UNIVERSITY OF EDUCATION, WINNEBA

COMPARATIVE CONTENT ANALYSIS OF CATEGORIES OF EXRECISES INMATHEMATICAL TASKS IN TWO GHANAIAN SENIOR HIGH SCHOOL MATHEMATICS TEXTBOOKS

AMOAH KINGSLEY JOSEPH

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DECLARATION

Student's Declaration

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

Signature……………………………..……

Date……………….………..………….

Supervisor's Declaration

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

Supervisor's Name: Mr. M. E. Amppiah

Signature……………………………..……

Date……………….………..………….

DEDICATION

I dedicate this work to my dear family, my wife Ruth Tetteh and daughters Esther Nhyira Amoah, Josephine Ayeyi Amoah and Pearl Adom Amoah for their love, support and encouragement.

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LISTS OF ABBREVIATIONS

ACM	AKIOLA core mathematics textbooks
ACM 1	AKIOLA core mathematics textbook 1
ACM 2	AKIOLA core mathematics textbook 2
ACM 3	AKIOLA core mathematics textbook 3
DST	Double step tasks
ECM	Enriched core mathematics textbooks
ECM 1	Enriched core mathematics textbook 1
ECM 2	Enriched core mathematics textbook 2
ECM 3	Enriched core mathematics textbook 3
EXX	Exercises
MST	Multiple step tasks
REEX	Review Exercises
SST	Single step tasks
WEX	Worked examples

ABSTRACT

This study was an attempt to Compare the Categories of mathematical tasks in two SHS mathematics textbooks namely AKIOLA core mathematics series (ACM) and the Enriched mathematics (ECM) textbooks for SHS. It specifically sought to find out the categories of exercises in mathematical tasks as well as the categories of steps in mathematical tasks and whether or not there were differences between the categories of exercises and steps in the ACM textbooks and ECM textbooks. In all, eight (8) SHS core mathematics teachers from two senior high schools were involved in the study. The researcher used a content analysis guide, content analysis codebook, an interview guide, a task analysis codebook and two observation checklists to find out the categories of mathematical tasks in terms of exercises and steps in the ACM and ECM textbooks. The results of the descriptive statistics indicated that there were differences in the categories of exercises in mathematical tasks presented in the textbook 1, 2 and 3 all in favour of the ACM textbook 1, 2 and 3 (ACM textbook 1: (WEX = 1057; EXX = 2863 and REEX = 545), (ECM textbook 1: (WEX = 414, EXX = 1026 and REEX = 29). (ACM textbook 2: ((WEX = 970, EXX = 1336, REEX =443), and (ECM textbook 2: (WEX = 242, EXX = 483, REEX = 30). (ACM textbook 3: WEX = 282, EXX = 323, REEX = 226), and (ECM textbook 3: (WEX = 151, EXX = 406, REEX = 30) in favour of the ACM textbook 3. The results of the descriptive statistics indicated that there were differences in the categories of steps in mathematical tasks presented in the textbooks 1, 2, and 3 all in favour of the ACM textbooks (ACM textbook 1: (SST = 1095; DST = 207 and MST =3136), (ECM textbook 1: (SST = 156, DST = 58 and MST = 1356) (ACM textbook 2: ((SST = 499, DST = 124, MST =2126), and (ECM textbook 2: (SST = 39, DST = 67, MST = 649) in favour of the ACM textbook 2. (ACM textbook 3: SST = 40, DST = 6, MST = 787), and (ECM textbook 3: (SST = 21, DST = 45, MST = 521) in favour of the ACM textbook 3. Hence the study concluded that there were differences between the categories of mathematical tasks in the ACM textbooks and the ECM textbooks in terms of exercises and steps in favour of the ACM textbooks. The study observed that there was collaboration between the profile dimensions in the SHS syllabus and the SHS mathematics textbooks. Based on the conclusion, the study recommended that more mathematical tasks that are of the category of MST should be included in the SHS textbooks since MST aid problem solving in mathematics.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter discusses the background to the study, statement of the problem, purpose of the study, research questions, significance of the study, the delimitations and limitations of the study, and the organization of the study.

