secondary Certificate Examination In Mathematics. *Journal of Educational Practice* , 57-62.

Fabunmi, M., & Adewale, J. G. (2002). A Path-Analytic Model of Schooling Situations and Secondary School Students' Academic Performance in Oyo State Nigeria. *Journal of Educational Management* , 46-59.

Fook, C. Y., & Sidhu, G. K. (2010). *School-Based Assessment among ESL Teachers in Malaysian Secondary Schools.* Retrieved June 10, 2015, from www.medc.com.my/medc/journals/volume9/chan%20yuen.pdf

Ghartey-Ampiah, J. (2012). *Pathways to effective school and classroom assessment: The case of Ghana.* Retrieved July 3, 2015, from www.gsid.nagoya-u.ac.jp/syamada/Dr.%20Ghartey_PPT_assessment.pdf

Gottheiner, D., & Siegel, M. (2012). Experienced Middle School Science Teachers' Assessment Literacy: Investigating Knowledge of Conceptions in Genetics and Ways to Shape Instruction. *J Sci Teacher Educ* , 531-557.

Gravetter, F. J., & Forzano, L. B. (2006). *Research Methods for the Behavioural Sciences (2nd ed.)*. Belmont, CA: Wadsworth.

Hanna, G. S., & Dettmer, P. A. (2004). *Assessment for effective teaching: Using context-adaptive planning.* Boston, MA: Pearson A&B.

Harlen, W. (2005). Teachers‟ summative practices and assessment for learning - tensions and synergies. *The Curriculum Journal, 16*(2), 207–223.

Henderson, A., & Mapp, K. (2002). *A new wave of evidence: The impact of school, parent and community connections on student achievement*. Austin, TX.: Southwest Educational Development Laboratory.

Herrera, S.G., Murry, K. G., & Cabral, R.M. (2007). *Assessment accommodations for classroom teachers of culturally and linguistically diverse students.* Boston, MA: Pearson Education Inc.

Hill, R. (1998). What Sample Size is "Enough" in Internet Survey Research? Interpersonal Computing and Technology. *An Electronic Journal for the 21st Century* , 3-4.

Jabbarifar, T. (2009). The Importance of Classroom Assessment and Evaluation in Educational System. *2nd International Conference of Teaching and Learning (ICTL)* (pp. 1-9). Malaysia: INTI University College.

Kapambwe, W. (2010). The implementation of school based continuous assessment (CA) in Zambia. *Educational Research and Reviews* , 99-107.

Khadijeh, B., & Amir, R. (2015). Importance of Teachers' Assessment Literacy. *International Journal of English Language Education* , 139-145.

Krathwohl, D. (2002). Retrieved August 12, 2015, from http://www.unco.edu/cetl/sir/stating_outcome/documents/Krathwohl.pdf

Kumar, R. (2005). *Research Methodology – A Step-by-Step Guide for Beginners* (2nd ed.). Singapore: Pearson Education.

Linn, R. L., & Miller, M. D. (2005). *Measurement and assessment in teaching* (9th ed.) Upper Saddle River, NJ: Prentice Hall.

Lowery, N. V. (2003). *Assessment insights form the classroom*. The Mathematics Educator, 13(1), 15-21.

McGraw, B. (2006). *Assessment fit for purpose.* Keynote presentation at the 32nd IAEA annual conference held in Singapore.

Mereku, D. K. & Appiah, J. (2012). *Report on the workshop on use of child friendly pedagogy in teaching JHS mathematics*. Winneba: University of Education, Winneba.

Mintah, E. K. (2014). Using Group Method of Teaching to Address the Problem of Large Class Size: An Action Research. *International Journal of Learning & Development, 4*, 82-97.

MoE. (2013). *Education Sector Performance Report.* Accra: Ministry of Education.

MoE. (2014). *Reforming Science and Mathematics Education in Basic Schools in Ghana.* Accra: Ministry of Education.

