UNIVERSITY OF CAPE COAST

RESOURCES AVAILABLE FOR TEACHING MATHEMATICS IN SENIOR HIGH SCHOOLS IN THE WESTERN REGION OF GHANA

DAVIDSON TEYE KABUTEY

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BY

DAVIDSON TEYE KABUTEY

Thesis submitted to the Department of Mathematics and ICT Education of the College of Education Studies, University of Cape Coast, in partial fulfillment of the requirements for the award of Master of Philosophy degree in Mathematics Education

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature..……Date:……

Name: Davidson Teye Kabutey

Supervisors' Declaration

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature……. Date….……...

Name: Dr. Christopher Beccles

Co-Supervisor's Signature …… Date …….

Name: Prof. Eric M. Wilmot

ABSTRACT

The study investigated teaching and learning resources available for teaching mathematics at the Senior High School (SHS) level in the Western region of Ghana. Specifically, it tried to find out the available resources and if they differ among the school categories, the state of the available resources, teachers' access to the available resources and the difference in the use of the resources across sex, academic qualification and school categories. The study used pragmatist paradigm approach mainly through Mixed-Methods Explanatory Sequential design. Eighty-four mathematics teachers and 16 store keepers were used for the study. A total of ten teachers were observed and interviewed in the qualitative phase. The study, however, found that the resources available for teaching mathematics in the Senior High Schools were mathematics syllabus, textbooks, library books, mathematical set for students, calculators, marker board drawing instruments, classrooms, furniture, and marker board. The extent to which the resources were available in the schools was low and there was no significant difference in their availability among the school categories. Further, the available resources were old and not all the parts were in good condition or working well. Although the result of the study indicated teachers acknowledged the positive effect of resource use on teaching of mathematics, yet they had little access to the available resources. Further, it was revealed that mathematics teachers do not use resources too often. A Kruskal Wallis test revealed that mathematics teachers differ in the use of resources in teaching mathematics across school categories, ($H(3) = 26.82$, $p = 0.000$).

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DEDICATION

To memory of Mr. Moses Kabutey

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CHAPTER ONE

INTRODUCTION

This chapterincludes the background to the study, statement of the problem, purpose of the study, research questions and hypotheses. It also contains the significance of the study, limitations and delimitations, definition of terms and the organizationof the study.

Background to the Study

The African people had developed their own systems of education long before the arrival of the Europeans but their systems differ from one community to the other although their goals were similar (Sifuna&Otiende, 1994). After independence, education was seen by the African countries as the necessary instrument for the consolidation of their independence, for securing the new nation and for making workable the newly established self-government in a multi-ethnic society. Undoubtedly, education is seen as the best legacy a nation can give to her citizenry. This is due to the fact that the development of any nation largely depends on the quality of education of the nation. The quality of a nation is judged by the quality of its human resources, and the quality of human resources is maximized through education (Harber, 2010). Education provides the knowledge and skills needed to steer the developmental wheels of a nation to its destination of prosperity by improving the lives of individuals and enriching the wider society (Harber, 2010; Philips &Schweisfurth, 2007). Apart from security and economic empowerment, there are a number of reasons why education is important for the development of any nation. These include making one leada

happy and stable life. If you want to lead a happy life and enjoy the good things the world has to offer, you certainly need to get educated. A great job and a good social reputation are few of the many benefits of being an educated person. Education increases employment opportunities and earnings, and allows even the poor within the society an opportunity to develop knowledge and skills (The Task Force, 2000). A well trained workforce contributes to rising tax streams, improve institutional capital and affordability of better healthcare than can prolong lives and encourage sustainable economic growth (The Task Force, 2000).

Education is a must for a promising and secure future and a stable life. Education also makes one confident. Your educational degree is considered as a proof of your knowledge by many. If you are educated, you have more chances of being heard and taken seriously. Education encompasses our lives; it is the foundation of our society. It helps to stimulate our minds and mould inquisitive minds into intellectuals. Higher learning takes the intellect to the next level, providing a deeper understanding of the world around us. Generally, researchers and educational policy-makers are focusing more on improving the quality of education as the variance between schools is shown to be related to the economic growth of a nation (Hanushek, 2003; Hanushek&Kimko2000). This is further emphasized by a worldwide enterprise for quality education as a human right (Yasin, Petra & Mollie, 2013). The mission of the Ministry of Education in Ghana is to provide relevant education to all Ghanaians at all levels to enable them to acquire skills that will assist them to develop their potentials, to be productive, to facilitate poverty reduction and to promote socio-economic growth and

national development (Ministry of Education, 2009), but how can these materialize without the basic knowledge in Mathematics.

Polya (1962) defined mathematical knowledge as information and know-how. Of the two, he regarded know-how as being more important, defining it as the ability to solve problems requiring independence, judgment, originality and creativity. It is generally agreed thatmathematics is a critical skill for all, including those who have not achieved a grade 'C' at GCSE by age 16(Hodgen& Marks, 2013). In addition, an argument put forward that in today's world of 'rapid change' (ACME, 2011), especially in terms of technological change, the demand for mathematics skills is increasing (Burghes, 2011; Norris, 2012; Vorderman, Porkess, Budd, Dunne &Rahman-hart, 2011). According to Norris (2012), Mathematics is important as a school subject because not only is it needed for the sciences but it also provides access to undergraduate courses in areas such as engineering, psychology, sciences, and social sciences. Mathematics is also seen as a core skill for life.

According to Burghes (2012), adults can function (reasonably well) in this complex world when they have a basic level of numeracy. There is little or no doubt that mathematical skills are increasingly needed in the workplace. Importantly, people in the workplace need to understand the mathematics they are using if they want to avoid making mistakes in the workplace (Hodgen& Marks, 2013).All these can be achieved when students are taken through mathematics education.

In contemporary terms, mathematics education is the practice of teaching and learning mathematics, along with the associated scholarly research.According to Adenegan (2003), one of the reasons for teaching

Mathematics at all levels of the educational system is the attainment of an understanding of the nature of the subject in relation to everyday activities of life. Ensuring that children have a good grounding in mathematics will equip them for their future lives by developing the skills valued in industry and university (Ofsted, 2011). The effect of mathematics education on an economy is understood in many leading industrialized nations, including those of the Pacific Rim, whose students perform particularly well in international comparisons (Vorderman et al., 2011).

The significance of Senior High School education is the preparing of learners into responsible citizens for the future whichcannot be undermined (Kurian, 2008), and that is why it is a right. Uganda, Kenya and Tanzania are among the few sub Saharan African countries which have implemented free education (Oketch& Rolleston, 2007), and since Mathematics is one of the compulsory subjects which will aid progression, there is the need for the teaching and learning of itto be understandable by students in the classroom. Despite the major role mathematics plays in the development of the society, there has always been poor performance in the subject at national examinations in Kenya (Aduda, 2003).

A wide range of factors causing the poor performance of students in Mathematicsand the way forward have been identified by researchers, educators and other stakeholders in the education sector (Agyeman, 1993; Asiedu-Addo&Yidana, 2004; Kraft, 1994;Mereku, 2003). Three different major but interrelated factors affecting mathematics teaching and learning have been identified and these are personal, home, and classroom and related factors (Lamb &Fullarton, 2002). In their study, they classified personal

factors as attitude and beliefs, preparedness and willingness to learn; home factorsas socio-economic status, parents' educational background and occupation, and classroom and school factors as the school physical environment, learning resources, teaching and learning strategies. According to Mbugua, Kibet, Muthaa and Nkonke (2012), the poor performance of senior secondary school students in Kenya can be linked to the following factors: student factors, socio economic factors and school based factors. They explained further what the three categories entailed. The student factors include gender and attitudes of students towards mathematics. The female students see mathematics as a male-dominated subject and, due to that; they do not put in their all in the teaching and learning process. The attitude of students also plays an important role in their performance in mathematics. Haimowitz(as cited in Mbugua et al. 2012) opined that the cause of poor performance in schools might not be due to insufficient or inadequate instruction but by active opposition by the learners.

Socio-economic factors such as students' parent/guardians' educational background of the parents/guardians of students play an important role in the academic performance of the student. The parent/guardian is the immediate role model of the child and has direct effect on the child. The extent to which the student's immediate family members are actively engaged in his/her academic work may positively influence his/her performance (Desarrollo, 2007). Apart from the parent's level of education, their income level also counts. As cited in Mbugua et al. (2012), Conger et al. noted that low parental income status is associated with diminished resources hence the poor academic performance of students. The school based factors which influence

student's academic performance in mathematics includes teaching methods adopted by teachers, mathematics teachers' workload, the effectiveness of mathematics in teaching and teaching/learning resources for mathematics.A key issue in achieving quality in teaching and learning is the selection of resources that will most effectively enhance the teaching and learning process.The issue of poor performance by less endowed schools is true in the case of the Ghanaian schools since most of the grade 'A' schools do better in the WASSCE than most schools in the other categories. Of all the factors identified as causing poor performance of students in mathematics, the teaching and learning resources have more direct contact with the teaching and learning process and need to be looked at on a more serious note by all stakeholders to improve students' performance.

According to UNESCO (2008), practical work forms an important feature in any science and mathematics course. Yadar (2007) also agrees to the assertion that no course in science and mathematics can be considered as complete without including some practical work. The work ought to be carried out by individuals either in the laboratory or in classes. At school level, practical work is even more important because of the fact that we learn by doing (Yara&Otieno, 2010). It was further explained that the abstract nature of mathematics can be reduced through demonstration, practical methods and use of teaching/learning materials.Yadar (2007) and UNESCO (2008) postulate thatan object well-handled practically impresses itself more firmly in the mind than the object merely seen from a distance or in an illustration.

It will be difficult for any educational setting or a nation to achieve quality education without adequate resources for teaching and learning. Without any reasonable doubt, Court and Kinyanjui (1985) documented the need to advance the quality of education through provision and effective use of teaching and learning resources. In agreeing to this, Maicibi (2003) posited that all institutions and organizations are made up of human beings (workers) and other non-human resources. He further asserts that, when the right quantity and quality of human resources are brought together, it can manipulate other resources towards realizing institutional goals and objectives. According to Konyango (2011) availability, acquisition and utilization of resources require closer examination.

Research have proved that teaching and learning resources aid to retain more concepts permanently and also serve as a motivating factor for students to learn better.Adjei (2013) and Adenegan (2010) testified to this that, when teaching and learning resources are used appropriately, theywill provide a better example of conceptual thinking and also create an environment that is conducive for learning.Heinich et al. (1996) also pointed out the concrete experiences that aid learning retention and usability of abstract symbols.Also, Askew and William (1995) "showed that practical work can provide images that help students contextualize mathematics ideas. It can also provide experiences out of which students can abstract mathematics" (p. 10) cited in Drews and Hansen (2007). According to Yara and Otieno (2010), availability and use of teaching and learning resources enhances the effectiveness of schools, as these are basic things that can bring about good academic performance in the students. Effective resource

utilization is both to facilitate effective and balance concrete abstract learning experiences. Adjei (2013), in his research, shows that the use of teaching and learning resources provides good example for conceptual thinking and also creates an environment of interest for students. It is assumed that increasing the amount of school resources will increase the quality of education (Yasin, Petra & Mollie, 2013). Accordingly, the relationship between school resources as input and student achievement as output is of interest to policy-makers who are responsible for the allocation of school resources. According to Hanushek (2003), this relationship is one of the most debated issues in education across the globe because current literature provides mixed results.

According to Lance, Rodney and Hamilton-Pennell (2000), some researchers think that this relationship leads to increase in student achievement whereas others (e.g. Yasin, Petra & Mollie, 2013) disagree to this relationship.

In a meta-analysis, Hanushek (2003) reveals that significant relationships between school resources and student achievement result from misapplication of sampling and methodological procedures.

Mullis et al. (2004) contend in the Assessment Frameworks for the 2007 Trends in International Mathematics and Science Study (TIMSS) that internationally, students from well-resourced schools generally have higher achievement than students from schools that report resource shortages. However, this is not so with the Programme for International StudentAssessment (PISA) 2009, which concludes that, between countries, School

resources are not significantly related to student achievement (QECD, 2010).

Tamakloe, Amedahe and Atta (2005) defined teaching and learning resources as materials used to facilitate learning, understanding and acquisition of knowledge, concept, principles or skills. This tells us that the teaching and learning resources are there to complement the efforts of teachers and cannot be a replacement for teachers.

Statement of the Problem

As they say, education is the systematic development and cultivation of the natural power by inculcation, example and training. It is therefore necessary that the young individuals are helped to learn these acquired abilities and skills through an organized and intensive education programme. The future of a man and his way of life can be shaped by the present. It is for this reason that school exists, and everybody must share in the responsibility that the society has entrusted us with. Education as they say should develop personality. Similarly,Yara and Otieno (2010) opined that education should develop moral, aesthetic, physical and practical capacities, not just cognitive knowledge organized in academic disciplines. They added that practical subjects can have the additional justification because they allow students to learn from more active doing than what is typical in academic subjects.

In the development of any nation with respect to science and technology, mathematics as a subject cannot be left out since it is the language of science (Adenegan, 2003) and leads people into discovering things.According to Adetunde (2009), mathematics has now entered into the field of studies which were thought to be non-mathematics in the past, and as a result, the poor performance of students in the subject cannot be left unattended to. Despite the importance placed on mathematics, researchers

(Okereke, 2006; Maduabum&Odili, 2006; Okigbo&Osuafor, 2008) have observed that students lack interest in the subject and perform poorly in it. The problem of poor performance in mathematics as a subject is global and it is a serious concern to parents and education stakeholders (Mudulia, 2012). This problem is made more serious in developing countries by poverty and other problems peculiar to third world countries (Oguntuase, Awe &Ajayi, 2013) including Ghana.The evidence of Ghanaian students' poor performance showed up in the results of Trend in International Mathematics and Science Study (TIMSS), which was conducted in 2003, 2007 and 2011. Ghana placed 43rd out of the 45 countries who participated in 2003, 46th out of 47 countries in 2007 and the worst performance was in 2011, when Ghana placed 45th out of the 45 countries (UEW/MoE, 2004).

In addition, students perform poorly in WASSCE and this is shown in Table 1.

Table 1: *WASSCE mean pass rate in mathematics*

Year	2006	2007	2008	2009	2011	2012	2013	2014	2015
Pass rate (%)	32	25	26	29	44	50	36.8	34.2	25.3

Source: (MoE, 2012, p. 22; 2013, p. 61; GNA, 2015, March 16; Giovanni, 2015, August 10, Blog).

Although the mean performance of the students in the WASSCE improved from 2008 to 2012, that of 2013 dropped, and this has been of much concern to teachers and all stakeholders in education. The causes of the abysmal performance of students can be classified into three. These include student factors, socio economic factors and school based factors (Mbugua et al. 2012). The school based factors include the teaching and learning

resources and school type. The availability and usage of teaching/learning resources and school type have direct influence on students' performance (Mbugua et al. 2012). According to Wang et al. (1993), research reviews indicate that factors that are closer to the students' actual learning process have the strongest impact. They further explained that the school factors have more impact than distant factors. Teaching and learning resources help in the teaching and learning process. They make the class lively and students enjoy the lesson which the teacher teaches them (Adjei, 2013). He asserts further that the teaching and learning resources helpthe teacher to test the level of students' understanding of the subject. Despite the important role teaching and learning resources play in the teaching and learning process and their effect on students' performance, literature shows that little is known about the teaching and learning resources for teaching mathematics in the Senior High Schools in Ghana. It is due to this that the researcher intends to provide baseline information on the availability and use of mathematics teaching and learning resources in the Senior High Schools in the Western Region.

Purpose of the Study

In order to meet the expectations of Senior High School mathematics education in terms of performance, schools must be stocked with adequate mathematics teaching and learning resources. Since the students cannot use or manipulate the resources on their own, there will be the need for teachers who possess the knowledge and are willing to use these resources in the classroom to direct them.The purpose of the study is to provide the baseline data on the availability, usage and the state of teaching and learning resources in mathematics in Senior High Schools in the Western Region of Ghana. .

Objectives of the study

The objectives of this study have been grouped in two. These are the general objective and the specific objectives.

General Objective

The general objective of the study is to provide the basic information on the teaching and learning resources available for teaching mathematics in the Western region of Ghana.