1.1 Background to the Study

Evidence abounds that many students all over the world encounter severe difficulties in solving mathematical tasks (Tambychik & Meerah, 2010; Aforklenu, 2013). Some of the difficulties identified include weak problem solving abilities, teachers inability to teach through problem solving approach (Japan International Cooperation Agency, JICA, 2006), and students helplessness in understanding the language of text (Anamuah-Mensah & Mereku, 2007; Aforklenu, 2013).

In acknowledging these difficulties by Ghanaian students with solving mathematical tasks and affirming the relevance of solving mathematical tasks in amending these difficulties, stated in the TIMSS-2003 report that Ghana has not utilized problem solving to the fullest in mathematics textbooks (Anamuah-Mensah & Mereku, 2005),.

In Ghana, the Education Reform Review Committee recommended that a problem solving curriculum was necessary for pre-university education (Ministry of Education, (MOE), 2002). This Ghanaian SHS curriculum became operational in 2007. Currently, pre-university problem solving mathematics syllabus require the use of mathematics in solving practical life problems. The report specifically recommended that application of suitable mathematical problem solving strategies in the teaching and learning of mathematics in helping students to acquire the techniques of problem solving was necessary (MOE, 2002). This therefore has become one of the main objectives of teaching mathematics in pre-university institutions in Ghana.

Several studies have also clearly shown that there are enough similarities but also differences in curricula and textbooks of countries with different history, culture, economy, language and geographical stretch (Eda, Kingji-Kastrati & Fitore, 2015). Apart from the culture of a country, language and structure of the school, students' performance is also affected mainly by the educational background of teachers and textbooks that are used in certain countries of which Ghana is no exception (Eda, Kingji-Kastrati, & Fitore, 2015). However, the major written source as far as teaching and learning is concerned which also serves as a guide for teachers in lesson planning and presentations in classrooms are textbooks.

Textbooks as a learning tool or resource convey different pedagogical messages to teachers (and students) and provide them with an encouraging or discouraging curricular environment, promoting different teaching and learning strategies. As a matter of fact, available studies have also consistently revealed that textbooks can, and to different extent, affect not only what to teach, but also how to teach, which ultimately affect students' performance in mathematics (Fan, 2010). One of the key components of the intended curriculum is that textbooks also, to a large extent reveal the educational pedagogical values and philosophy of the decision makers and textbook developers which have substantial influence on teachers' teaching and students' learning.

As such, having useful documentation and information of how textbooks from the educational systems offer a strong curricula background for students to be exposed to diverse categories of tasks and also helps in exploring possible methods to improve the representation of diverse tasks in mathematics textbooks, improves students learning experiences in mathematics (Fan and Zhu, 2006). Hence, this study was an attempt to examine the categories of tasks in the Ghanaian SHS mathematics textbooks.

The last four decades have seen the importance of textbooks in mathematics education receiving mounting attention from the international mathematics education community (Fan & Zhu, 2006; Berisha, 2015). This development of researchers' interest in textbooks have been perceived from the fact that in the Third International Mathematics and Science Study (TIMSS) included an examination of hundreds of textbooks and other curricular materials from about fifty (50) countries which was a major study of such a large scale which included textbooks as a major research area. Nevertheless, compared to other research areas in mathematics education, several concerns have been raised indicating that research concentrating on textbooks are still insufficient as such many researchers have called for more studies centering on textbooks (Fan & Zhu, 2006).

In recent years, it has consistently been shown that cross-national comparative studies involving Asian students from Mainland China, Taiwan, Singapore, Hong Kong, Korea, and Japan, performed significantly better in mathematics than their peers from other geographical regions (Fan & Zhu, 2006). To find out the potential explanations for the differences in performance, researchers investigated the features of textbooks that the students were using, with a basic acceptance that textbooks play a significant role in the teaching and learning process (Fan & Zhu, 2000). According to Berisha, (2015), Mathematics textbook, as the most significant tool in teaching and learning mathematics, is also ―a provider" of robust link between mathematics content, history of mathematics, , everyday experiences of the real world, modern technology, other school disciplines as well as using a variety of presentation styles, methods and classroom activities.