Nabie, M. J., Akayuure, P., & Sofo, S. (2013). Integrating Problem Solving and Investigations in Mathematics: Ghanaian Teachers' Assessment Practices. *International Journal of Humanities and Social Sciences* , 47-56.

National Council of Teachers of Mathematics. (2000). *Principles and Standards for School Mathematics*. Reston, VA: NCTM.

Ontario. (2005). Retrieved november 29, 2015, from eworkshop.on.ca: eworkshop.on.ca/edu/pdf/Mod21_assessment_strgs.pdf

Pallant, J. (2001). *SPSS Survival Manual*. Buckingham: Open University Press.

Philippou, G., & Christou, C., (1997). *Cypriot and Greek primary teachers' conceptions about mathematical assessment.* Educational Research and Evaluation, 3(2), 140-159.

Popham, J. W. (2009). Assessment Literacy for Teachers: Faddish or Fundamental? *Theory Into Practice* , 4-11.

Salkind, N. J. (2010). *Encyclopedia of Research Design.* Thousand Oaks, CA: SAGE Publication, Inc.

Saunders, M., Lewis, P., & Thornhill, A. (2007). *Research Methods for Business Students*. Harlow, England: Financial Times/Prentice Hall.

Sethusha, M. J. (2012). Retrieved november 30, 2015, from uir.unisa.ac.za: uir.unisa.ac.za/bitstream/handle/10500/8128/thesis_sethusa_mj.pdf?sequence=1

Siaw, A. O., & Nortey, S. (2011). Teaching and Learning of Visual Arts in Senior High Schools in Ghana. *Journal of Education and Practice* , 111-119.

Stake, R. E. (2008). Qualitative case studies. In N. K. Denzin, & Lincoln, Y. S. (Eds.), *Strategies of qualitative inquiry* (pp. 119-149). Los Angeles: Sage.

Stiggins, R. (2005). From Formative Assessment to Assessment FOR Learning: A Path to Success in Standards-Based Schools, *Phi Delta Kappan*, Vol. 87, No. 04, pp. 324-328**.**

Tashakkori, A. & Teddlie, C. (2003), Major Issues and Controversies in the Use of Mixed Methods in the Social and Behavioral Sciences in: A. Tashakkori, & C. Teddlie (Ed.) *Handbook of Mixed Methods in Social & Behavioral Research,* (London, Sage Publications), pp. 3 - 47.

Webb, D.C. (2005). *Classroom assessment as a research context: variations on a theme of pedagogical decision making.* Madison, WI: University of Wisconsin Press.

Wiliam, D., & Thompson, M., (2008). Integrating assessment with learning: What will it take to make it work? In C. A. Dwyer (Ed.). *The future of assessment: Shaping teaching and learning.* (pp. 53-82). New York: Lawrence Erlbaum Associates.

World Bank (2013). *SABER students' assessment: Ghana Country Report*. Washington, DC: World Bank. Downloaded April 28, 2015 at http://wbgfiles.worldbank.org/documents/hdn/ed/saber/supporting_doc/CountryReports/SAS/SABER_SA_Ghana_CR_Final_2013.pdf

APPENDIX A

QUESTIONNAIRE FOR TEACHERS

Dear Respondent,

Thank you for taking time to complete this questionnaire. Please answer each question to the best of your knowledge. Your thoughtful and truthful responses will be greatly appreciated. **Your individual name or identification number is <u>not required</u> and will not at any time be associated with your responses.** However, please indicate the name of your school. Your responses will be kept completely **<u>confidential.</u>**

Name of School:……

SECTION A

1. What are your reasons for conducting classroom assessment?
   Scale: 1 = Yes (Y), 2 = No (N)

	Reasons for Classroom Assessment	**Y**	**N**
a.	To find out if students are adequately learning	1	2
b.	To find out if students properly understand the lessons	1	2
c.	To inform the planning of the next batch of lessons	1	2
d.	To satisfy continuous assessment requirement	1	2

1e. Any other reason for conducting classroom assessment? **(Optional)**

.....