Specific Objectives

Three main objectives guided the study. These are

1.To find out the resources available for teaching and learning mathematics in theSHS

2. To find out how mathematics teachers use the teaching resources

3. To establish the state of the mathematics teaching resources

Research Questions

The study sought to find answers to the following research questions:

1. What resources are available for teaching mathematics in the Senior High Schools?
2. How are the available teaching resources in the Senior High Schools acquired?
3. To what extent do mathematics teachers have access to teaching resources in the Senior High Schools?
4. How often do mathematics teachers use the available teaching resources for lesson delivery?
5. What is the mode of resource usage among mathematics teachers during instruction in the Senior High Schools?

6. What reasons account for mathematics teachers' usage or non-usage of teaching and learning resources?
7. What is the current state of resources for the teaching and learning of mathematics in the school?

Hypotheses

1. Ho: There is no difference in the availability of resources in the school categories.
2. Ho: Male and female teachers do not differ significantly in the use of mathematics resources during lesson delivery.
3. Ho: There is no significant difference in the use of resources inteaching mathematics across academic qualification of teachers.
4. Ho: There is no significant difference in the use of resources in teaching mathematics across the categories of Senior High Schools.

Significance of the Study

It is pictured that findings from the research may disclose the current teaching and learning resources available for the teaching and learning of mathematics in the Senior High Schools. It will also reveal the current status of the available teaching and learning resources in use.Researchers who will replicate this study in other regionswill benefit immediately from the knowledge gained from this effort. The study will offer mathematics teachers the opportunity to reflect on the use of teaching and learning resources and the way forward.The findings will also help the departments of mathematics education in the various universities to restructure their programmes to prepare prospective teachers in the use of teaching and learning materials.The availability of this information will allow mathematics teachers to make well

informed decisions immediately on the effectiveness of teaching and learning resources.

Delimitations

It will be unwise to generalize the findings of the study to all Senior High Schools and mathematics teachers in Ghana since the respondents were selected from one out of the ten regions in Ghana. Due to the swift developments going on in the Senior High Schools, the findings need to be seen as "snapshots" which were current at the time they were taken; it is expected that certain facts and figures presented in the findings may become obsolete. The study was also restricted to only mathematics teachers in the public schools in the Western region of Ghana.

Limitations

The study was limited in some sense. Some Headmasters were not willing to allow the study to be conducted in their schools. Also, the unwillingness of some of the respondents to return the questionnaire could affect their genuine response to the questionnaire. In addition, since the interview and observation were other means of collecting data, issues of participant bias could affect the quality of the data.

Definition of Terms

Teaching and learning resources (TLRs)

In this study, human resource refers to the mathematics teacher whilethe non-human resources refer to the curriculum materials (textbooks, syllabus, library books); mathematics tools (solid shapes, mathematical instruments for students, white/blackboard mathematical instruments, calculators, technological tools), and school building and furniture (classroom,

furniture, library block, mathematics laboratory, chalk/marker boards). Technological tools also refer to computers, projectors, computer software and computers with internet connectivity.

"Availability" in this study refers to the situation where the teacher resource ratio or the student resource ratio is at least 2:1.

Organization of the Study

The research will be organized into five chapters. Chapter One will talk about the background to the study, statement of the problem, purpose of the study, research questions, hypotheses, significant of the study, delimitations and limitations encountered, definition of terms and lastly the organization of the rest of the study. The literature review in chapter Two will comprisethe conceptual framework and other sub-headings in relation to the study. The research design and the methodology will be discussed in chapter Three. Chapter Four will discuss the results from the study. Summary, conclusions, and recommendations were made under chapter Five.

CHAPTER TWO

LITERATURE REVIEW

Overview

This chapter gives detailed information on the literature related to mathematics teaching and learning resources and their use. The discussion was based on the following themes: definition of teaching and learning resource, available mathematics teaching and learning resources, uses of the available teaching resources, state of the available teaching and learning resources and the difference in the use of the available teaching resources across gender, academic qualification and school categories.

Theoretical Framework

A research is to find solutions to real-world problems in a manner that can be generalized and the knowledge gained transferred into a change in practice. According to Tashakkori and Teddlie (1998), there are three approaches to research quantitative, qualitative, and mixed methods. Each of these approaches is based on a world-view. For the sake of this research, the researcher has adopted the learning theory on pragmatism. According to Creswell (2003), a mixed method approach to research is the one in which the researcher tends to base the knowledge claims on pragmatic grounds. According to him, pragmatism opens the door to multiple methods, different worldviews, and different assumptions, as well as to different forms of data collection and analysis. Pragmatism is a philosophical movement that includes those who claim that an ideology or proposition is true if it works satisfactorily, that the meaning of a proposition is to be found in the practical consequences of accepting it, and that unpractical ideas are to be rejected

[Internet Encyclopedia of Philosophy]. In addition to this, Goldkukl and Rostlinger (2003) defined pragmatism as an interest for practical consequences of knowledge. According to them, a basic knowledge interest of a pragmatist researcher is what differences this knowledge will have in practice. Pragmatism treats knowledge, concepts and values as true if they are useful (Harvey, 2012). In this worldview according to Dewey (1968), it is the responsibility of the teacher to design and select proper educative experiences for the learner. Not only that a teacher has to design the learning experience, but he or she also has to conduct that experience. This approach to classroom work makes use of teaching and learning resources in teaching and learning.

Available Mathematics Resources

Mathematics is a subject presumed to be technical and as such requires the requisite instructional resources, both the human (the mathematics teacher) and material resources (mathematics print materials, mathematics tools and buildings and furniture) for its effective teaching and learning.

A teacher is someone acknowledged as a guide or helper in processes of learning. His/her training and knowledge level has a direct influence on their students. For that matter, the teacher must be well vest in handling the teaching and learning materials available in the school to the benefit of thestudents. As the facilitator in the classroom, the teacher effectively transmits knowledge with the help of other resources in the locality.

In developing students' mathematical identities, according to Cobb and Hodge (2002), teachers are the most important resource in the school. This is because teachers have great influence on the way students think of

themselves in the classroom (Walshaw, 2004). Due to the abysmal performance of students in mathematics recently, the Ministry of Education (MOE) and the Ghana Education Service (GES) have refocused their attention on the teacher. The teacher's work is being followed keenly to find out if they are really performing their roles as teachers in the classroom. Researches into the effectiveness of teachers in mathematics have suggested that there are significant differences between teachers (Carroll, 2005). In agreement to this, Sullivan and McDonough (2002) found a proof that students from similar backgrounds have markedly different experiences at school which could only be associated to differences between teachers. In a Victorian study of middle schools conducted by Siemon, Virgona and Corneille (2001) on mathematics teachers' effectiveness shows that there was much difference within schools in student achievement. This is to say that individual teachers make that great difference. In agreement to this, Wöbmann (2004) posited that the teacher as an input is the principal factor in the provision of education.

It was pointed out by Carroll (2005) that the more effective teachers tend to demonstrate deeper understanding of the links between different numeracy concepts and could provide alternate meanings and representations. She further explained that it was not the level of formal qualification, but the nature of knowledge about the subject. Studies show that an effective teacher facilitates learning by truly caring about their students' involvement in the teaching and learning process (Noddings, 1995). The kind of relationship that develops in the classroom becomes a resource, according to Anthony and Walshaw (2009) for developing mathematical competencies and identities of

students. Both teachers and students work together to develop interrelationships which create space for students to develop their mathematical identities. In effect, the quality and level of education of a teacher has a direct bearing on his/her subject matter delivery. For instance, according to the Government of Ghana (2003), in guaranteeing quality education, quality teachers are necessary. To this, Mbugua (2011) reported that data available show that 98.52% of teachers in the secondary schools in Kenya were professionals but the case in Nigeria was different. According to Yemi and Adeshina (2013), secondary schools within Gombe Metropolis of Nigeria lack qualified mathematics teachers. Teacher qualification and development is an important determinant of quality of education today besides school facilities and teaching and learning materials. In this regard, every school or institution should strive to attract and retain the best of teachers. As reported by Monk and King (1994), teacher's subject preparation in mathematics and science does have some positive impact on student achievement in those subjects. This implies that, when well trained teachers in mathematics are well deployed to the Senior High Schools will bring about students who will perform academically well in mathematics (Yara&Otieno, 2010). In developing insight into the work of effective teachers, Carroll (2005) raised many questions about professional development. According to her, how teachers develop their understanding of the teaching and learning process and how the understanding grows and changes throughout their careers are important considerations which those who plane teacher education must look at. An important role of the teacher is to provide students with working arrangements that are responsive to their needs (Anthony

&Walshaw, 2009). The teachers' teaching role as suggested by Ankoma et al. (2005), does not only involve the selection of subject-matter content according to the child's age, needs, interests, abilities and aptitudes, but also involves the selection of appropriate learning techniques and resources to facilitate learning in the classroom. Oduro (2008) explains that the Ghanaian child, like any other child elsewhere, learns new things from what they see, hear around them and from what they do. He ended by arguing that learning in children can therefore be promoted when they are provided with the opportunities to make maximum use of their sense organs.

According to Blanton and Kaput (2005), one of the major roles of the teacher is to ensure that tools and materials are effectively used to help students organize the way they reason mathematically and support their sense-making. Teachers in schools which lack these teaching and learning materials cannot effectively perform this role and this will go a long way to hinder the students' performance in examinations. When planning for learning, an effective teacher puts his/her students' current knowledge and interests at the center of his/her instructional decision making (Anthony &Walshaw, 2009). According to them, teachers who state where students are at with their learning are also able to design appropriate levels of challenges for their students. According to Houssart (2002), teachers find ways to reduce the complexity of task for low-achieving students without compromising the mathematical integrity of the activity. To increase the task challenge in all classroom, effective teachers put obstacles in the way of solutions, remove some information, required the use of particular representations or ask for generalization (Sullivan, Mousley&Zevenbergen, 2006).

Teaching ways of communicating mathematically demands skillful work on the teacher's part (Anthony &Walshaw 2009). Teachers need to teach their students how to communicate sound mathematical explanations and how to justify their solutions. By encouraging the use of oral, written and concrete representations, effective teachers model the process of explaining and justifying, thereby guiding students into mathematical conventions (Anthony &Walshaw, 2009). They use explicit strategies such as telling students how they are expected to communicate (Hunter, 2005). Effective teachers draw on a range of representations and tools to support learners' mathematical development (Anthony &Walshaw, 2009). Teachers have a critical role to play in ensuring that tools are used effectively to support students to organize their mathematical reasoning and support their sense-making (Blanton & Kaput, 2005).

In this study, non–human resources refer to the curriculum materials (Syllabus, mathematics textbooks), mathematics tools (marker/chalk board mathematical instrument, calculators, computers etc),furniture and buildings.The availability of material resources for teaching mathematics has also been discussed in literature. In their work on principles and methods of teaching, Tamakloe, Amedahe and Atta (2005) referred to teaching and learning materials as resources used by teachers to enhance learning, understanding and acquisition of knowledge, concept, principles or skills by students.Gbodi and Laleye (2006) defined instructional materials as the possible channels through which information is conveyed from sender to the receiver. Also, Adjei (2013) in his work on teaching and learning resources for teaching business management, refers to teaching and learning materials

in education as materials and equipment which are relevant to motivate, inform, instruct and present the subject matter to the learner as well as making learning easier than it would have been without using it. According to him, the use of teaching and learning materials in mathematics will make students love and appreciate the subject more than it is now. However, it was found that senior secondary schools were poorly equipped with mathematics teaching and learning resources (Mbugua, 2011).

In his definition, Fademiro (2000) sees teaching and learning materials as the materials, equipment and techniques that can be used to communicate with the learners, as well as, create opportunity for independent learning. The availability and use of teaching and learning materials affect teachers' motivation and the effectiveness of their lessons as well (Etsey, 2005). Additionally, the success of a teachers' lesson may be a determiner of an enriched academic performance. As posited by Agyemang (1993), teachers who are academically and professionally qualified but do not have the needed teaching and learning resources to work with will be less dedicated to the teaching work and thus be less productive than a teacher who is unqualified but works under favourable conditions. A study conducted by Etsey (2005) on the causes of low academic performance of students in some schools in Ghana identified inadequacy of teaching and learning materials as one major cause. According to him, this inadequacy makes it difficult for students to understand the lessons and this leads to the low performance in examinations.Under the curriculum resources, the researcher will be looking at the syllabus and the mathematics textbook.According to the Oxford English Dictionary (2005), a syllabus is a guide to a course and what will be

expected of a student in the course. Generally it includes course policies, rules and regulations, required texts and a schedule of assignment. A syllabus can tell nearly everything one needs to know about how a course will be run and what will be expected of the student. Slattery and Carlson (2005) also sees a syllabus as a contract between faculty members or a teacher and their students, designed to answer students' questions about a course, as well as inform them about what will happen should they fail to meet course expectations. It is also a vehicle for expressing accountability and commitment (Habanek, 2005).

Bruce (1997) asserted that greater availability of text and reading materials raises the quality of learning activities, thus increasing achievements. In the view of Jarolimek and Foster (1989), in any learning environment, there must be a quantity of good quality material suitable for a wide range of abilities and learning styles.One important role of teachers is to transform and implement curricular ideas in the classroom. In doing this, they benefit from different types of curriculum materials including textbooks. A textbook is a collection of the knowledge, concepts, and principles of a selected topic or course. They provide additional information on topics outlined in the syllabus. It is usually written by one or more teachers or education experts who are authorities in a specific field. Textbooks are the most widely used and trusted curriculum materials that are directly related to teacher's teaching and student's learning (Beaton, Mullis, Martin, Gonzalez, Kelly & Smith, 1996). Aggarwal (2002) asserted that textbooks remain essential tools preserving and diffusing the world's storehouse of knowledge and wisdom. Attabach (1983) has cited that nothing has ever replaced the

printed word as the key element in the educational process, and as a result, textbooks are central to schooling at all levels. He added that textbooks substitute for gaps in teachers' knowledge and skills. It is not an overestimation to treat textbook as an assistant teacher for the student. Even today, the reliance of the student on textbook is as important as that of the teacher. Therefore, textbooks of good quality can offer the needed backing for the students in all aspects of learning. The availability of textbooks affords teachers and students the opportunity to read in advance before lessons are held. Textbooks tend to be the main resource for teachers in deciding what to teach and sometimes they are the only resources to which all students has access during a lesson in addition to the teacher. Most problems for student's class work and homework are taken from them.

Enu, Agyeman, and Nkum (2015) reported on the availability of TLM for teaching mathematics in the Colleges of Education in Ghana and showed that textbook is the most available and used. On the other hand, it was reported that senior secondary school students were not exposed to mathematics textbooks due to its unavailability in schools in the GombeMetropolis in Nigeria (Yemi&Adeshina, 2013). This according to them affected the performance of students in mathematics exams.This confirms the findings of Obilade, 1989 (as cited in Ekundayo, Oyerinde, &Kolawole, 2013) that resources like curriculum materials, and teaching aids were not only unavailable but also the available ones were not sufficient, underutilized and not properly handled.

According to Rouse (2005), a calculator is a device that performs arithmetic operations on numbers. The simplest calculators can do only

addition, subtraction, multiplication, and division. More sophisticated calculators can handle exponential operations, roots, logarithms, trigonometric functions and hyperbolic functions. In Ghana, calculators are used in examinations for all necessary calculations from the senior school level and above. Although calculator use is taught as a topic in mathematics at junior high level, it is not allowed in examinations at that level. According to Close, at al. (2007), calculator availability during assessment is a key factor in producing better results. However, access to a calculator during assessment can impede performance if students are not familiar with its usage (Hopkins, 1992) or if they have not had prior experience in using it in mathematics tests (Bridgeman, Harvey &Brasswell, 1995).

A mathematical instrument is a tool or device used in the study or practice of mathematics especially in geometry. As opined by Enu, Agyeman and Nkum (2015) in their study, most of the mathematics tools that enhance the teachers' work and students understanding of concepts like mathematical sets mathematical models were not enough.A teacher geometry set gives teacher the ability to draw angles, circles of various sizes and also to measure the length of lines and size of triangles and squares on chalk/marker board. Without much variation, the set contain a D-shaped protractor, adjustable compass, divider, ruler, 45-degree and 60-degree triangle dusters. According to Mbugua (2011), chalk/marker board geometrical instruments facilitate proper and accurate drawing of figures on the board. This will make the teacher's work much easier in teaching of construction and the other topics which may require the use of the instruments.