When Mathematics content is enriched in this way, it makes the subject more acceptable, interesting, making students motivated and ready to solve more questions as compared to the abstract and isolated mathematics information (Berisha, 2015). Thus, a textbook is the concentration of attention which serves as a basic tool in changing and expanding educational curricula which contains organized subject matter considered as a key medium among educational media since it serves as a guide for learners, reflecting a specific and focused image of education. The aim of mathematics textbook is to ensure that mathematics content is presented to students at a certain age using exponential methods (Hatam, Zeinali & Hatam, 2015). The content of the textbooks must be analyzed bringing to bear the important factor of content analysis.

Johansson (2003), defines a textbook as a book designed to offer a solid academic version of an area of study. To her, textbooks are important in mathematics education due to their close link to classroom instruction. They identify the topics and order them in a way students should explore them. They also attempt to specify how classroom instructions can be planned with appropriate activities and exercises.

In effect, textbooks provide an interpretation of mathematics to teachers, students and their parents. Although, textbooks have a prominent position in curriculum reforms and are considered as the most important instrument for the implementation of a new curriculum in many countries, there arise the question of whether textbooks contain the needed mathematical tasks that help students to solve problems so as to build their problem solving skills and abilities.

Due to the fact that solving problems is crucial in mathematics education, the import of solving mathematics problems are also evident in many curricula and educational policy documents. National Council of Teachers of Mathematics (2000), explains that problem-solving standards indicates that the instructional programs should empower all students to build new mathematical knowledge through problem solving; solve mathematics problems that arise in both their contexts and other contexts; apply and adapt a variety of suitable and proper strategies in solving problems; follow and reflect on the mathematical problem solving process.

The position of solving mathematical tasks has been emphasized as a means of developing the logical reasoning ability of mathematics. 'Education will evidently be imperfect if it fails to contribute to the expansion of the intelligence. Yet intelligence is the ability to solve personal and everyday problems essentially (Kaye, 2014). Since the inception and fusion of solving mathematical tasks into the mathematics curriculum, it has been the heart of mathematics because it embraces lots of thinking. Kaye (2014), identified three ways by which mathematical thinking is important; Mathematical thinking as an important goal of schooling, mathematical thinking as an important way of learning mathematics; and mathematical thinking as an important tool for teaching mathematics. This makes mathematical thinking to be a highly complex activity (Kaye, 2014).

Wilson, Fernandez and Hadaway (1993), explained that solving mathematical tasks is an important facet of mathematics because it is the sum and substance of mathematics. Solving mathematical tasks as a discipline is given as a set of exercises and skills presenting mathematics as a challenging discipline. In addition to that, solving mathematical tasks has countless applications and often these applications represent central problems in mathematics. It is used at the work, understanding and communication within other disciplines. In addition to that, there is an intrinsic drive embedded in solving mathematics tasks (Kinard, 2000).

Mathematical tasks are involved in school mathematics because they arouse the interest and enthusiasm of students making mathematics fun to learn. Finally, solving mathematics tasks must be in the school mathematics curriculum to allow students to develop the art. This art is so indispensable to understanding mathematics and appreciating mathematics that it must be an instructional goal. Although teachers around the world have considerable successes with achieving this goal, especially with more abled students, there is always a great need for improvement, so that more students get a deeper obligation of what it means to think mathematically and to use mathematics to help in their regular and operational lives (Kaye, 2014).

Different researchers have different understanding of what a mathematical task is. Fan and Zhu (2000), defined a mathematical task generally as "a situation in which a goal is to be attained and a direct route to the goal is blocked"(p.6). The definition stresses the point that the solution to the mathematical task is not readily available in problem solving. Hence a mathematical task can be said to be a situation that requires a decision and/or an answer, no matter if the solution is readily available or not to the potential problem solver. It can also be said to be a task for which the person confronting it wants or needs to find a solution or the person has no readily available procedure for finding the solution or the person must make an attempt to find a solution (Fan & Zhu, 2006).

Kaur and Yeap (2009) also described a mathematical task as a task that a person or a group of persons want or need to find a solution to and for which they do not have a readily available procedure that pledges or completely defines the solution. However, mathematical tasks can never be solved without the individual possessing the needed computational and problem-solving skills.