2. What is the frequency of use of assessment tools or types?

Scale: 1 = Daily/Weekly (D/W), 2 = Monthly (M), 3 = Termly (T), 4 = Never Used (NU)

	Assessment Tools/types	D/W	M	T	NV
a.	Class test	1	2	3	4
b.	Class Exercise	1	2	3	4
c.	Assignment	1	2	3	4
d.	Project Work/ Practical Skills Test	1	2	3	4
e.	Discussion	1	2	3	4
f.	Oral Presentation	1	2	3	4
g.	Group Work	1	2	3	4
h.	Assessment by interview	1	2	3	4
i.	Observation	1	2	3	4

3. What is the level of knowledge in the development of the assessment tools?

Scale: 1 = Very Limited (VL), 2 = Limited (L), 3 = Sufficient (S), 4 = Very Sufficient

	Assessment Tools/types	VL	L	S	VS
a.	Class test	1	2	3	4
b.	Assignment	1	2	3	4
c.	Project Work/ Practical Skills Test	1	2	3	4
d.	Discussion	1	2	3	4
e.	Oral Presentation	1	2	3	4
f.	Group Work	1	2	3	4

g.	Interview	1	2	3	4
h.	Observation	1	2	3	4

4. What competence/value(s) do you assess?

Scale: 1 = Yes (Y), 2 = No (N)

	What is Assessed	**Y**	**N**
a.	Product : Knowledge or Mastery of Basic Concepts	1	2
b.	Product : Routine procedures	1	2
c.	Process : Problem-solving or investigation	1	2
d.	Process : Mathematical reasoning/understanding in subjective test	1	2

5. What is your level of knowledge in these aspects of planning assessment?

Scale: 1 = Very Limited (VL), 2 = Limited (L), 3 = Sufficient (S), 4 = Very Sufficient

	ITEM	**VL**	**L**	**S**	**VS**
a.	Taxonomy of educational objective: cognitive.	1	2	3	4
b.	Core Mathematics syllabus: content, teaching and learning activities	1	2	3	4
c.	Writing specific objective for lesson plan.	1	2	3	4
d.	Outlining instructional content for the test.	1	2	3	4
e.	Listing instructional objectives for the test.	1	2	3	4

6. What is your level of knowledge in assessment preparation with respect to question construction? **NB: MCQ implies Multiple Choice Questions**

Scale: 1 = Very Limited (VL), 2 = Limited (L), 3 = Sufficient (S), 4 = Very Sufficient

		VL	L	S	VS
a	Constructing MCQ in Number and Numeration.	1	2	3	4
b	Constructing MCQ in Plane Geometry.	1	2	3	4
c	Constructing MCQ in Mensuration.	1	2	3	4
d	Constructing MCQ in Algebra.	1	2	3	4
e	Constructing MCQ in Statistics and Probability.	1	2	3	4
f	Constructing MCQ in Trigonometry.	1	2	3	4
g	Constructing MCQ in Vectors and Transformation in a Plane.	1	2	3	4
h	Constructing application of knowledge or word problem questions.	1	2	3	4
i	Constructing questions that require an understanding of mathematical principles.	1	2	3	4
j	Constructing questions for practical and investigational works (problem solving).	1	2	3	4

7. What is your level of competence with regard to the following?

Scale: 1 = Very Limited (VL), 2 = Limited (L), 3 = Sufficient (S), 4 = Very Sufficient

	Scoring, Reporting and Analyzing	VL	L	S	VS
a	Preparing answer keys for MCQs	1	2	3	4

b	Scoring the MCQ	1	2	3	4
c	Developing standard marking scheme for subjective questions before scoring	1	2	3	4
d	Give students frequent feedback on their scripts after scoring	1	2	3	4
e	Analyzing students‟ achievement data (quantitative & qualitative)	1	2	3	4
f	Planning remedial teaching based on information got from assessment	1	2	3	4
g	Reporting score on students‟ performance	1	2	3	4

SECTION B

8. What challenge(s) do you experience in implementing SBA?

Scale:
1 = Not true of me (NT), 2 = Somewhat true of me (ST), 3 = Very true of me (VT).