The world is experiencing information revolution. Wealth creation has become knowledge-based. Yet majority of Ghanaian children have never set eyes on computers, let alone take advantage of the numerous opportunities that computer offers. Technology is now used in all domains of human endeavour. Current trends in computer usage and in information and communication technology worldwide therefore call for early introduction of pupils to computer skills to enable them go along with the rest of the world (Republic of Ghana, 2003).

One of the major issues in education today in both developed and developing countries is the integration of Information and Communication Technology in the teaching and learning process (Agyei&Voogt, 2012). This is true because the benefits of using educational technologies in the teaching and learning process cannot be exaggerated. Due to this, more and more educators are searching for ways to improve education by reforming all disciplines within the education system at all levels (Strassenburg, 1996). According to Picciano (1994), the increase technology integration in the teaching and learning process is a way to improve opportunities in education and also to enhance students' performance. It was due to this that Tilya (2008) researched into development of technology in education policies in sub-Saharan African countries. According to him most of these countries including Ghana have a national policy on ICT integration in education and implementation plan. Ghana as a country has two policy documents supporting technology in education. These include the Ghana Information and Communication Technology for Accelerated Development (Republic of Ghana, 2003) policy document and the Anamuah-Mensah National Education

Review Committee report (2002). Such documents recommend a greater importance be placed on allowing students to solve authentic problems, reason and think critically and make more fruitful use of instructional time and to enrich their educational experiences (Lavigne&Lajoie, 1996). For these changes to be realized, teachers should move away from traditional teacher-centered classroom practices, such as lectures and drill and practice activities into more student-centered context that allows students to work collectively and supportively to develop learning skills (Kilpatrick & Davis, 1993).

The study discussed furniture used by students and teachers in the classroom, library, math laboratory, and classroom block.According to Makori and Onderi (2014), school furniture in many countries is either lacking or poor. In some circumstances, as reported by the World Bank (2008), the shortage has been described as severe. For example, Dierkx (2003) reported that a lot of schools in Nairobi, Kenya have inadequate furniture. He explained further that they are either broken or lost. In Culcutta, India, a research involving head teachers of primary schools, identified lack of electricity, space and furniture as major challenges facing the schools (Makori&Onderi, 2014). Another typical example is the inadequacy of school furniture in the Fiji islands to the extent that students or pupils had to sit on the floor (Lingam &Lingam, 2013).Learners need physical comfort when sitting, reading and writing and furniture plays a key role in ensuring the comfort of learners (Makori&Onderi, 2014).

A school library (or a school library center) is a library within a school where students, staff, and often, parents of a public or private school

have access to a variety of resources. The goal of the school library is to ensure that all members of the school community have equitable access to books and reading, to information and to information technology. On the benefits of library use in schools, Information Management Associates (2002) identified some key areas in which the school library could have a positive effect on teaching and learning. The study suggests that the library can help shape the learning environment; provide a variety of learning experiences; support systematic skills development and research; facilitate equal access to the curriculum; enhance self-esteem and independent learning. Adding to the above, school library provides information and ideas that are fundamental in today's information and knowledge-based society. Despite the importance of libraries in the lives of both students and teachers,Shodimu (1998) reported that it is surprising to note that many schools operate without libraries whereas Ogunseye (1986) had earlier noted that total absence of an organized school library would continue to spell dooms for thousands of secondary school students.

Teaching and learning goes on in the classroom and for that matter every school need enough classroom blocks which will contain all the students in the school. Lack of classroom blocks in most of the senior high schools has blotted the class size making teaching and learning difficult.According to Adeyemi (2008), class size is an educational tool which can be used to describe the average number of students per class in a school. This according to him differs from country to country. This was agreed to by Cakmak (2009) who posited that the definition of a "small" or "large" classroom might differ in context. According to Norris (2012),

mathematics is important as a school subject because not only is it needed for the sciences but it also provides access to undergraduate courses in engineering, psychology, sciences, social sciences etc. Despite the importance placed on mathematics, researchers (Okereke, 2006; Maduabum&Odili, 2006 and Okigbo&Osuafor, 2008) have observed that students lack interest in the subject and perform poorly in it.

Adeyegbe (2005) have identified many factors including class size as the causes of the poor performance. Cakmak (2009) stated that there is a relationship between class size and children's achievement, children's motivation, teacher satisfaction, and teacher stress. He further explained that classes might be small or large in size but in both cases, it is expected that teachers should teach effectively by having students' interest and learning experiences in mind.In support of this, Holliday (1994) opined that in small classes there is more teacher/student interaction and more effective use of teaching and learning resources. However, other researchers see this as a mere coincidence seeing other factors as being responsible for effective use of resources in teaching (Tobih, Akintaro, &Osunlana, 2013).According to Cakmak (2009) as referenced in Okyere-Kwakye (2013), class size effects cannot be just a matter of the number of children in a class. The number of children must have an effect on other classroom processes and activities which has an effect on learning (Okyere-Kwakye, 2013). He further explained that reduced number of teacher-student ratio would promote quality teaching.

According to Agwagah (1997) as cited in Oguntuase, Awe, and Ajayi (2013), problems of infective teaching can be tackled through planned and

intelligent application of the mathematics laboratory. Laboratory, According to Adenegan (2003) is a unique room or place, with relevant and up-to-date equipment known as instructional materials, designated for the teaching and learning of mathematics. He reported that the non-existence of mathematics laboratories in our schools is one of the major contributory factors to mass failure in mathematics. Adenegan reiterated that it is expected that the 21st century mathematics educators/teachers should be readily acquainted with the modern day mathematics laboratories to enable them achieve the objectives of the mathematics education. In line with Adenegan's finding, Ahmed (1999) reported similarly linking the decline in students' academic achievement to non-availability of teaching materials, non-availability of classrooms, libraries, and laboratories, among others.

The chalk/marker board is a smooth hard panel which is generally black or white board and is used to write something with a piece of chalk or a marker. Technology in terms of power point presentation has not yet taken root in the senior high schools in Ghana and Africa as a whole and this has made the use of the chalk/marker board very essential in the teaching of mathematics (Mbugua, 2011). The chalk/marker board is the most available instructional material which can be used in presenting lessons in the classroom. According to Mbugua (2011), mathematics is taught by solving problems on the chalk/marker board therefore the presence of if in the classroom is obligatory.

According to Danso, Owusu-Ansah and Alorwu (2012), the Ghana education service has categorized all the senior high schools into four groups, with category 'A' schools being the most endowed in terms of

academic performance and physical infrastructure. This view was also shared by Ms. Blay who was then the central regional director of education according to the Ghana news Agency (2009). According to her, the criteria used in the categorization included facilities, geographical location, gender and cut-off-mark. According to Brew (2011), highly endowed schools have enough classrooms, and classroom based factors which support effective teaching and learning of mathematics as compared to the less endowed schools. Also, Odhiambo (2006) and Yeya (2002) also observed that urban schools are not badly hit by resource shortages (e.g. Teachers) as many prefer teaching in urban areas to the rural communities. This was contradicted by a report by Owoeye and Yara (2011) which stated that there was no significant difference between urban and rural school locations in terms of availability of resources such as textbooks, library and laboratory facilities.

Acquisition of Mathematics Resources

In a draft report on a survey on the availability of textbooks, school libraries, and the provision of information and communication technologies for secondary schools in Uganda, Read, Read, and Okwenul (2008) reported different methods of acquiring school resources. It was reported that textbooks utilized by the secondary schools surveyed, six out of eleven schools purchased books out of their own allocated operational budget, and one school purchased textbooks using part of the school fees specifically identified to parents as being for this purpose. Only five out of eleven schools had parents to be the dominant source of textbook acquisition for the school. Three schools reported that government supplies was the main source of their textbooks, although it is clear that these schools also made some (inadequate)

budget provision for textbook procurement in addition to the government supplies. On the other hand, the acquisition of computers and other instructional media was reported. It was indicated in the report that 70% of computers were purchased by the schools from their operational budget. A further 40% of the schools reported that computers were donated by individuals and NGO's. Only 20% of the schools (3 out of 11) received computers from the government. Furthermore, the report on the acquisition of libraries in the secondary schools shown that 90% of schools (10 out of 11) used some of their general operational budget on some aspect of school library funding. Local donors (Individuals, and Old Students Associations) were also considered important in seven out of eleven schools. The government and external donor donations were important in five out of eleven schools. Parents/PTA was not considered very significant.

In the Senior High Schools in Ghana, mathematics syllabus and computers were mostly supplied by the government while library books (mathematics) were mostly supplied by NGO's/PTA's. Calculators, projectors, mathematics software, and internet connectivity were mainly acquired through school purchases. On the other hand, instruments for students use were purchased by students while solid shapes were prepared by teachers.

Access to Mathematics Resources

Accessibility of information or any teaching and learning resource is very important in all educational institutions across the globe. As opined by Aguolu and Aguolu (2002), resources may be available in the library or the school and even identified bibliographically as relevant but the user may not

be to lay hands on them. The more accessible teaching and learning resources are, the more likely they are to be used. Teachers and students tend to use resources that require the least effort to access. These observations have been validated by an empirical study conducted by Slater (1963).Aguolu and Aguolu (2002) noted that availability of resources does not necessarily imply its accessibility, because the resources may be available but access to it prevented for one reason or the other.

Usage of Mathematics Resources

Under the usage of teaching and learning resources, the study discussed the use of the teaching resources during lesson delivery, mode of usage of teaching resources, differences in the use of resources by mathematics teachers across their gender, academic qualification, and school category. Also, reasons teachers give for usage and non-usage of teaching resources were found out in the study.For students to have high academic achievement in mathematics teachers should be able to skillfully apply relevant instructional materials in order to drastically reduce the abstract and difficulty attributes of Mathematics (Akuezuilo&Chinwoeke, 2009).

Curriculum materials are used by teachers during lesson planning and also during the teaching and learning process. The mathematics syllabus is purposely for lesson preparation whiles the textbook is for both lesson preparation and lesson delivery.The syllabus ensures a fair and impartial understanding between the teacher and the students such that there is minimal confusion on policies relating to the course, setting clear objectives of topics to be learned, behaviour in the classroom and effort on a student's behalf to be put into the course. According to Parkes and Harris (2002), the purpose of

the syllabus should drive the decision as to what content to include. The first purpose of a syllabus according to Matejka and Kurke (1994) is to serve as a contract between the teacher who is the implementer of the syllabus and the student. Like any contract, the syllabus spells out what is expected during the term or academic year. It spells out the objectives to be achieved in the term or the academic year and the roles of both teachers and students. Syllabus as a permanent record serves accountability and documentation purposes according to Parkes and Harris (2002). For accountability, it has information to be used to assess teachers, students, courses and programmes. For documentation purposes, the syllabus documents what was covered in a subject/course and at what level. A syllabus as a learning tool helps students to become more effective learners in the subject/course (Pastorino, 1999). All syllabuses in the senior high schools in Ghana are prepared by the curriculum research and development division (CRDD) of the Ghana education service for the use of teachers in preparing their lesson notes. In line with the purpose of the syllabus as a learning tool, teachers need to make it available to students.

The mathematics textbook is one of the most important resources for teaching and learning mathematics (Rezat, 2010). Mathematics textbooks, according to Mbugua (2011) could be the second most powerful tool for teaching and learning mathematics to the chalkboard. In this sense, mathematics textbook is used "as source of problem and exercises, as reference book, and a teacher in themselves" (Howson, 1995, p. 25) because teachers often rely heavily on textbooks for many decisions such as what to teach, how to teach it, what kinds of tasks and exercises to assign to their

students (Robitaille& Travers, 1992). According to him, a number of studies have examined the use of mathematics textbooks by teachers (e.g. Pepin &Haggarty, 2001; Remillard, 2005; Woodward & Elliott, 1990) whereas there is a dearth of research into the use of mathematics textbooks by students (Love &Pimm, 1996). According to Howson (1995), despite the obvious powers of new technologies and their role in the teaching and learning of mathematics in the vast majority of the world's classrooms, the use of the textbook still remains number one but Lerman (2006) has a different opinion. According to him, the role of the mathematics textbook as an instrument for teaching and learning has not gain much attention due to the role of new technological tools in use. This is striking, because as pointed out by Kang and Kilpatrick (1992), textbook authors regard the student as the main reader of the textbook. It is reasonable to argue, therefore, mathematics textbook is an important part of mathematics learning and teaching context in which students and teachers work.

The use of calculators, solid shapes, geometrical instruments, and technological tools were discussed.The benefits of the calculator are not confined to only its availability in tests of mathematical achievement (Close et al., 2007) but its exposure to students during mathematics instruction (Groves & Stacey, 1998). Heller, et al. (2005) investigated the relationship between instructional use of calculators and students achievement in an algebra course at secondary level. Their results from the study including 458 high-school students show that the more calculators were used and integrated in instruction, the higher end-of-course test scores were achieved. This result was also confirmed in a study by Close et al. (2007) which revealed that

graphics calculators are likely to improve understanding of function and graph concepts, problem-solving skills and readiness for the study of calculus. It was further revealed that project children performed as well or better on tests of basic skills than those who did not have exposure to the calculator. The calculator, according to Close, et al. (2007) is not a panacea that cures all mathematical ills but used appropriately, it is one of several factors that contribute to mathematical achievement and to the flexible mathematically thinking that is required to today's society.

Chalkboard drawing instruments promotes proper correct drawing of figures on the board (Mbugua, 2011). According to a study in Kenya by Mbugua (2011), it was realized that 62.7% of schools have chalkboard drawing instruments, but only 27% of teachers rarely use them or to think of as important tools for teaching mathematics. This tells that achievement in mathematics could be improved to some extent if teachers make good use of drawing instruments when teaching (Mbugua, 2011). According to Mbugua (2011), drawing instruments should be provided to schools which lack them.

Technology, especially computer technology, is viewed as a way to provide the needed tools to enable the changeover and also serving as a facilitator for further change in mathematics education in the senior high school (Owens & Waxman, 1995). According to Sorensen (1996), the 21st century mathematics classroom is not restricted to the marker board and the walls surrounding the students due to the ICT integration. Yelland (2001) stated clearly that schools cannot claim to prepare their students for life in this modern world if they have not incorporated the use of ICT. However, Enu, Agyemang, and Nkum (2015) reported that resources for teaching

mathematics like projectors and computers were never used in the colleges of education in Ghana.The senior high school mathematics syllabus inspires teachers to make use of computers, graphical calculators and worksheet to help students gain the habit of analytical thinking and capacity to apply knowledge in solving practical problems (Ministry of Education, Science and Sports, 2007).

According to the Ministry of Education, Youth and Sports (MOEYS) and Ghana Education Service (GES) (2002), integrating ICT in classroom instruction guarantees greater motivation, improves good questioning skills, encourages initiatives and independent learning, develops problem solving capabilities increase focus time on task and improves social and communication skills.Similarly, Ochkov and Bogomolova (2015), reported on the use of computer software and internet for teaching mathematics. They pointed out that advanced mathematical computer programs allow using a fresh approach to the teaching of mathematics in schools and universities, taking into account the attraction of pupils and students to computers by means of graphics and animation. As such, one can significantly increase the understanding of pupils and students of the basic concepts and theorems of mathematics. These modern information technologies can transform and change the traditional solutions of mathematical problems. However, to make this new direction to teaching and learning a reality, more needs to be done by the Ministry of Education, Ghana Education Service and teachers than the recommendation contained in syllabuses. For the mathematics teachers to effectively prepare their students for life, the Ghana Education Service needs to provide ICT in-service training that would empower

teachers to effectively integrate technology in the teaching process. This is very important because the problem of teachers' confidence in their ICT competence as a major factor for integrating technology in teaching is reported in other studies as well. If the confidence level of teachers in their ability to handle computers is low it may hinder their willingness to introduce technology in their classroom (Mooij&Smeets, 2001). When teachers can handle technology very well it helps them to introduce better mathematics (Roschelle et al., 2000). For example, Heid (1988) mentioned that teachers can focus less on memorizing facts and doing routine computations and more on developing ideas, discovering consequences, explaining solutions and understanding connections-the real heart of mathematics.