Tasks in mathematics textbooks can be classified into two general categories. Example tasks, which are contained in the text part and exercise tasks which are located in the exercises of all kinds in the textbooks. These tasks can further be classified based on the classifications of tasks types such as single step tasks, double step tasks and multiple step tasks. However, most mathematics textbooks simply instruct students to evaluate tasks. When doing so, however, students have difficulty either solving the mathematical tasks because they do not understand the tasks. In response to the fast development to solving mathematical tasks globally and to also ensure that students skills used in solving tasks are improved, Ghana has developed and maintained a compulsory mathematics curriculum for all students from the first cycle to the second cycle.

According to the Curriculum Research Development Division, (CRDD) (2010), the mathematics syllabus has its focus on attaining one crucial goal; to enable all Ghanaian students to acquire the mathematical skills, values, insights, and attitudes that they will need to be successful in their preferred careers and daily lives. The syllabus was founded on the basis that, all students can study mathematics and that all need to study mathematics. The syllabus was therefore planned to meet the probable standards of mathematics in many parts of the world. To meet the demands communicated in the rationale, the SHS core mathematics syllabus was designed to help the students problem solve and investigate real life situations use mathematics in daily life by recognizing and applying appropriate mathematical problem-solving strategies (CRDD, 2010).

The general aims of the syllabus is to help students to: "Use mathematics in their daily lives by recognizing and applying suitable mathematical problem-solving strategies; Understand the process of measurement and use appropriate measuring instruments; Develop the ability and willingness to perform investigations using various mathematical ideas and operations; Work co-operatively with other students in carrying out activities and projects in mathematics; Use the calculator and the computer for problem solving and investigations of real life situations" (CRDD, 2010).

The specific objectives of the SHS 2010 Syllabus further indicates that; students should perform calculations by means of appropriate methods to develop computational skills; recall, apply and deduce mathematical knowledge in the context of everyday situations; improve on their ability to translate word problems (story problems) into mathematical language and solve them with associated mathematical knowledge; Organize, interpret and present information accurately in written, graphical and diagrammatic forms; use mathematical and other instruments to measure and construct Figures to an acceptable degree of accuracy; develop precise, logical and abstract thinking; analyse a problem, select a suitable strategy and apply an appropriate technique to obtain its solution; estimate, approximate and work to degrees of accuracy appropriate to the context; organize and use spatial relationships in two or three dimensions, particularly in solving problems; respond orally to questions about mathematics, discuss mathematics ideas and carry out mental computations; carry out practical and investigational works and undertake extended pieces of work; use the calculator to enhance understanding of numerical computation and solve real life mathematical tasks" (CRDD, 2010).

From the arguments so far advanced, educators and curriculum developers continue to adopt processesof solving mathematical tasks since it helps in identifying perceived needs, problems or productivity gains (Hiebert, Carpenter and Fennema, 1996). Thus, to address a need, one must know what a task is and use the skills acquired to solve the mathematical tasks. In line with the integrated senior high school curriculum, mathematics which is a compulsory subject in the integrated SHS Curriculum in Ghana has its focus on problem solving such that teachers have been urged to give due emphasis to solving mathematical tasks in their planning and teaching of mathematics (NCTM, 2000). However, there has always been the challenge of identifying the categories of exercises in mathematical tasks as well as the categories of steps in mathematical tasks in the Core mathematics for SHS (ACM) and Enriched mathematics for SHS (ECM) textbooks for SHS and to also find out whether there are differences between the two textbooks.

1.2 Statement of the Problem

Even though school mathematics textbooks have a powerful impact on classroom teaching and learning in a developing country like Ghana, low students' achievement in mathematics has been raised as a major concern which has often been attributed to teachers' inability to teach a substantial part of the content of the textbooks. Most Ghanaian teachers use textbooks as a resource for teaching mathematics and cannot distinguish between ―teaching the textbook" and ―using the textbook to teach mathematics (Berisha, 2015). These textbooks although contain different categories of mathematical tasks, it cannot, however, be said that they contain the worthwhile mathematical tasks that brings about problem solving. This study therefore seeks to identify the categories of mathematical tasks in the textbooks in terms of exercises and steps in solving the mathematical tasks in the ACM and ECM textbooks.