	Challenge in Implementing SBA	**NT**	**ST**	**VT**
a	Heavy teaching workload (above 24 periods per week).	1	2	3
b	Overloaded classes (a class of above 50 students).	1	2	3
c	Lack of SBA coordination and monitoring mechanism.	1	2	3
d	Poor recording and reporting on students‟ school based assessment.	1	2	3
e	Lack of guideline for preparing/implementing SBA.	1	2	3
f	Lack of interest from parents in schoolwork of students.	1	2	3
g	Insufficient time to carry out SBA.	1	2	3
h	Absenteeism of learners.	1	2	3

9. Pre-service and In-service Training in Assessment

Scale: 1 = Yes (Y), 2 = No (N), 3 = Not Sure (NS)

	Question Asked	Y	N	NS

a.	Did you have training in assessment when you were under training?	1	2	3
b.	Have you participated in any training programme on assessment since you started teaching?	1	2	3

SECTION C

10. Mention one (1) challenge you indicated above which you consider most pressing?

1. .....

11. How do you propose your stated challenge can be addressed?

APPENDIX C

TABLES OF RESULTS

Frequency of use of assessment types

Table 2a. Class Test

		Frequency	Percentage
Valid	Daily/Weekly	55	53.9%

	Monthly	40	39.2%
	Termly	7	6.9%
	Never Used	0	0%
Total		102	100%

- Mode = 55

Table 2b. Class Exercise

		Frequency	Percentage
Valid	Daily/Weekly	102	100%
	Monthly	0	0%
	Termly	0	0%
	Never Used	0	0%
Total		102	100%

- Mode = 102

Table 2c. Assignment

		Frequency	Percentage
Valid	Daily/Weekly	102	100%
	Monthly	0	0%
	Termly	0	0%
	Never Used	0	0%
Total		102	100%

- Mode = 102

Table 2d. Project Work

		Frequency	Percentage
Valid	Daily/Weekly	0	0%
	Monthly	0	0%
	Termly	18	17.6%
	Never Used	84	82.4%

Total	102	100%

- Mode = 84

Table 2e. Discussion

		Frequency	Percentage
Valid	Daily/Weekly	102	100%
	Monthly	0	0%
	Termly	0	0%
	Never Used	0	0%
Total		102	100%

Table 2f. Oral Presentation

		Frequency	Percentage
Valid	Daily/Weekly	0	0%
	Monthly	5	4.9%
	Termly	52	51.0%
	Never Used	45	44.1%
Total		102	100%

- Mode = 52

Table 2g. Group Work

		Frequency	Percentage
Valid	Daily/Weekly	6	5.9%
	Monthly	37	36.3%
	Termly	41	40.2%
	Never Used	18	17.6%
Total		102	100%

- Mode = 41

Table 2h. Interview

		Frequency	Percentage
Valid	Daily/Weekly	31	30.4%
	Monthly	38	37.3%
	Termly	30	29.4%
	Never Used	3	2.9%
Total		102	100%

- Mode = 38

Table 2i. Observation

		Frequency	Percentage
Valid	Daily/Weekly	12	11.8%
	Monthly	14	13.7%
	Termly	30	29.4%
	Never Used	46	45.1%
Total		102	100%

- Mode = 46

Level of Knowledge in the Development of these Assessment Tools

Table 3a. Class Test

		Frequency	Percentage
Valid	Very Limited	0	0
	Limited	0	0
	Sufficient	45	44.1%
	Very Sufficient	57	55.9%
Total		102	100%

- Mode = 57

Table 3b. Assignment

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	0	0%
	Sufficient	36	35.3%
	Very Sufficient	66	64.7%
Total		102	100%

- Mode = 66

Table 3c. Project Work/Practical Skills Test

		Frequency	Percentage
Valid	Very Limited	51	50%
	Limited	30	29.4%
	Sufficient	21	20.6%
	Very Sufficient	0	0%
Total		102	100%