According to Mbugua (2011) the use of computers and power point has not yet penetrated secondary schools in Kenya. This is also the case in Ghana where chalk boards still remain the most powerful tool for teaching mathematics. This has made the chalk board a mandatory tool in the classroom (Mbugua, 2011). Mathematics is taught by solving problems on the chalk board according to Mbugua (2011) and that is why mathematics cannot be taught meaningfully without the presence of chalk board in the classroom.Information is of paramount importance to the development of an individual and for the growth of the nation. Studies carried out by Baughman (2000) and Smith (2001) on libraries and students' achievement in Massachusetts and Texas respectively found a strong correlation between school libraries and student achievement. The study showed that the highest achieving students attend schools with good libraries (Baughman, 2000). Similarly, the study by Smith (2001) examined the impact of school libraries

on student performance; found that students scored higher marks on the Texas Assessment of Academic Skills (TAAS) at each level in schools with good libraries and librarians. The two studies above found that school libraries does have great impact on a broad range of learning but if the learning potential is to be fully maximized there is the need for greater collaboration between librarian and teachers (William & Wavell, 2001a). Apart from the government mathematics textbooks supplied to students, the library makes available other supplementary textbooks which students and teachers consult for further studies. Despite the numerous benefits both students and teachers derive from school libraries, Etsey (2005) posited that school libraries in sub-Saharan Africa are either not available or in poor condition or both. However, availability of libraries is one thing and utilizing them effectively is another (Makori&Onderi, 2014); for instance, a report by Seniwoliba (2013) states that in Ghana, libraries are not fully utilized by either teachers or pupils.

Educators of mathematics are always looking out for various ways of improving their teaching and helping students to understand mathematical concepts (Mutodi&Ngirandi, 2014). As opined by Steedly et al. (2008), researchers hold the view that teaching of mathematics and the understanding of students can be more effective when concrete materials are used. The use of these concrete materials or teaching resources is also greatly influenced by some teacher related factors such as gender, academicqualification, and school category.

Gender

A study conducted by Almekhlafi and Almeqdadi (2010) on teachers' perceptions of technology integration in the United Arab Emirates revealed that out of 100 teachers sampled, the mean scores for female teachers on technologies used were all above 4.4, while the mean scores for male teachers ranged from 2.5 – 3.5. The One-Way ANOVA test further showed a significant difference in technology use between male and female teachers. In support of this, Mutodi and Ngirande (2014) concluded in their study that there is a significant difference in the way concrete materials are perceived and used between males and females. In contradiction to what was found by Mutodi and Ngirande (2014), Li and Kirkup (2007) in their study found that technology application is a male dominant activity and made them to have more positive attitudes towards its use than females. This is consistent with findings by Perry Wong, and Howard (2006) that showed that male consistently reported slightly more positive perceptions and attitudes in the use of concrete materials in mathematics classroom than females.

Academic qualification

Experience and qualification is the best asset for handling a task (Birgen, 2005). In his findings, teaching is one of the duties that require both qualification and experience for better delivery.Teachers with different forms of academic and professional qualifications teach mathematics in the various senior high schools in the country. These includes first degree holders without teacher training, first degree with teacher training, second degree in math without teacher training, second degree in math with teacher training etc.Secondary school mathematics teachers are expected to be professionals by

training. According to Birgen (2005) data obtained shows that 98.52% of secondary school mathematics teachers are professional teachers; therefore their output is expected to be high. Mastery of the subject is an absolute necessity for effective teaching, the teacher must possess a basic qualification in the subject and the level of qualification should be much higher than that of the information he/she is expected to impact (Njeru&Orodho, 2003). Hence, in this case teachers are expected to use effectively mathematics teaching and learning resources as professional teachers.

A study conducted by Betts, Zau, and Rice (2003), and Goldhaber and Brewer (2000), there is a positive effect of advance degrees on teachers' use of teaching and learning resources and the impact on students' performance. Furthermore, Lai, Sadoulet and Janvry (2009), opined that these qualifications, particularly as characterized by their ranks are important predictors of student performance. On the contrary, a study by Ehrenberg and Brewer (1994) found no correlation between the advance degrees on teachers' use of teaching and learning resources to impact on students' performance.

School category

In Ghana, the senior high schools have been categorized into four by the Ghana education service based on academic performance and physical infrastructure (Danso, Owusu-Ansah&Alorwu, 2012). Category 'A' schools are the most endowed followed by categories 'B', 'C' and 'D'. The categories 'A' and 'B' schools may have enough resources as compared to the category 'C' and 'D' schools and the teachers may be well motivated to use teaching and learning resources in their teaching process. Olasunkanmi and

Olufunmiayo (2012) reported that most of the public secondary schools in Nigeria were infrastructural deficient, that is, there are shortages of seats for students, dilapidated school buildings, and classroom which hamper teachers' use of resources in such classrooms. If this is something to go by then mathematics teachers in categories A and B schools are expected to make good use of learning resources than those in the categories C and D schools. Furthermore, Babalola (2004) also reported that well designed school facility can complement a well-planned teaching process by teachers while a poorly designed facility can hamper the best of teacher's teaching resources usage.

Educators of mathematics in all levels of education are trying various ways to improve the way they teach mathematics and helping students to understand mathematical concepts (Mutodi&Ngirandi, 2014). As opined by Steedly et al. (2008), researchers hold the view that teaching of mathematics and the understanding of students can be more effective when concrete materials are used. Nevertheless, the improper use of these materials can have negative effects on students (Maslen,et al. 2014). Mathematics teachers worldwide have various reasons for using or not using teaching and learning materials in their classrooms.

According to Mutodi and Ngirandi (2014), teacher's knowledge in the use of teaching and learning resources as reported by researchers is an important factor in enhancing conceptual retention in mathematics. Most of our mathematics teachers were not trained with these materials hence they lack the knowledge in using them in the classroom. Classroom management according to Mutodi and Ngirandi (2014) is one of the major factors which impede teachers' use of teaching and learning resources in the classroom. The

use of these resources is seen as a strategy where students could get out of control as they may get overly enthusiastic (Ormrod, 2014).

Lack of time is also another factor which impedes the use of teaching and learning resources in the classroom. Uribe-Florez and Wilkins (2010) asserted that lack of time is considered to be an important factor because some teachers understand that activities involving concrete materials require more time.

Motivation is another reason to explain the use of concrete materials in mathematics classes since lessons involving concrete materials are fun and engage students throughout the entire lesson (Mutodi&Ngirandi, 2014). Furthermore, literature have it that teachers use teaching and learning materials if they are looking for ways to involve students (Furner et al. 2005), and help students learn mathematics (McNeil &Jarvin, 2007).

State of Available Mathematics Resources

Teaching and learning resources in the various schools are of importance to both the teacher and the student in achieving their various goals and for that matter the condition/state of these resource may have positive or negative impact on the users including their health. This assertion is also shared by Siddhu (2011) based on a study in India. According to him, the quality of classroom conditions has strong positive effect on girls.Furthermore, Adedeji and Olaniyan (2011) also noted that many rural schools in Africa lack essential infrastructure thus making the learning environment less safe, less efficient, and less effective. According to Alhassan and Adzalilie-Mensah (2010), schools with poor physical environment are less likely to attract both teachers and students. In

consonance with this, the Kenya government commission of inquiry on education system in part linked declining standards of primary education to inadequate and unsuitable physical facilities (Republic of Kenya, as cited in Dierkx, 2003). As reported by Dierkx (2003), many schools in Nairobi inner-city have inadequate furniture; they are either broken or lost. This is not different in the Fiji islands where school furniture was reported as poor and inadequate to the extent that in some schools furniture shortage was acute and students and/or pupils had to sit on the floor (Lingam & Lingam, 2013). These support the assertion that furniture is either lacking or poor in many countries and in some situation the shortage has been described as acute (World Bank, 2008).

CHAPTER THREE

RESEARCH METHODS

Overview

This chapter provides detailed description of the methodology which was used in the study. This includes the research design, study area, population, sample and sampling technique, research instruments, data collection procedure and the method of data analysis that will be used to find out the resources available for teaching mathematics in the Senior High Schools. It also contains the chapter summary.

Research Design

The purpose of a research and its objectives determines the type of research design to be used by the researcher (Katundu, 1998). A research design refers to the overall strategy that you choose to integrate the different components of the study in a coherent and logical way (Kirshenblatt-Gimblett& Barbara, 2006).Koul (2003) also defined research design as a number of decisions needed to be taken concerning collection of data. The design therefore, constitutes a frame for the collection, measurement, and analysis of data. Fink (2001) describes research design as all the stages and the processes involved in reaching the respondents. A research design will typically include how data is to be collected, what instrument will be used and the intended means for analyzing the data collected. In addition to these, Creswell (2003) refers to a research design as the plan of action that links the philosophical assumptions to specific methods. Different researchers use different designs based on their philosophical background.

This study made use of the Mixed–Methods Sequential Explanatory design. This approach combines both quantitative and qualitative methods of research. According to Tashakkori and Teddlie (2003), multiple methods are useful if they provide better opportunities for a researcher to answer research questions. According to Stange et al. (2006),mixed methods research involves integrating quantitative and qualitative approaches to generating new knowledge which can involve either concurrent or sequential use of these two classes of methods to follow a line of inquiry. In other words, Creswell et al (2003) also defined it as a way of integrating quantitative and qualitative data collection and analysis in a single study or a program of enquiry. Adding to the above definitions, Johnson et al. (2007) agreed that mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the purpose of breadth and depth of understanding and corroboration. Creswell (2012) posited that mixed method research is a systematic integration of quantitative and qualitative methods in a single study for purposes of obtaining a fuller picture and deeper understanding of a phenomenon.

Mixed methods research acknowledges that all methods have inherent biases and a weakness; that using a mixed method approach increases the likelihood that the data collected will be richer, more meaningful, and ultimately more useful in answering the research questions (Creswell, 2012). In shot mixed methods is a style for conducting research which includes collecting, analyzing, and combining bothquantitative and qualitative data in

a single study or a longitudinal program of inquiry. According to Tashakkori and Teddlie (2003), there are about forty mixed- methods research designs reported inliterature. Creswell et al. (2003) recognized the six most often used designs, which include three concurrent and three sequential designs. As indicated earlier, the researcher will be making use of the explanatory design.

This design according to Ivankova et al. (2006) is highly popular among researchers and implies collecting and analyzing first quantitative and then qualitative data in two consecutive phases within one study.This design starts with the collection and analysis of quantitative data. The first phase is followed by the subsequent collection and analysis of qualitative data. The phase of the study is designed so that it follows from the outcome of the first phase (Creswell & Clark, 2011). One major decision to be taken by a researcher using this design has to do with priority. According to Creswell (2003), priority refers to which approach or phase, quantitative or qualitative (or both), a researcher places more weight throughout the data collection and analysis process in the study. The researcher takes this decision depending on his/her interest and/or what he/she seeks to emphasize in the study. For this particular study the researcher will be putting more weight on the quantitative approach. The overall purpose for this approach is that the quantitative data and their subsequent analysis provide a general understanding of the research problem whilst the qualitative data and their analysis refine and explain those statistical results by exploring participants' view in more depth (Creswell, 2003). This design is very appropriate to a study according to Morse (1991) in which a researcher needs qualitative data to explain significant (or non-significant) outcomes, outlier outcomes or surprising outcomes.

Study Area

According to the Information Service Department (2016), the Western Region of Ghana covers an area of approximately 23921 square kilometers which is divided into 13 districts and it is bordered on the east by the Central Region, to the west by Ivory Coast, to the north by Ashanti and Brong-Ahafo Regions, and to the south by the Gulf of Guinea. The region has a population of 1,924,577 with a literacy level of 58.2%. The five major ethnic groups in the region are the Ahantas, Nzemas (including Evalues), Wassa, Sefwis, and the Aowins.

Research Population

Population refers to the complete set of individuals having common observable characteristics in which the researcher is interested (Fraenkel&Wallen, 2003; Creswell, 2002; Koul, 2003). In his work, Fink (2001) also defines a population as any collection of specified group of humans or non-human entities. Hummelbrunner, Rak and Gray (1996) posited that population is the total of all items in the group of items in which the researcher is interested. In other words a population can be seen as a well-defined collection of humans or items.

The population for this research consists of only public senior high schools in the Western region. Currently there are 41 public Senior High Schools in the region. Private schools will not be included in the study because they do not receive funds from government to purchase teaching and learning materials. Also these private schools do not get assistance from the Ghana Education Service in terms of human resource. The participants

weremathematics teachers and store keepers in public Senior High Schools in the Western region.

Sampling Procedure

A sample, according to Fink (2001) is a portion or a subset of a larger group. It is a representative of the population if the important characteristics are distributed proportionally in both groups. He further explains that the importance of a sample lies in the accuracy with which it reflects the target population.

Sampling, according to Sarantakos (1998) is a process of selecting the units of the target population which are to be included in the study.Osuala (1993) posited that sampling in itself is not a technique for data collection but it makes sure that any technique used will help collect data from a smaller group, which could accurately represent the whole group. He further explained sampling as a way of selecting from a larger population, a group about which a generalized conclusion can be made. Also according to Osuala (1993) and Fink (2001), sampling is efficient and precise in that those resources that might go into collecting an unnecessary number of individuals or items can be spent on other activities of the research. It helps focus the survey on precisely the characteristics of interest samples which are expected to be representative of the population. Samples are therefore chosen by means of sound methodological principles. However, Nwana (1993) posited that there is no perfect sampling technique since it usually has some element of error.

The public Senior High Schools in Ghana have already been grouped by the Ghana Education Service in categories 'A', 'B', 'C' and 'D' based on school facilities. The Western region has 6 category 'A' schools, 6 category 'B', 13 category 'C' and 16 category 'D' public Senior High Schools (Ministry of Education, 2009). The researcher used these categories as strata where simple random sampling will be used to select a percentage of schools from each stratum. The researcher used sampling fraction of 33% to sample schools from each stratum. The researcher used 33% because it gives a fair representation of the schools in the region. By this, 13 out of the 41 public Senior High Schools were selected. This comprised2 schools each from categories 'A' and 'B', 4 from category 'C' and 5 from category 'D'. Out of the 13 selected schools for the study, one is a single sex (Boys), one single sex (Girls) and 11 mixed schools representing 7.7%, 7.7%, and 84.6% respectively. Averagely, each school has 12 mathematics teachers and 1257 students. The schools which participated in the study had an average of ten (10) form 2 classes.

In all, eighty-four (84) Senior High School mathematics teachers were used in the study out of which 80 of them representing 95.2% were males and four(4) representing 4.8% were females. In all, a total of 67 (79.8%) out of the eighty four (84) respondents were40 years and below, and 17(20.2%) were persons who were above forty (40) years. Bill (2003) posited that the age of teachers has direct association with the use of educational technology (Teaching and learning resources) in the teaching and learning process. According to Adams (2002), younger teachers are more prone to using educational technology than older teachers. Therefore, based on his assertion,

a better proportion of the respondents in this study were within the youthful group and would be more likely to make good use of teaching and learning resources to teach mathematics if the best opportunities are presented to them.

Besides the age, teachers' professional qualification was also looked at. First degree holders with teacher training background numbered fifty two (52) representing 61.9%. The respondents with first degree but without teacher training background were eighteen (18) in number representing 21.4% of the total sample. Only eight (8) out of the total respondents representing 9.5% were with their master degrees in mathematics with teacher training background. The remaining six (6) of the respondents representing 7.1% were teachers who possessed first degrees in other mathematics related areas.

The least rank for any teacher in the Senior High School was Principal Superintendent and it is no surprise to have sixty five (65) participants representing 77.4% of the total sample on that rank. There were sixteen (16) people representing 19% who were assistant directors (Assistant director l, Assistant director ll). Two (2) of the respondents were senior superintendents representing 2.4% of the total sample size. Only one (1) person out of the eighty four (84) respondents was above the rank of an assistant director and this represented 1.2% of the total sample.

Majority of the teachers (53.6%) had taught mathematics for five (5) years and below, and only 4.8% of the teachers had taught mathematics between 6 – 10 years. A further 41.6% of the teachers had taught mathematics for 11 years and above. Nine (9) out of the sixteen store keepers

representing 56.2% were males, and seven (7) representing 43.8% were females. More than half of the store keepers(56.2%, n = 9) were people who were 41 years and above, and the rest representing 43.8% were forty (40) years and below. On their educational level, the Middle School Leaving Certificate (MSLC) was the least qualification of the store keepers and 37.5% (n = 6) of the participants possessed it. Only five (5) representing 31.2% of the store keepers possessed Senior Secondary School Certificate (SSSC) and 18.8% (N = 3), possessed Higher National Diploma (HND) Certificates.

Data Collection Instruments

Qualitative instruments

In this study, classroom observation and interview were used to collect qualitative data. According to Domegan and Fleming (2007), "qualitative research aims to explore and to discover issues about the problem on hand, because very little is known about the problem" (p. 24). There is usually uncertainty about dimensions and characteristics of a problem. According to Myers (2009), qualitative research is designed to help researchers understand people, and the social and cultural contexts within which they live. Such studies allow the complexities and differences of worlds-under-study to be explored and represented (Philip, 1998).

Interview

The second phase of the data collection for this study was done by using interviews. As reported by Zohrabi (2013) and Burns (1999) an interview is a popular and widely used means of collecting qualitative data. By using an interview for data collection, the researcher gets firsthand information directly from targeted respondents. Flick (2006) adds that an

interview reveals exiting knowledge on an issue in a way that can be expressed in the form of answers and so become accessible to interpretation. In his view, Zohrabi (2013) said an interview can be conducted in two forms: person-to-person and group or collective formats. According to Merriam (1998), both forms of interview are a kind of goal oriented conversation.

A semi-structured interview (Appendix C) focused on three themes. The first theme was on the availability teaching and learning resources in the school categories. The second theme was on the low usage of mathematical tools by teachers and the third theme focused on reasons behind the usage or non-usage of resources by Teachers in the school categories.

Classroom observation

The researcher used an observation guide (Appendix E) to collect data. According to Cohen, Manion and Morrison (2007), observation method implies the collection of information by way of observing without interviewing the respondents. They further explained that the information obtained relates to what is currently happening and is not complicated by either the past behaviour or future intentions or attitudes of respondents. Observation as a research tool is preplanned and carried out purposefully to answer research questions (Zhrabi, 2013). The researcher employing this method observed classroom interactions and events as they actually occurred (Burns, 1999). Flirk (2006) also contends that observation is an attempt to observe events as they naturally occur. To end this, Merriam (1998) believes that observation is a kind of data triangulation in order to substantiate the finding. This method was used to collect information on the available mathematics teaching/learning resources in the classroom and those used

during math lessons and the stages at which they were used during the lesson and by whom. It also gave firsthand information on the state of the available resources in the classroom and the school as a whole.

The classroom observation (Appendix D) also consisted of three sections (A, B, & C). The first section(A) contained four items that elicited information the teacher, the students and the lesson observed. The second section (B) contained items on use of learning resources, the mode of presentation of the observed lessons, and the stages of lessons where resources were used. The third section (C) captured the state of the observed mathematics resources used during lessons.

Quantitative instruments

Teacher questionnaire

The questionnaire for teachers had four main sections, A, B, C and D. Section A consisted of seven items eliciting basic information on the participants' background. These were the respondents' sex, age, professional qualification, rank, teaching experience and attendance to in-service training activities for mathematics teachers. Section B had six items eliciting information about the school such as the number of math teachers and the second year classes which the respondents' teach.Section C of the questionnaire comprises two items on the availability of resources for the teaching and learning of mathematics and their state. The last section (D) consists of nine items with two focusing on the extent to which the teachers have access to the teaching resources in lesson planning and delivery. Two of the items also focused on respondents' reasons for using teaching/learning resources and how they use these resources in their lessons. Two open-ended

questions in this section elicit information on effects of the availability and non-availability of mathematics teaching/learning resources on respondents' lesson delivery. This can be seen in Appendix A.

Store Keepers' Questionnaire

This questionnaire has seven items on it. The first three questions elicited information on the store keepers' sex, age and educational qualification. Item four elicits information on the available mathematics teaching/learning resources in the store and their quantity. Items five and six elicited information on how teachers are informed when the school acquires new materials for teaching and how teachers request for the available resources from the store. This questionnaire is at appendix B.

Data Collection Procedures

The researcher visited the all the participating schools with a consent form from the department of science and mathematics at the University of Cape Coast signed by the supervisor. This form explained the purpose of the research. After meeting with the heads of the schools, theygave their consent and also informed the heads of mathematics department to help the researcher carryout the study in the school. The researcher made participants understand what the research requires from. The researcher thenadministered the questionnaire to the mathematics teachers and storekeepers in the selected schools. The researcher sought help from some colleagues who were also doing their Master of Philosophy inMathematics education in the same department in administering the questionnaire in some of the schools. The researcher organized training for those who assisted in the questionnaire administration to standardize the data collection process. It took the

researcher two weeks to collect the quantitative data in the various selected schools.The only problem faced by the researcher was teachers' unwillingness to participate in the study.

To protect the anonymity and ensuring confidentiality of the identities of participants in this research, the researcher did not include items such as names of the participating schools and that of the teachers and other personal information.

The piloting of the instrument was done with selected schools in the Abura - Aseibu -Kwamankese district which is outside the target population. Eighteen (18) mathematics teachers and four (4) storekeepers responded to the questionnaires. As a result of the pattern of responses, statements felt to be vague or misleading were revised for clarity and substitutions made for items indicating trifles. In all, 100 questionnaires for mathematics teachers and 20 for school store keepers were sent out and 84 of the mathematics teachers' and 10 of store keepers were returned representing 84% and 50% respectively. The teacher questionnaire had a reliability coefficient of 0.868 and that of the storekeepers also yielded a reliability coefficient of 0.540. All two questionnaires were highly reliable since all yielded reliability coefficients above 0.5. According to Mugenda and Mugenda (2003), an instrument is judged highly reliable for a research if its reliability coefficient is above 0.5. In establishing the content validity, four experts in educational research of the Department of Science and Mathematics Education, University of Cape Coast reviewed the items. They also analyzed unclear, biased and deficient items and evaluated the sections where items have been

placed. Their suggestions helped to establish the items' face and content validity.

Data Processing and Analysis

The researcher examined all returned questionnaires for completeness and accuracy of response. This helped to detect all defective questionnaires for an appropriate action to be taken. Bell (1999) gave three stages which data collected should be taken through. These include, data coding, data input and cleaning and analysis of data.The study employed the three stages. All data was analyzed using the Statistical Package for Social Science (SPSS) software version 16.0. Descriptive statistics was used to describe participants' responses on the state of mathematics teaching and learning resources, how often teachers use the available resources and the reasons which account for mathematics teachers' use of the resources.

A Shapiro-Wilk's test ($p > 0.05$) (Razali& Wash, 2011), and inspection of the Skewness and Kurtosis measures and standard errors (Field, 2013; Pallant, 2005), and a visual inspection of their histograms, normal Q - Q plots and box plots showed that the sample data were not approximately normally distributed. A non-parametric Levene's test was used to verify the equality of variances in the samples (homogeneity of variances) ($p > 0.05$) (Nordstokke&Zumbo, 2010). The non-parametric Levene's test for equality of variances for both the availability of resources in the schools and teachers use of resources is presented in Tables 2 and 3 respectively.

Table 2: *NParLevene's Test for Equality of Variance for Availability of Resources in the Schools*

Factor	Levene's Statistic (F)	df1	df2	Sig.
School Category	0.03	3	12	0.99*

Source: Field survey, 2015

The result in Table 3.1 shows that there is homogeneity of variances of the dependent variable across groups ($p > 0.05$).

Table 3: *NParLevene's Test for Equality of Variances for SHS Mathematics Teachers' Use of Resources*

Factor	Levene's Statistic (F)	df1	df2	Sig.
Gender	1.30	4	79	0.28*
Academic Qualification	2.99	1	82	0.09*
School Category	0 .38	3	80	0.77*

Source: Field survey, 2015

The result in Table 3 shows the results of p – values greater than 0.05 meaning there was an equality of variances for SHS mathematics teacher's use of resources across groups.

Kruskal-Wallis H test was also employed to find out the difference in the use of teaching and learning resources in the mathematics classroom across academic qualifications and school categories. The Mann Whitney U test was used to test how the gender of the teacher differs in the use of teaching and learning resources.

Scoring of the instrument

A two point Likert scale (Available, Not Available) was used to score the availability of mathematics teaching/learning resources in the school and/or classroom on the store keepers' questionnaire. The scoring of the items was as follows:

ResponseScore

Available	2
Not Available	1

The average scores for all the mathematics resources were obtained by adding the responses of all the teachers. The average score was calculated for each of the resources and the interpretation given. An average score of 2.00 means the resource is available whilst a score of 1.00 was interpreted as not available.

A three point Likert scale (Enough, Too few or little, Not at all) was used to score mathematics teachers' access to mathematics teaching and learning resources in their various schools. This item is in the mathematics teachers' questionnaire and was scored as follows:

Response	Score
Enough	2
Too few or little	1
Not at all	0

A Likert scale of four options (Very Good, Good, Fairly Good, Bad) was used to rate the state of the available mathematical teaching/learning resources in the school. This item was on the teacher's questionnaire and was scored as follows:

Response Intensity	Score
Very Good	4
Good	3
Fairly Good	2
Bad	1

A Likert scale of four options (Very Often, Often, Not too Often, Not at all) was used to rate the mathematics teachers' use of teaching and learning resources. The items were scored as follows:

ResponseScore	
Very Often	3
Often	2
Not too Often	1
Not at all	0

A four option Likert scale (Strongly Agree, Agree, Disagree, and Strongly Disagree) was also used to rate the reasons teachers gave for their usage of mathematics teaching/learning resources during lessons. The scores were as follows:

Response Intensity	Score
Strongly Agree	4
Agree	3
Disagree	2
Strongly Disagree	1

Chapter Summary

The research was conducted to find out the available mathematics teaching and learning resources in the senior high schools in the western region of Ghana, their current state, teachers reasons for using them and the factors that influence the teacher's use of the teaching and learning resources. Data was collected from mathematics teachers and store keepers in the schools. Descriptive statistics was used to describe the state of the available

resources and the reasons teachers give for their use of the available resources. Kruskal – Wallis test was conducted to find out if there exist significant differences among school categories and academic qualifications in terms of resources available. Besides, Mann – Whitney U test was also conducted to find out the difference between male and female teachers in the use of teaching and learning resources.

CHAPTER FOUR

RESULTS AND DISCUSSION

Overview

This chapter focuses on the results that were obtained from the analyses of the data collected and the discussion of the findings revealed by this study. The results are presented on the following themes:

i. Available mathematics resources
ii. Usage of mathematics resources
iii. The state of the available mathematics resources

Available Mathematics Resources

Research question 1

What resources are available for teaching mathematics in the Senior High Schools?

The first research question was to find out the available teaching and learning resources available in the various schools. In an attempt to answer this question, the researcher used item five in the storekeeper's questionnaire to elicit the needed information. The item is a 2-pointLikert scale to determine if a particular resource is available or not as indicated in Chapter three (3).

It is seen in table 4 that all the schools in the study have mathematics textbooks whiles fifteen (93.8%) and ten (62.5%) indicate that they have mathematics library books and mathematics syllabus respectively.

Table 4: *Available Curriculum Materials in the SHS*

Materials	Available	Not Available
Library Books	93.8% (15)*	6.2% (1)
Math Syllabus	62.5% (10)	37.5% (6)
Math Textbooks	100% (16)	

Source: Field survey, 2015

Apart from computer software which 68.8% (n = 11) and solid shapes which 87.5% (n = 14) of the total sample who indicated they do not have, more than fifty or more percent of the store keepers indicated that they have other mathematical tools in their schools. These include chalk/marker board instruments (75%), calculators (68.8%), computers (56.2%), computers with internet connectivity (68.8%) and projectors (50%).

Table5:*Available Mathematical Tools in the SHS*

Mathematics Tools	Available	Not Available
Board Mathematics Inst.	75% (12)*	25% (4)
Calculator	68.8%(11)	31.2% (5)
Computer	56.2% (9)	43.8% (7)
Computer with internet	68.8%(11)	31.2% (5)
Computer software	31.2% (5)	68.8%(11)
Projector	50% (8)	50% (8)
Solid Shapes	12.5% (2)	87.5% (14)

Source: Field survey, 2015

All the sixteen store keepers indicated that they had classrooms for learning, chalk/marker board in all the classrooms andfurniture. Out of the sixteen store keepers, fourteen representing 87.5% indicate that they had library blocks in their schools. Only three store keepers (18.8%) said they had mathematics laboratories in their schools.

Table 6: *Available Buildings and Furniture in the SHS*

Building & Furniture	Available	Not Available
Classroom	100% (16)*	0% (0)
Chalk/Marker Board	100% (16)	0% (0)
Furniture	100% (16)	0% (0)
Library Block	87.5% (14)	12.5% (2)
Math Laboratory	18.8% (3)	81.2% (13)

Source: Field survey, 2015

Research Question 2

How are the available teaching resources in the Senior High School acquired?

The second research question focused on how the mathematical resources were acquired. The result from the study shows that the government is the highest supplier of syllabus and math textbooks (Table 7). With regard to the mathematics library books, 62.5% of the store keepers indicated that they were mainly acquired through PTA/NGO donations, 25.0% said they were purchased by the school, and only 6.2% reported that they were supplied by the government.

Table 7: *Acquisition ofCurriculum Materials*

Curriculum Materials	Government Purchase	School Purchase	Teacher Made	PTA/NGO Donation
Syllabus	87.5%	6.2%	6.2%	0%
Math textbook	93.8%	6.2%	0%0%	
Library books	6.2%	25.0%	0%	62.5%

Source: Field survey, 2015

Regarding the acquisition of mathematical tools, 56.2% of the respondents reported that marker board and mathematics instruments were purchased by the school and 25% indicated that they were supplied by the government (Table 8). However, 81.2% and 93.8% of the respondents reported that students bought their own mathematical sets and calculator respectively. Table 8 also revealed that 75.0% of respondents made it known that the schools were responsible for the purchase of projectors with only 18.8% saying they were donated by the PTA/NGO. The acquisition of math software and solid shapes were mainly by school purchase as indicated in table 8. Finally, 37.5% of respondents reported that computers were supplied by government and another 37.5% deemed that the computers were purchased by the schools. Additionally, 25.0% indicated that the computers were donations by the PTA/NGO.

Table 8:*Acquisitionof Mathematics Tools*

Mathematics Tools	Government Purchase	School Purchase	Teacher Made	PTA/NGO Donation	Student Purchase
Marker board math Instrument	25.0%	56.2%	6.2%	0%	0%
Students' Math Instrument	0%	18.8%	0%	0%	81.2%
Calculators	0%	6.2%	0%	0%	93.8%
Projectors	0%	75.0%	0%	18.8%	0%
Solid Shapes	0%	50.0%	43.8%	0%	0%
Math Software	0%	81.2%	0%	0%	12.5%
Computers	37.5%	37.5%	0%	25.0%	0%

Source: Field survey, 2015

The study also revealed that 81.2% of the respondents indicated that the provision of classroom blocks and math laboratories werethe sole responsibility of the government (Table 9). In the case of library blocks, 43.8% said they were built by the school, whilst 31.2% said it was the government that built them.

Table 9: *Acquisition of Buildings and Furniture*

Curriculum Materials	Government Purchase	School Purchase	PTA/NGO Donation
Classroom block	81.2%	12.5%	0%
Library block	31.2%	43.8%	18.8%
Math laboratory	81.2%	0%	12.5%

Source: Field survey, 2015

Differences in resource availability across school categories

Hypothesis

H_0: There is no difference in the availability of resources in the school categories.

H_1: There is a difference in the availability of resources in the school categories.

A Kruskal-Wallis test was later conducted to determine whether the four school categories differ in the availability of curriculum materials. The result is presented in Table 10.

The analysis of the results of the Kruskal-Wallis test conducted indicated that there was no significant difference in the availability of curriculum materials, ($X^2(3) = 0.00$, $p > 0.05$) across school categories. This means that all the school categories have equal quantities of curriculum materials.