- Mode = 51

Table 3d. Discussion

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	4	3.9%
	Sufficient	47	46.1%
	Very Sufficient	51	50%
Total		102	100%

Table 3e. Oral Presentation

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	6	5.9%
	Sufficient	42	41.2%
	Very Sufficient	54	52.9%
Total		102	100%

- Mode = 54

Table 3f. Group Work

		Frequency	Percentage
Valid	Very Limited	7	6.9%
	Limited	21	20.6%
	Sufficient	55	53.9%
	Very Sufficient	19	18.6%
Total		102	100%

- Mode = 55

Table 3g. Interview

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	7	6.9%
	Sufficient	39	38.2%
	Very Sufficient	56	54.9%
Total		102	100%

Table 3h. Observation

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	18	17.7%

	Sufficient	54	52.9%
	Very Sufficient	30	29.4%
Total		102	100%

- Mode = 54

Knowledge in these aspects of planning assessment

Table 5a. Taxonomy of Educational Objective: Cognitive

		Frequency	Percentage
Valid	Very Limited	11	10.8%
	Limited	20	19.6%
	Sufficient	43	42.2%
	Very Sufficient	28	27.5%
Total		102	100%

- Mode = 43

Table 5b. Core Mathematics Syllabus: Content, Teaching & Learning Activities, Evaluation

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	12	11.8%
	Sufficient	48	47.1%
	Very Sufficient	42	41.2%
Total		102	100%

- Mode = 48

Table 5c. Writing Specific Objective for Lesson Plan

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	23	22.5%
	Sufficient	51	50.0%
	Very Sufficient	28	27.5%
Total		102	100%

- Mode = 51

Table 5d. Outlining Instructional Content for the Test

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	2	2.0%
	Sufficient	49	48.0%
	Very Sufficient	51	50.0%
Total		102	100%

- Mode = 51

Table 5e. Listing Instructional Objectives for the Test

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	4	3.9%
	Sufficient	48	47.1%
	Very Sufficient	50	49.0%
Total		102	100%

- Mode = 50

Knowledge of Assessment Preparation with regards to Question Construction

Table 6a. Constructing MCQ in Number and Numeration

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	8	7.9%
	Sufficient	44	43.1%
	Very Sufficient	50	49.0%
Total		102	100%

- Mode = 50

Table 6b. Constructing MCQ in Plane Geometry

		Frequency	Percentage
Valid	Very Limited	0	0%

	Limited	8	7.8%
	Sufficient	43	42.2%
	Very Sufficient	51	50.0%
Total		102	100%

- Mode = 51

Table 6c. Constructing MCQ in Mensuration

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	6	5.9%
	Sufficient	51	50.0%
	Very Sufficient	45	44.1%
Total		102	100%

- Mode = 51

Table 6d. Constructing MCQ in Algebra

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	2	1.96%
	Sufficient	62	60.79%
	Very Sufficient	38	37.25%
Total		102	100%

- Mode = 62

Table 6e. Constructing MCQ in Statistics and Probability

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	18	17.6%
	Sufficient	42	41.2%
	Very Sufficient	42	41.2%
Total		102	100%

Table 6f. Constructing MCQ in Trigonometry

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	7	6.9%
	Sufficient	50	49.0%
	Very Sufficient	45	44.1%
Total		102	100%

- Mode = 50

Table 6g. Constructing MCQ in Vectors and Transformation in a Plane

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	21	20.6%
	Sufficient	42	41.2%
	Very Sufficient	39	38.2%
Total		102	100%

- Mode = 42

Table 6h. Constructing Application of Knowledge or Word Problem (subjective) Questions

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	26	25.5%
	Sufficient	42	41.2%
	Very Sufficient	34	33.3%
Total		102	100%

- Mode = 42

Table 6i. Constructing Subjective Questions that Require an Understanding of Mathematical Principles

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	9	8.8%
	Sufficient	48	47.1%
	Very Sufficient	45	44.1%
Total		102	100%

- Mode = 48

Table 6j. Constructing Questions for Practical and Investigational Works (Problem Solving)