Table 10*: Resources Availability in the school categories and School Types*

Factor	Category	N	Mean Rank	χ^2	df	Sig
Availability Of Curriculum Materials	Category A	2	8.50	0.000	3	1.000
	Category B	4	8.50			
	Category C	5	8.50			
	Category D	5	8.50			

Source: Field survey, 2015

Mathematical Tools

The Kruskal-Wallis results for the availability of mathematical tools were not different from that of the curriculum materials. There was no significant difference (Table 11) in the school categories in terms of the availability of mathematical tools $\chi^2(3) = 0.00$, $p > 0.05$). This is to say that the schools do not differ in terms of available mathematics tools.

Table 11:*Resources Availability in the school categories and School Types*

Factor	Category	N	Mean Rank	χ^2	Df	Sig
Availability Of mathematical Tools	Category A	2	8.50	0.000	3	1.000
	Category B	4	8.50			
	Category C	5	8.50			
	Category D	5	8.50			

Source: Field survey, 2015

Furniture and Buildings

From the Kruskal – Wallis test result in Table 12 indicated that the school categories did not vary significantly in terms of available buildings and furniture $\chi^2(3) = 0.00$, $p > 0.05$).

Table 12: *Availability of Buildings and Furniture across school categories*

Factors	Category	N	Mean Rank	χ^2	df	Sig
Availability of Furniture and Buildings	Category A	2	8.50	0.000	3	1.000
	Category B	4	8.50			
	Category C	5	8.50			
	Category D	5	8.50			

Source: Field survey, 2015

An observation was made in five selected schools from the previous 13 schools for the research. This was to ascertain the authenticity of the teaching and learning resources available in those schools. The five schools comprise one school each from categories 'A', 'B', 'C' and two from category 'D'. The observation revealed that all the five schools did not have mathematics laboratory and enough classrooms per the number of students occupying each class. Although the schools have libraries, they are not equipped with relevant mathematics textbooks.

An interview to verify Resource Availability

An interview with some mathematics teachers revealed that, although the schools had computers, they were not being used to learn mathematics because schools did not have the necessary software to do that. Table 6 revealed that classroom blocks were available in all the schools but the interview revealed another side of the issue. A head of mathematics department in one of the schools had this to say:

"Boss, can you believe a big school like this cannot boast of a single projector and not to mention of three dimensional solid shapes. Most of these

big schools like this one only have names but all is not well in terms of the tools to use. We are just like any other school" (J. K. Abbey, personal communication, July 10, 2015**)**.

Another teacher had this to say: "teaching math in this school is very difficult. Look at how the classroom is overcrowded. Teachers cannot meet the needs of individual students because of their number. We need more classrooms and teachers" (B. S. Ansah, personal communication, July 10, 2015).

Teachers' access to teaching resources

Research Question 3

To what extent do mathematics teachers have access to teaching resources in the senior high schools?

Generally, it has been made clear that mathematics teaching and learning resources are available in the various schools. As part of the study, the researcher used item 14 in the teachers' questionnaire to find out the extent mathematics teachers had access to teaching resources in the senior high school. Table 13 gives the general overview of the extent of access to curriculum materials.

Table 13: *Mathematics teachers Access toCurriculum Materials in the SHS*

Items	Accessibility
Library Books	1.58
Math Syllabus	2.00
Math Textbooks	1.08

Source: Field survey, 2015

As shown in table 13, mathematics teachers' access to math syllabus recorded a mean value of 2.00. This means that mathematics teachers have

enough access to math syllabuses in the schools. The library books (math) and math textbooks recorded 1.58 and 1.08 respectively. This means that math teachers have little access to math textbooks and library books (math) in the schools.

Table 14 gives a summary of teachers' access to mathematical tools in the course of their work. The mean values of 1.38, 1.37 and 1.49 for marker board math Instruments, mathematical set for students and calculators respectively, implies that mathematics teachers had little access to such tools. Table 14 clearly shows that math teachers do not have access to computers, projectors, solid shapes, computer software, and computers with internet in the schools.

Table 14: *Mathematics teachers access to Mathematics Tools*

Items	Accessibility
Board mathematics Instrument	1.38
Mathematical Set (Students)	1.37
Calculators	1.49
Computers	0.51
Projectors	0.26
Solid Shapes	0.57
Computer Software	0.44
Computer with internet	0.30

Source: Field survey, 2015

With the issue of teachers' access to buildingsand furniture, Table 15shows that teachers have enough access to classrooms and marker boards in the schools. These recorded a mean mark of 2.00 each. Teachers' access to furniture and library was too little with a mean of 1.70 and 1.06 respectively. Mathematics teachers' access to math laboratory recorded a mean mark of 0.04 which means that teachers do not have access to math laboratory.

Table 15: *Mathematics teachers access to Buildings and Furniture*

Items	Accessibility
Classroom Block	2.00
Furniture	1.70
Chalk/Marker Board	2.00
Math Laboratory	0.04
Library Block	1.06

Source: Field survey, 2015

Usage of Mathematics Resources

Research Question 4

How often do mathematics teachers use the available teaching resources for lesson delivery?

Every mathematics teacher in one way or the other makes use of some resources during his/her lesson delivery. This is a requirement of the mathematics syllabus since it helps in making the teaching of the subject real to students.

Table 16 revealed that mathematics teachers' use of math syllabus, math textbooks, and library books (math) recorded mean values of 0.33, 2.60 and 1.11 respectively. This means that teachers do not use the syllabus during lesson delivery. They often use mathematics textbooks and rarely use library books in the classroom.

Table 16: *Mathematics teachers' use of Curriculum Materials during lesson delivery*

Items	Extent of use
Math Syllabus	0.33
Math Textbooks	2.60
Library Books	1.11

Source: Field survey, 2015

The result in table 17indicates that math teacher'soften use marker board drawing instruments, mathematical set for students and calculators during teaching.

Table 17: *Mathematics teachers' use of Mathematics Tools during lesson delivery*

Items	Extent of use
Board mathematics Instrument	2.44
Mathematical Set (Students)	2.44
Calculators	2.62
Computers	0.82
Projectors	0.15
Solid Shapes	1.32
Computer Software	0.62
Computer with internet	0.14

Source: Field survey, 2015

The extent of use of solid shapes recorded a value of 1.32 which means teachers rarely use solid shapes in class. Mathematics teachers do not use technological tools during lesson delivery at all since the mean marks for them were less than 1.00.

The results in the Table 18 shows that the averages for teachers' use of classroom block, chalk/marker board and furniture were 2.90, 2.77 and 2.77 respectively. This implies that teachers often use these resources during lesson delivery. The average values of 0.05 and 0.37 for the extent of use of math laboratory and library block respectively mean that teachers do not use them at all during lesson delivery.

Table 18: *Mathematics teachers' use of Buildings and Furniture during lesson delivery*

Items	Extent of use
Classroom Block	2.90
Furniture	2.77
Chalk/Marker Board	2.77
Math Laboratory	0.05
Library Block	0.37

Source: Field survey, 2015

Low usage of most mathematics tools by teachers during lesson

Table 14 indicates that the available mathematical tools were moderately accessible to teachers in the various schools. It was realized from the analysis that majority of teachers did not use them. This is what some of the teachers said when interviewed: "Mathematics tools like computers, computers with internet connectivity, and projectors are available but are used to teach only ICT. They are simply not enough for math teachers to use for their lessons. This is not our fault" (A. B. Mensah, personal communication, July 10, 2015). Another teacher also claimed that "I must confess, my head of department gave as software which can be used to teach math but I do not have the ability and the skill to put it to use. I will try and learn how to use it and probably you may see me using it in the classroom on your next visit" (S. A. Korah, personal communication, July 10, 2015). In addition, a teacher also said that "Sometimes the use of these resources waste instructional time. It disorganizes class and that is why I prefer to teach without most of them" (E. K. Petiafo, personal communication, July 13, 2015).

Teachers' mode of use of teaching and learning resources during lessons

Research Question 5

What is the mode of resource usage among mathematics teachers during instruction in the senior high schools?

Generally, mathematics teachers agreed that they used instructional aides for demonstrations in class and also guide students to use the instructional aides as a means of remedial help (Table 19). However, the teachers generally disagreed to the claim that they allowed students to use the instructional aides as they wishedand to the statement to check their work.

Table 19: *How mathematics teachers use instructional aides during lesson delivery*

Mode of use	Average
I used instructional aides for demonstration in class	3.43
I allow students to use the instructional aides as they wish	2.73
Students use the instructional aides to check their work	2.95
I guide the students to use the instructional aides as a means of remedial help	3.29

Source: Field survey, 2015

Classroom observation of how mathematics teachers use resources during teaching and the stages at which they use them.

An observation of ten mathematics teachers was made in all the school categories coupled with a semi-structured interview. Two teachers each in category 'A' and 'B' schools and three each from categories 'C' and 'D'

schools were observed and interviewed on their use of resources during lessons. The purpose of the observation was to ascertain the information given by teachers on their use of resources during lesson, their mode of lesson delivery and the stages at which the resources were used. An average of 45 minutes was used for the observation and the table below shows the outcome. The topic of the lessons observed were Construction, Plane Geometry ll, Mensuration ll and Quadratic Graph.

Table 20 shows the stages at which teachers made use of some of the math resources during lesson delivery at the time the researcher visited the class.

Table 20: *Math Resources used during the various stages of lesson presentation*

Resources	Introduction Stage	Development Stage	Closure Stage	Frequency of Occurrences
Textbooks	•	•	•	6
Notebooks	•	•	•	10
Marker boards	•	•	•	10
Solid Shapes	•	•		1
Mathematical Instruments		•		3
Calculators				
Computers				
Projectors				

Source: Field survey, 2015

The results from the observation show that all teachers made use of the marker board, andtheir note books at all stages of the lesson delivery (Table 20). Only six out of the ten teachers observed used the math textbooks at all the three stages. One teacher was seen using solid shapes made with manila cards at the introduction and the development stages during the lesson

delivery. Three other teachers were also observed using marker board mathematical instruments at the development stage of the lesson.

Mode of Lesson Presentation

The observation was also to look at mathematics teachers' mode of lesson presentation. Out of the 10 teachers observed, 2, representing 20%, used teacher centered approach, 5, representing 50%, used learner/student centered approach, and 3 (30%) teachers used the mixed approach (Table 21).

Table 21: *Mathematics teachers' mode of lesson presentation*

Mode of Presentation	No.	Percentage
Teacher Centered	2	20%
Learner Centered	5	50%
Mixed Approach	3	30%
Total	10	100%

Source: Field survey, 2015

Mathematics Teachers' reasons for the use or non-usage of Teaching/Learning Resources

Research Question 6

What reasons account for mathematics teachers' usage or non-usage of teaching and learning resources?

Teachers were asked the reasons that accounted for their use ofmathematics teaching and learning resources in the classroom. The majority of the respondents, seventy-four (74), representing 88.1%, were in agreement (agree and strongly agree) that they used mathematics teaching and learning resources because the syllabus said they had to, with only 11.9% (n = 10) in disagreement (disagree and strongly disagree) to that (Table 22).

Table 22: *Reasons which account for Teachers' use of mathematics resources*

Reasons for using teaching/ Learning resources	Strongly Agree N (%)	Agree N (%)	Disagree N (%)	Strongly Disagree N (%)
Syllabus says you have to	45 (53.6)	29(34.5)	8 (9.5)	2 (2.4)
They benefit students	61 (72.6)	23 (27.4)	0 (0)	0 (0)
Students enjoy using them	37 (44.0)	40(47.6)	3 (3.6)	4 (4.8)
It is a school math policy	34 (40.5)	24(28.6)	15 (17.9)	11 (13.1)

Source: Field survey, 2015

All the participants (100%) in the study indicated that they used teaching and learning resources in their lessons because they were of a strong belief that those resources benefitted students' learning. Seventy seven (77) of the total sample, representing 91.6%, said they made use of mathematics teaching and learning resources purposely because their students enjoyed using them, but the remaining 8.4% (n = 7) disagreed to that assertion. With the reason that teachers use teaching and learning resources because it is in their school mathematics policy, 69.1% (n = 58) were in agreement while 31% (n = 26) disagreed to it.

Items 20 and 21 on the teachers' questionnaire were to find out if the availability or non-availability of teaching and learning resources affected their lesson delivery. Majority of respondents reported that the availability of these resources positively affected their lesson. When they were asked why they preferred to use or not to use math resources during the lessons, this was what a teacher said:"I strongly believe the use of resources in the classroom helps student to become positively involved in the teaching and learning process. It makes students think, analyze, and deduce concepts on their own"

(E. K. Ayekpa, personal communication, July 14, 2015).Another teacher wrote that "non-availability of teaching and learning resources in the school does not affect my lessons in any way. I teach the way I need to teach for my students to understand whether with or without resources" (A. K. Arthur, personal communication, July, 14). In addition, a teacher said"The use of these resources in teaching is a school policy and every teacher is expected to use them in his/her lesson delivery. The school believes that their use helps to deepen students' understanding of mathematics as they discover new concepts" (P. N. Aryee, personal communication, July 14, 2015**)**. One head of department also has this to say: "Any teacher who cannot make use of resources to teach is not fit to be in this school. Teachers are given the necessary support to improvise even when the material needed to teach a particular topic is not available. We believe in discovery learning" (T. R. Nunoo, personal communication July, 14, 2015**)**. Another teacher also made this comment: "I will love to use these resources to teach in the classroom but where are they? Common cardboards to use for improvisation are not there. The best we can do here is to teach with what we have" (T. W. Mensah, personal communication, July 14, 2015)

Difference in the use of resources in teaching mathematics across sex

Hypothesis 2

H_0: Male and female teachers do not differ significantly in the use of mathematicsresources during lesson delivery.

H_1: Male and female teachers differ significantly in the use ofmathematics resourcesduring lesson delivery.

To answer this question, the score on mathematics teachers' general use of teaching and learning resources were analyzed for the differences in the categories for each of the factors under consideration. Mann – Whitney U test was used to find out if there exists significant difference between the male and female mathematics teachers in the use of teaching and learning resources. The results were shown in Table 23.

Table 23: *Use of Teaching and Learning Resources across Gender*

Factor	Categories	N	Mean Rank	Mann-Whitney U	Z	Sig
Sex	Female	80	43.35	92.00	- 1.60	0.093
	Male	4	25.50			

Source: Field survey, 2015

The result of the test was not statistically significant, z = -1.60, p = 0.093. At an α = 0.05, the null hypothesis (H_0) was upheld since there was not sufficient evidence to show that gender was related to the use of resources in teaching mathematics in the senior high schools by teachers.

Difference in the use of resources in teaching mathematics across academic qualification

Hypothesis 3

H_0: There is no significant difference in the use of resources inteaching mathematics across academic qualification of teachers.

H_1: There is a significant difference in the use of resources in teaching mathematics across academic qualification of teachers.

Kruskal Wallis H test was used to find if there is a significant difference in the categories of the teachers' academic qualification (Table 24).

Table 24: *Use of Teaching/Learning Resource across Academic Qualification*

Factor	Categories	N	Mean Rank	χ^2	df	Sig
Academic Qualification	1st Degree (math) with Teacher training	52	43.27	2.92	3	0.404
	1st Degree (math) with No teacher Training	18	46.50			
	2nd Degree (math) with Teacher training	8	36.00			
	Other Qualifications	6	32.50			

Source: Field survey, 2015

A Kruskal – Wallis test was conducted to determine whether the use of mathematics teaching and learning resources by mathematics teachers in the senior high schools varied depending on the teachers' professional qualification. Results of the analysis indicated that the teachers' professional qualification did not differ significantly from one another in terms of teaching and learning resource usage, χ^2 (3) = 2.92, p > 0.05.

Difference in the use of resources in teaching mathematics across school category

Hypothesis 4

H_0: There is no significant difference in the use of resources in teaching mathematics across the categories of Senior High Schools.

H_1: There is a significant difference in the use of resources in teaching mathematics across categories of Senior High Schools.

Table 25: *Use of Teaching/Learning Resource across school categories*

Factor	Category	N	Mean Rank	χ^2	df	Sig
School Category	Category A	15	61.90	26.82	3	0.000*
	Category B	16	49.12			
	Category C	22	42.68			
	Category D	31	29.56			

Source: Field survey, 2015

The Kruskal Wallis test conducted for school categories shows that there was a significant difference among school categories in terms of resource usage. The post hoc rank sum test for the school categories indicates that category 'A' schools mathematics teachers use more teaching and learning resources than categories 'C' school teachers, $z = -2.75$, $p < .05$, or category 'D' mathematics teachers, $z = -5.08$, $p < .05$. Mathematics teachers in category 'B' schools also use more teaching and learning resources than those in category 'D' schools, $z = -3.43$, $p < .05$. Teachers in category 'C' schools also seem to use more resources in teaching than their colleagues in category 'D' schools. However, categories 'A' and 'B' mathematics teachers did not have any significant difference in their use of teaching and learning resources and likewise teachers in categories 'B' and C schools.

To better explain the above result, ten mathematics teachers were selected and interviewed. Below are some of the responses they gave during the interview:

"Using of resources to teach mathematics may help the students but I do not like using them because it takes too much of the instructional time" (Juliana Kalleh, personal communication, July 21, 2015). Another teacher has this to say "In this school if even the teaching resource to use is not available, you are forced to improvise because the materials to use are provided for" (Bernice B.Baiden, personal communication, July 21, 2015).

All ten interviews conducted were analyzed and put under four major themes. The summary is shown in Table 26 below.

Table 26:*Summary of interview results*

Theme	Interview results on resource usage			
	School Category			
	A	B	C	D
Willingness to improvise	2	2	1	1
Resources are not available	1	0	2	3
It is a must to use TLRs	2	2	0	1
It is a waste of time	0	0	2	2

Source: Field survey, 2015

State of the Available Mathematics Resources

In finding out the state of the available mathematics teaching and learning resources in the various schools, the teachers were asked to rate the resources used to teach on 4-scaleLikert point (very good, good, fairly good, and bad).

From Table 27, the average value for the stateof math syllabus recorded a value of 3.00 which means that they are in a good state. The average values for math textbooks and library books (math) recorded the values of 2.86 and 2.11 respectively. This means that the math textbooks and the library books are in a fairly good state.

Table 27: *State of Curriculum Materials*

Items	State of resource
Math Syllabus	3.00
Math Textbooks	2.86
Library Books	2.11

Source: Field survey, 2015

Considering the results in table 28, the state ofmarker board drawing instrument (2.57), mathematical set for students (2.68), calculators (2.82) and computers (2.42) were considered as being fairly good. The state of solid shapes (1.44) in the schools wasbad.Projectors (0.88), computer software (0.75) and internet connectivity (0.18) were classified as not applicable because they were not in existence in the schools.This means the school has a lot of old mathematical tools with all the parts not in good condition or not working at all.

Table 28: *State of Mathematics Tools*

Items	State of Resource
Board mathematics Instrument	2.57
Mathematical Set (Students)	2.68
Calculators	2.82
Computers	2.42
Projectors	0.88
Solid Shapes	1.44
Computer Software	0.75
Computer with internet	0.18

Source: Field survey, 2015

Table 29 shows that majority of the furniture used in the schools, the classrooms blocks and chalk/marker boards were in good state, since they recorded average values of 3.00, 3.02 and 3.12 respectively. The mean score for the library blocks was 2.27 which means that they were fairly good state.

Math laboratory with an average value of 0.35 is considered as not applicable because the schools had none. School buildings and furniture in general were considered as being fairly good with an average value of 2.35. This is to say that most of the buildings and furniture in the school were old and some parts were not in good condition.

Table 29: *State of Buildings and Furniture*

Items	State of Resource
Classroom Block	3.02
Furniture	3.00
Chalk/Marker Board	3.12
Math Laboratory	0.35
Library Block	2.27

Source: Field survey, 2015

State of available resources during observation

During the observation, the researcher also observed some of the resources available in the schools visited. The result is shown in table 30.

Table 30:*State of Available school resources during observation*

Resources	Very good	Good	Fairly good	Bad
Textbooks			•	
Library books			•	
Notebooks		•		
Marker boards	•			
Solid Shapes				
Mathematical				
Instruments		•		
Calculators	•			
Computers			•	
Projectors				
Library block			•	
Classroom block			•	

Source: Field survey, 2015

Averagely, five of the resources observed in the schools studied were rated as being fairly good. These were math textbooks, library books (math), computers, the library block and the classroom blocks. Two of the resources, namely teachers' notebooks and the marker board mathematical instruments were also rated as good. The resources rated as being very good were the calculators used by students and the marker boards in the classrooms.

Discussion of Results

The discussion was made under the three main themes, namely, mathematics resources in the senior high schools, mathematics teachers' use of resources for teaching and learning, and the state of the available mathematics resource.

Available Mathematics Resources

The teaching and learning resources were put into three categories; curriculum materials, mathematical tools, and buildings and furniture. The result from the data analyzed revealed that majority of the schools had enough access to mathematics syllabus, textbooks and library books (mathematics). This is so because the curriculum materials are the basic things a teacher needs to discharge his/her duties even if there are no classrooms because of their importance to education. Slattery and Carlson (2005) affirms the importance of a syllabus by saying that it is a contract between the teacher and the student and spells out what happens if a student failed to meet course expectations. As a contractual document, whatever is in it must be respected by both the teacher and student and for that reason, the Ghana Education Service and the ministry of education have made the syllabus available to all schools. With the available mathematics syllabuses in the schools, mathematics teachers will know what to teach at a particular

point in time.It is not surprising to see mathematics textbooks available in all categories of schools because according to Rezat (2010) it is one of the most important teaching and learning resources. This will help students to learn a lot of things on their own and to do enough practice of what they have learnt in the classroom. Averagely, all the schools in the various categories have enough curriculum materials for use by both teachers and students.

Apart from chalk/marker board drawing instruments and mathematical set for students, which are highly available in all school categories, some of the other mathematical tools are simply available in less quantity and others not available at all in all the school categories. This result is in agreement with Education insight in Kenya (2005) which revealed that inadequate teaching and learning resources is a common feature in many schools. With the unavailability of most of the mathematical tools in schools, teachers will not be able to function at their best in terms of lesson delivery. How can teachers prepare their students for the world of work in this technological age when there are no computers, internet connection, and mathematics software to use in the teaching and learning of mathematics in our schools?

The result indicated that classroom blocks, library blocks and marker boards were available in all the schools but the only problem was that they were not enough. This has caused over-crowding in the classrooms where you can count as many as eighty or more students in a class which was to contain thirty-five to forty students. Situations like this may not allow teachers to cater for the individual needs of the student since they cannot move round to supervise students' work.

Usage of Mathematics Resources

Mathematics as a subject is abstract in nature and for students to fully understand its concepts; teachers need to find ways to make the teaching of the subject practical. According to Steedly et al. (2008), researchers are of the view that mathematics instruction and students understanding are more effective if concrete materials are used. Despite this, mathematics teachers have various reasons for using or not using teaching resources. From the study, all the respondents (100%) indicated that they used these teaching resources in the teaching and learning process because they believed it benefitted students by bridging the gap which divides lesson presentation by teachers and the understanding of the lesson by students. This is to say that all teachers believed a gap is created in concept assimilation when TLRs are not used during lesson delivery. This finding affirms the findings of Ferguson and McDonough (2010) that supported the idea that teaching and learningresources can help both teachers and students to bridge the gap that divides how mathematics is taught and how it is learned.

The study also revealed that 91.6% of respondents are in support of the perception that teachers use teaching resources because their students enjoy using them. Majority gave the reason that as students enjoy the use of these resources, it motivates them to develop deep interest in the subject. This is in agreement with the study conducted by Allen (2007) that some teachers use concrete materials with the purpose of giving students enjoyment and fun. What the above result implies is that most mathematics teachers in the Western region make good use of the available resources in their schools to teach. This will take away the abstract nature of mathematics to some extent

and help student to understand better the concepts behind most of the topics they learn in mathematics. The 8.4% who disagreed with this assertion are of the view that some teachers only use these materials as a cover up for their laziness. According to some of them, it wastes instructional time and makes class management very difficult. The reason they gave is also in line with Trespalacios (2008) who argued that teachers in his study recommended that time spend on concrete materials could be better utilized with other instructional approaches. On the issue of classroom management, Ormrod (2014) reported that the use of concrete materials is viewed as a strategy where students could get out of control. Teachers who had this in mind may not help their students in getting deeper understanding of concepts since most of their teaching may be in abstract.

The study revealed that gender has no influence on mathematics teachers' use of teaching and learning resources. This is to say that the rate at which both male and female teachers adopt and use curriculum materials, mathematical tools, furniture and buildings was statistically the same. This finding is in agreement with that of Norris et al. (2003) whose research in California, Florida, Nebraska and New York revealed that gender has no influence on the extent of technology use in K – 12 in U.S. Moreover, the study is in conflict with that of Almekhlafi and Almeqdadi (2010) on teachers' perceptions of technology integration in the United Arab Emirates which revealed that there is a significant difference between male and female mathematics teaches. With both male and female teachers using teaching resources at the rate in teaching mathematics in the senior high schools in the Western region implies that students may appreciate the work of all the

teachers in their schools. They may not be selective based on lesson delivery in the classroom by teachers and will make them love the subject.

The study found no significant difference between mathematics teachers' academic qualification and his/her resource usage in the classroom. This means that, teachers holding first or second degree either with teacher training or not use teaching and learning resources at the same rate. This finding is in consonance with Ehrenberg and Brewer (1994) who found no correlation between the advance degrees on teachers' use of teaching and learning resources to impact on students' performance. However, the finding conflicts the finding of Betts, Zau, and Rice (2003), and Goldhaber and Brewer (2000) who found that there is a positive effect of advance degrees on teachers' use of teaching and learning resources to impact on students' achievement. The result from this study implies that mathematics teachers with different qualifications can handle all mathematics topics which may require the use of resources in the classroom effectively.

The study found a significant difference in the use of mathematics teaching and learning resources by teachers in the category 'A' schools as against the teachers in category 'C' and 'D' schools. The study revealed that category 'A' and 'B' teachers used teaching learning resources more than category 'C' and 'D' teachers. Though there is no statistically significant difference between school categories in terms of available resources, classroom space per number of students favours the categories 'A' and 'B' schools. This has created a good classroom environment for their teachers to use teaching resources to teach the students. The finding is in agreement with Olasunkanmi and Olufunmiayo (2012) who reported that most of the public

secondary schools in Nigeria were infrastructural deficient, that is, there are shortages of seats for students, dilapidated school buildings, and classroom which hamper teachers' use of resources in such classrooms. An interview conducted revealed that the categories 'C' and 'D' school teachers do not use much teaching resources due to the congestions in the classrooms. The physical environment of the categories 'A' and 'B' schools look very attractive and well-arranged as compared to the less endowed schools (Categories 'C' and 'D'). These schools attract the best of teachers and students.

The State of the Available Mathematics Resources

The state of a schools' physical environment including the teaching and learning materials may have effects on the teaching and learning abilities of teachers and students and also has health implications on the students. On the state of the resources in the schools, the results indicated that the furniture in the schools is good although inadequate for students. This affirms the report by Dierkx (2003) that many schools in Nairobi inner-city have inadequate furniture; they are either broken or lost. This situation is not different from what pertains in the senior high schools in the western region of Ghana although not alarming. According to information gathered by the researcher, all the senior high schools have carpenters who do all the furniture repair works. One major issue which is of worry is the physical environment of the schools. According to Alhassan and Adzalilie-Mensah (2010), schools with poor physical environment are less likely to attract both teachers and students. This also the case in Kenya as government commission of inquiry on education system in part linked declining standards of primary

education to inadequate and unsuitable physical facilities (Republic of Kenya, as cited in Dierkx, 2003). The situation as revealed in this research through observation is that some of the buildings in the schools lack maintenance (painting) and psychologically, it may not create that needed environment for learning. In general, curriculum materials (Syllabus, mathematics textbooks, and library books) are rated as being fairly good. This means they are old and not all parts are in good condition or working well.

Chapter summary

At the end of the study, the major findings were that math syllabus, math textbooks, board mathematics instruments, mathematical set for students, classroom blocks, furniture, marker boards, and library blocks were available in the schools whiles those not available include library books, solid shapes, technological tools, and math laboratory. It was also released from the study that there is no significant difference across school categories in terms of available resources. In terms of accessibility, the study revealed that mathematics teachers have little access to curriculum materials, no access to mathematical tools and low access to buildings and furniture. When it comes to the use of teaching/learning resources during lesson delivery, the study showed that on the average math teachers rarely use curriculum materials, do not use math tools and building and furniture too often. It also came to light that there is no significant difference in the use of math resources across sex and academic qualification. In terms of school categories, it was released that teachers in category A schools use teaching resources more than their counterparts in categories C and D schools but use TLRs equally as teachers in category B schools. Teachers in category B schools also use TLRs more

than the category D math teachers but do not vary in TLRs usage as those in the category C schools. Categories C and D math teachers also do not vary in TLRs usage during lesson delivery. Regarding the state of the TLRs, it was released that most of them are old and not in good condition.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Overview

This chapter gives a summary of the study, conclusion and outlines recommendations, and areas for further research.

Summary

The study investigated teaching and learning resources available for teaching mathematics at the SHS level. Specifically, it tried to find out if the available resources differ among the school categories, the state of the available resources, and the reasons teachers give for their usage. The study also investigated the difference in the use of resources in teaching mathematics across sex, academic qualification of teachers, and school categories. Mathematics teachers in the western region took part in the study. Stratified sampling technique was used to select 84 mathematics teachers and 16 storekeepers for the study. Mixed-Method with sequential explanatory design was used. A questionnaire, lesson observation and an interview was used for the data collection. Descriptive statistics was used to analyze the state of available resources and the reasons for the use of these resources. Kruskal-Wallis test and Mann-Whitney U test were used to find difference in the use of teaching and learning resources across sex, academic qualification, and school categories.

The research revealed that there is no significant difference between the school categories in terms of resources available for mathematics teachers for teaching in the classroom. This is to say that per the school enrollment

and the resources available, both well endowed (category A and B) and less endowed (category C and D) schools are on the same level.

Regarding the state of the available teaching and learning resources, it was revealed that most of the teaching resources in the schools are fairly good, that is they are old and all parts are not functioning well.This study also brought to light that most of the mathematics teachers use the teaching resources because they believe they benefit students and also because students like using them. To them, once the student showed interest in the use of the resources, it goes a long way to help them understand concepts in mathematics

According to the research, the mathematics teachers' gender and academic qualification has no influence on their use of teaching and learning resources. The only factor with a significant influence on mathematics teachers' use of resources is the school category. It was revealed that categories 'A' and 'B' school mathematics teachers use more teaching resources in their lessons as compared to the teachers in categories 'C' and 'D' schools.

Conclusions

It was found that there was no difference in the available resources between the participating schools in the research. Although all the school categories have enough curriculum materials, they all lack infrastructure in one way or the other. This was due in part to the fact that although categories 'A' and 'B' schools has more resources, they also admits more student than the categories 'C' and 'D' schools and that puts more pressure on their facilities which is the same problem faced by the less endowed schools. This

is also due to the fact that government is not doing enough to upgrade the existing schools in terms of infrastructure.

Most of the respondents in the study indicated that the resources in their schools are fairly good. This means most of these resources are old and not in good condition. This is due to the fact that the Ghanaian maintenance culture is bad. A substantial number of the respondents rated the resources in their schools as good. These respondents are mainly from the well-endowed schools which have vibrant old students' associations and parent and teachers' associations which donate items for the maintenance.

The research revealed that majority of the respondents make use of teaching and learning resources because they think it benefits students and also students like using them. These resources motivate students and keep them active throughout the lesson. When this happens students understand the mathematics concepts and appreciate mathematics the more. The students' love for the subject in a long way reflects in their performance.