		Frequency	Percentage
Valid	Very Limited	48	47.0%
	Limited	31	30.4%
	Sufficient	22	21.6%
	Very Sufficient	1	1 %
Total		102	100%

- Mode = 48

Knowledge with regard to Scoring, Reporting and Analyzing SBA Data

Table 7a. Preparing Answer Keys for MCQs

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	0	0%
	Sufficient	43	42.2%
	Very Sufficient	59	57.8%
Total		102	100%

- Mode = 59

Table 7b. Scoring the MCQs

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	0	0%
	Sufficient	44	43.1%

	Very Sufficient	58	56.9%
Total		102	100%

- Mode = 58

Table 7c. Developing Marking Scheme for Subjective Questions before Scoring

		Frequency	Percentage
Valid	Very Limited	10	9.8%
	Limited	48	47.1%
	Sufficient	36	35.3%
	Very Sufficient	8	7.8%
Total		102	100%

- Mode = 48

Table 7d. Providing Students Frequent Feedback on their Scripts after Scoring

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	0	0%
	Sufficient	55	53.9%
	Very Sufficient	47	46.1%
Total		102	100%

- Mode = 55

Table 7e. Analysing Students‟ Achievement Data (Quantitative & Qualitative)

		Frequency	Percentage
Valid	Very Limited	11	10.8%
	Limited	32	31.4%
	Sufficient	37	36.2%
	Very Sufficient	22	21.6%
Total		102	100%

- Mode = 37

Table 7f. Planning Remedial Teaching based on Information got from Assessment

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	10	9.8%
	Sufficient	44	43.1%
	Very Sufficient	48	47.1%
Total		102	100%

- Mode = 48

Table 7g. Reporting Score on Students‟ Performance

		Frequency	Percentage
Valid	Very Limited	0	0%
	Limited	0	0%
	Sufficient	50	49.0%
	Very Sufficient	52	51.0%
Total		102	100%

- Mode = 52

SBA Implementation Challenges

Table 8a. Heavy Teaching Workload (above 24 periods per week)

		Frequency	Percentage
Valid	Not True of Me	48	47.1%
	Somewhat True of Me	31	30.4%
	Very True of Me	23	22.5%
Total		102	100%

- Mode = 48

Table 8b. Overloaded Classes (a class of above 50 students)

		Frequency	Percentage
Valid	Not True of Me	32	31.4%
	Somewhat True of Me	36	35.3%
	Very True of Me	34	33.3%
Total		102	100%

- Mode = 36

Table 8c. Lack of SBA Co-ordination and Monitoring Mechanism

		Frequency	Percentage
Valid	Not True of Me	0	0%
	Somewhat True of Me	0	0%
	Very True of Me	102	100%
Total		102	100%

- Mode = 102

Table 8d. Poor Recording and Reporting on Students‟ School Based Assessment

		Frequency	Percentage
Valid	Not True of Me	17	16.7%
	Somewhat True of Me	25	24.5%
	Very True of Me	60	58.8%
Total		102	100%

- Mode = 60

Table 8e. Lack of Guideline for Preparing/Implementing SBA

		Frequency	Percentage
Valid	Not True of Me	0	0%
	Somewhat True of Me	0	0%
	Very True of Me	102	100%
Total		102	100%

- Mode = 102

Table 8f. Lack of Interest from Parents in Schoolwork of Students

		Frequency	Percentage
Valid	Not True of Me	52	51.0%
	Somewhat True of Me	29	28.4%

	Very True of Me	21	20.6%
Total		102	100%

- Mode = 52

Table 8g. Insufficient Time to Carry Out SBA

		Frequency	Percentage
Valid	Not True of Me	8	7.8%
	Somewhat True of Me	42	41.2%
	Very True of Me	52	51.0%
Total		102	

- Mode = 52

Table 8h. Absenteeism of Learners

		Frequency	Percentage
Valid	Not True of Me	51	50.0%
	Somewhat True of Me	29	28.4%
	Very True of Me	22	21.6%
Total		102	100%

- Mode = 51