The study found out that gender and academic qualification has no influence on mathematics teachers' use of teaching resources. This is because male and female mathematics teachers or mathematics teachers with different qualifications in the same school exhibit the same characteristics depending on the category of school in which they find themselves. What pertains in a particular school may determine how often the teachers use teaching resources. For example, it was revealed in this research that teachers in categories 'A' and 'B' schools use teaching resources more than the categories 'C' and 'D' schools. This is because the categories 'A' and 'B' schools are well motivated and the supervision in those schools is also

intensive because they have a reputation to protect in terms of performance. The well-endowed schools also have classrooms which are not too congested like the categories 'C'and 'D' schools thereby making it possible for teachers to use the teaching resources.

Recommendations

From the findings of this research, the following are recommended:

i. The SHS teachers should be encouraged to improvise the mathematics resources which are not available and are easy to be improvised.
ii. Resources which are not in good condition should be repaired or replaced entirely.
iii. Based on the findings from the study the government, teachers, and students are entreated to play their respective parts in ensuring the supply of mathematics resources for effective teaching and learning of mathematics in the SHS.

Suggestions for further studies

The following are recommended for further studies:

i. A similar research should be conducted in other regions in Ghana and the results compared with the findings from this study
ii. A research should be conducted on mathematics teachers' TLM usage and its influence on students' performance.

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APPENDIX A: TEACHER QUESTIONNAIRE

Resources Available for Teaching Mathematics in SHS Classroom

Dear Colleague,

The purpose of this study is to find out the available resources for the teaching and learning of mathematics and their use in Senior High Schools in Ghana. The study is therefore solely for academic pursuit and does not in any way evaluate either teachers or institutions, or to call for any administrative changes. Your genuine response is very much needed for the success of this study. You are assured that the information provided will be treated confidentially.

Thank you.

Please read the questions below and **tick (√) or write** where applicable.

SECTION A: GENERAL INFORMATION

1. Sex:

Male [ ]
Female [ ]

2. Age: ……

3. Professional Qualification

i. Bachelor degree (Math) with teacher training [ ]
ii. Bachelor degree (Math) with no teacher training [ ]
iii. Master degree (Math) with teacher training [ ]
iv. Master degree (Math) with no teacher training [ ]
v. Other (Please specify) ……

4. What is your rank?

i. Senior Superintendent [ ]
ii. Principal Superintendent [ ]
iii. Assistant Director [ ]
iv. Other (Please specify)

……

5. How many years have you been teaching?

……

6. How long have you been teaching Mathematics? .....

7. Have you ever attended In-Service Training for Mathematics teachers?

Yes [ ]
No [ ]

SECTION B

QUESTIONS ABOUT THE SCHOOL

8. What is the type of school?

i. Single sex (Boys) [ ]

ii. Single sex (Girls) [ ]

iii. Mixed [ ]

9. How many mathematics teachers are in your school?

……

10. How many students are in your school? ……

11. How many classes are in Form 2?……

12. How many classes in Form 2 do you teach?……

13. What is the number of students per class that you teach? Please indicate for each class.……

…

SECTION C:

Learning Resources for the Teaching and Learning Mathematics

14. Think about the availability of the following resources at your school. To what extent do you have access to these resources for use in your mathematics classroom?

RESOURCES	**Please check one box in each row**		
	Enough	**Too few or little**	**Not at all**
i. Math Syllabus [Please specify how many] ……	☐	☐	☐
ii. Math Textbooks [Please specify how many]……..	☐	☐	☐
iii. Library books (mathematics) [Please specify how many] ……	☐	☐	☐
iv. Chalk/Marker Board Mathematical Instruments (eg. ruler, set squares, etc) [Please specify how many] ……	☐	☐	☐
v. Mathematical instruments for Students [Please specify how many] ……	☐	☐	☐
vi. Calculators [Please specify how many] ……	☐	☐	☐
vii. Computers [Please specify how many] ……	☐	☐	☐
viii. Projectors [Please specify how many] ……	☐	☐	☐
ix. Solid Shapes (eg. globe, cubes, cylinder, etc)[Please specify how many] ……	☐	☐	☐
x. Classroom [Please specify how many] ……	☐	☐	☐
xi. Furniture [Please specify how many]…..	☐	☐	☐
xii. Chalk/Marker Boards [Please specify how many]…….	☐	☐	☐
xiii. Computer software [Please specify how many] …….	☐	☐	☐
xiv. Computers with internet connectivity [Please specify how many] ……	☐	☐	☐
xvi. Math Laboratory [Please specify how many] ……..	☐	☐	☐
xvi. Library Block [Please specify how many] ……	☐	☐	☐

15. Please **Tick (√)** appropriate state of the following resources for teaching mathematics in your school.

Definition:

- ***Very Good****: New and all parts are either in good condition or working well*
- ***Good****: New and not all parts are in good condition or working well*
- ***Fairly Good****: Old and not all parts are in good condition or working well*
- ***Bad****: Old and all parts not in good condition or not working at all*

RESOURCES	STATE			
	Very Good	**Good**	**Fairly Good**	**Bad**
i. Math Syllabus	☐	☐	☐	☐
ii. Math Textbooks	☐	☐	☐	☐
iii. Library books (mathematics)	☐	☐	☐	☐
iv. Chalk/Marker Board Mathematical ɜtruments (eg. ruler, set squares, compass, protractor, etc)	☐	☐	☐	☐
v. Mathematical instruments for ɯdents	☐	☐	☐	☐
vi. Calculators	☐	☐	☐	☐
vii. Computers	☐	☐	☐	☐
viii. Projectors	☐	☐	☐	☐
ix. Solid Shapes (eg. globe, cubes, cylinder, etc)	☐	☐	☐	☐
x. Classroom	☐	☐	☐	☐
xi. Furniture	☐	☐	☐	☐
xii. Chalk/Marker Boards	☐	☐	☐	☐
xiii. Computer software	☐	☐	☐	☐
xiv. Computers with internet connectivity	☐	☐	☐	☐
xv. Library Block	☐	☐	☐	☐
xvi. Math Laboratory	☐	☐	☐	☐

SECTION D

USE OF RESOURCES FOR THE TEACHING AND LEARNING OF MATHEMATICS

16. To what extent do you use the following in mathematics lessons?

RESOURCES	Please check one box in each row			
	Very Often	**Often**	**Not soo often**	**Not at All**
i. Math Syllabus	☐	☐	☐	☐
ii. Math Textbooks	☐	☐	☐	☐
iii. Library books (mathematics)	☐	☐	☐	☐
iv. Chalk or marker Board athematical Instrument (eg. ruler, set squares, etc)	☐	☐	☐	☐
v. Mathematical instruments for udents	☐	☐	☐	☐
vi. Calculators	☐	☐	☐	☐
vii. Computers	☐	☐	☐	☐
viii. Projectors	☐	☐	☐	☐
ix. Solid Shapes (eg. globe, cubes, cylinder, etc)	☐	☐	☐	☐
x. Classroom	☐	☐	☐	☐
xi. Furniture	☐	☐	☐	☐
xii. Chalk/Marker Boards	☐	☐	☐	☐
xiii. Computer software	☐	☐	☐	☐
xiv. Computers with internet connectivity	☐	☐	☐	☐
xv. Library Block	☐	☐	☐	☐
xvi. Math Laboratory	☐	☐	☐	☐

17. What reasons account for your usage of mathematics teaching/Learning resources in your lessons?

Reasons for use	Strongly Agree	Agree	Disagree	Strongly Disagree
i) Syllabus says you have to				
ii) I believe they benefit student's learning				
iii) Students enjoy using them				
iv) It is in school mathematics policy				
v. Other (Please specify)				

18. How do you use mathematics instructional aids in your classroom?

Classroom use of mathematics instructional aids	Strongly Agree	Agree	Disagree	Strongly Disagree
i) I use instructional aides for demonstrations in class				
ii) I allow the students to use the instructional aides as they wish				
iii) Students use the instructional aides to check their work				
iv) I guide the students to use the instructional aides as a means of remedial help				
v). Other (Please specify)				

APPENDIX B: STORE KEEPERS' QUESTIONNAIRE

Resources Available for Teaching Mathematics in SHS Classroom

Dear Store Keeper,

The purpose of this study is to find out the available resources for the teaching and learning of mathematics and their use in Senior High Schools in Ghana. The study is therefore solely for academic pursuit and does not in any way evaluate either storekeepers or institutions. Your genuine response is very much needed for the success of this study. You are assured that the information provided will be treated confidentially.

Thank you.

Please read the questions below and **tick (√)** or **write** where applicable.

SECTION A

1. Sex:

Male [ ]

Female [ ]

2. Age: ……

3. What is your highest level of formal education that you have completed?

i. Middle School Leaving Certificate (MSLC) [ ]
ii. Senior Secondary School Certificate (SSCE) [ ]
iii. Higher National Diploma (HND) [ ]
iv. First University Degree [ ]
v. Other (Please specify) ……

SECTION B

4. Please **tick (√)** the corresponding box under availability and **write (in figures)** the quantity of teaching/learning resources for teaching mathematics.

RESOURCES	AVAILABILITY		
	Available	**Not Available**	**Quantity**
i. Math Syllabus	☐	☐	
ii. Math Textbooks	☐	☐	
iii. Library books (mathematics)	☐	☐	
iv. Chalk or marker Board Mathematical Instruments (eg. ruler, set squares, etc)	☐	☐	
v. Mathematical instruments for Students	☐	☐	
vi. Calculators	☐	☐	
vii. Computers	☐	☐	
viii. Projectors	☐	☐	
ix. Solid Shapes (eg. globe, cubes, cylinder, etc)	☐	☐	
x. Classroom	☐	☐	
xi. Furniture	☐	☐	
xii. Chalk/Marker Boards	☐	☐	
xiii. Computer software	☐	☐	
xiv. Computers with internet connectivity	☐	☐	
xv. Math Laboratory	☐	☐	
xvi. Library Block	☐	☐	

5. How are the resources acquired? Please **check [√]** one box in each row

RESOURCES	Acquisition of resources				
	Gov't supply	**School Purchase**	**Teacher made**	**PTA/ NGO Donation**	**Students Purchase**
i. Math Syllabus	☐	☐	☐	☐	☐
ii. Math Textbooks	☐	☐	☐	☐	☐
iii. Library books (mathematics)	☐	☐	☐	☐	☐
iv. Chalk or marker Board Mathematical Instrument (eg. ruler, set squares, etc)	☐	☐	☐	☐	☐
v. Mathematical instruments for students	☐	☐	☐	☐	☐
vi. Calculators	☐	☐	☐	☐	☐
vii. Computers	☐	☐	☐	☐	☐
viii. Projectors	☐	☐	☐	☐	☐
ix. Solid Shapes (eg. globe, cubes, cylinder, etc)	☐	☐	☐	☐	☐
x. Classroom	☐	☐	☐	☐	☐
xi. Furniture	☐	☐	☐	☐	☐
xii. Chalk/Marker Boards	☐	☐	☐	☐	☐
xiii. Computer software	☐	☐	☐	☐	☐
xiv. Computers with internet connectivity	☐	☐	☐	☐	☐
xv. Library Block	☐	☐	☐	☐	☐
xvi. Math Laboratory	☐	☐	☐	☐	☐

APPENDIX C: INTERVIEW GUIDE

Resources Available for Teaching Mathematics in SHS Classroom

Dear Colleague,

The purpose of this study is to find out the available resources for the teaching and learning of mathematics and their use in Senior High Schools in Ghana. The study is therefore solely for academic pursuit and does not in any way evaluate either teachers or institutions, or to call for any administrative changes. Your genuine assistance is very much needed for the success of this study. You are assured that the information provided will be treated confidentially.

Thank you.

SEMI-STRUCTURED INTERVIEW GUIDE

The interview guide is to help researcher collect qualitative data to better explain these quantitative findings:

1. *Why is it that the School Categories do not differ in terms of Available Resources?*
2. *Reasons behind the use of less Technological Tools during lesson delivery.*
3. *Why teachers in Category A schools use TLRs more than those in Categories C and D schools.*

1. Please what kind of teaching/learning resources do you have in the school?

   ……
   ……
   ……
   ……

2. Please, are the teaching/learning resources enough for use by both teachers and students?

   ……
   ……
   ……

3. Please are the teaching/learning resources accessible to both teachers and student?

……
……
……
……
……

Reasons behind the less use of Technological Tools during lesson delivery?

4. Do you use technology to teach mathematics in your class? Why?

……
……
……
……
……

Why teachers in Category A schools use TLRs more than those in Categories C and D schools?

5. Please, what motivates you to use mathematics teaching learning resources in your lessons? Why?

……
……
……
……

6. Do you face challenges using TLRs in your lesson delivery? How?

……
……

APPENDIX D: LESSON OBSERVATION GUIDE

Resources Available for Teaching Mathematics in SHS Classroom

Dear Colleague,

The purpose of this study is to find out the available resources for the teaching and learning of mathematics and their use in Senior High Schools in Ghana. The study is therefore solely for academic pursuit and does not in any way evaluate either teachers or institutions, or to call for any administrative changes. Your genuine assistance to carry out this observation is very much needed for the success of this study. You are assured that the information provided will be treated confidentially.

Thank you.

SECTION A: *GENERAL INFORMATION*

1. Class Size/Enrolment:……..

No. of Boys: ……

No. of Girls: ……

2. Sex of the teacher in class: Male [ ] Female [ ]

3. Topic treated: ……...

4. Lesson Time.

Time lesson starts: ……..

Time lesson ends: ……...

5. Actual duration of lesson: ……

SECTION B
USE OF LEARNING RESOURCES

6. Resources used during the lesson

Computers
i. Available [ ]
ii. Used [ ]
iii. Not Used [ ]

Blackboard
i. Used for notes [ ]
ii. Used for other purposes [ ]
iii. Not used [ ]

Textbooks
i.Used [ ]
ii. Not used [ ]

Notebooks
i. Used [ ]
ii. Not used [ ]

Mathematical Instruments
i. Available [ ]
ii. Used [ ]
iii. Not used [ ]

Solid shapes
i. Available [ ]
ii. Used [ ]
iii. Not used [ ]

Mode of presentation
i. Teacher centered [ ]
ii. Learner centered [ ]
iii. Mixed approach [ ]

7. Resources used by the teacher at the various stages of the lesson

Stage of the lesson	**Resources used**	**Quantity**	**Usage**
Introduction			
Development			
Closure			

SECTION C

8. State of mathematics resourcesusedduring the lesson

Definition:

- ***Very Good****: New and all parts are either in good condition or working well*
- ***Good****: New and not all parts are in good condition or working well*
- ***Fairly Good****: Old and not all parts are in good condition or working well*
- ***Bad****: Old and all parts are not in good condition or not working at all*

RESOURCES	STATE OF RESOURCES				
i. Math Syllabus	☐	☐	☐	☐	☐
ii. Math Textbooks	☐	☐	☐	☐	☐
iii.Library books (mathematics)	☐	☐	☐	☐	☐
iv. Chalk or marker Board Mathematical Instrument (eg. ruler, set squares, etc)	☐	☐	☐	☐	☐
v. Mathematical instruments for Students	☐	☐	☐	☐	☐
vi. Calculators	☐	☐	☐	☐	☐
vii. Computers	☐	☐	☐	☐	☐
viii. Projectors	☐	☐	☐	☐	☐
ix. Solid Shapes (eg. globe, cubes, cylinder, etc)	☐	☐	☐	☐	☐
x. Classroom	☐	☐	☐	☐	☐
xi. Furniture	☐	☐	☐	☐	☐
xii. Chalk/Marker Boards	☐	☐	☐	☐	☐
xiii. Computer software	☐	☐	☐	☐	☐
xiv. Computers with internet connectivity	☐	☐	☐	☐	☐
xv. Library Block	☐	☐	☐	☐	☐
xvi. Math Laboratory	☐	☐	☐	☐	☐

APPENDIX E: RELIABILITY STATISTICS OF TEACHERS' QUESTIONNAIRE

Case Processing Summary

		N	%
Cases	Valid	18	100
	Excluded	0	0
	Total	18	100

Listwise deletion based on all variables in the procedure

Reliability Statistics

Cronbach's Alpha	N of items
0.868	79

APPENDIX F: RELIABILITY STATISTICS OF STORE KEEPERS' QUESTIONNAIRE

Case Processing Summary

		N	%
Cases	Valid	16	100
	Excluded	0	0
	Total	16	100

List wise deletion based on all variables in the procedure

Reliability Statistics

Cronbach's Alpha	N of items
0.540	16