In order to offer an improved learning experience and environment for students, it is expected that all teachers should be competent in using the textbook to teach mathematics effectively and efficiently and apply their expertise for teaching mathematics through problem solving (Mereku, 2003). Dewan, (2012) opined that demographic shifts indicates that textbook authors and publishers have responded by designing textbooks with new supports to help less-experienced teachers teach mathematics and solve mathematical tasks, it has therefore been very vital to do a content analysis to investigate whether there are different categories of exercises in mathematical tasks and different categories of steps in mathematical tasks in the ACM and ECM textbooks and find out the differences between the textbooks.

Despite the widespread application of solving mathematical tasks to improve the mathematics curricula in many countries, most African countries including Ghana have not utilized mathematical tasks and their solutions to the fullest in mathematics textbooks according to the TIMSS-2003 report (Anamuah-Mensah & Mereku, 2005).

My literature research also indicates that there has been little investigation involving categories of mathematical tasks in Ghana and on the Ghanaian SHS mathematics textbooks. And as far as I was able to ascertain very few studies have applied the conceptualization of mathematical tasks in the ACM and the ECM textbooks. It is in this light that, this study seeks to find out the categories of exercises in mathematical tasks and the categories of steps in mathematical tasks in the ACM and the ECM textbooks since information on the mathematics textbooks that produce these learners also play a useful role in helping the students to build on their abilities and processes of solving mathematical tasks.

Stemler (2001), in an Overview of Content Analysis cited that Content analysis is a systematic, replicable procedure for reducing many words of text into smaller quantity content categories based on unambiguous rules of coding. Stemler further offers a broad definition of content analysis as, "any technique for making implications and suggestions by objectively and systematically recognizing specified characteristics of messages". The definition stress that the technique of content analysis is not limited to the field of textual analysis, but may be functional to other areas such as coding student drawings or coding of actions perceived in videotaped studies. In order to allow for replication, however, the technique can only be applied to data that are durable in nature.

Although several studies (TIMSS, 2003; Johansson, 2003; Özgeldi, 2005; Hatam, Zeinali & Hatam, 2015), have established that textbooks, together with documents for use in classrooms as teaching aids, such as resources for exercises, continue to be essential tools in today‘s classrooms. Anamuah-Mensah and Mereku (2005), observed that the Ghanaian curriculum textbook experienced by the students, who participated in the Trends in International assessment programme in science and mathematics, known as TIMSS-2003, employed countless emphasis on procedures, knowledge of facts and number work.

The researchers further argued from their analyses that the abysmal performance of the Ghanaian students in the TIMSS-2003, was due to the following factors; the abysmal performance was largely an exact picture of the nature of school mathematics curriculum that students have experienced in Ghana in the last five decades; the poor performance was an outcome of the content of the textbooks and examinations which continue to be dominated by commonalities of ―new math"; the poor performance indicated that Ghana is the only nation in the world today that has not changed its mathematics curriculum away from positions adopted in the 1960s; the poor performance was attributed mainly to the lack of similarity between what is emphasized in the mathematics curriculum in Ghana and what is currently treasured globally in school mathematics which the TIMSS was designed to measure.

According to Anamuah-Mensah and Mereku (2005), the general performance of the African countries (Ghana, Egypt, Tunisia, Morocco, Botswana and South Africa) in TIMSS, 2003 was very poor on items that involved solving non-routine problems and reasoning. Contextual factors that influenced the abysmal performance of the six African countries that participated in the TIMSS, 2003 indicated from the analyses of data that although countries in the north of Africa performed significantly better than those in sub-Saharan Africa, contextual examination for learning science and mathematics revealed that there were several weaknesses in the curricula of the participating African countries including Ghana.

Furthermore, results from Mathematics examinations at all levels of the educational system in Ghana indicates that many students are failing in the subject (Else-Quest, Hyde & Linn, 2010; Tella, 2017;). Moreover, a summary of the Chief Examiners' Report (2017), on core mathematics in the West Africa Examinations Council's Senior High School Certificate Examinations indicated that students' performance in the mathematics paper was poor (Zalmon, & Wonu, 2017; Abreh, Owusu & Amedahe, 2018). In the report, students' weaknesses included comments such as:

"Candidates showed poor skills in computations and seemed to have a knack for solving easy problems in a rather difficult way" (Appiah, 2016). Observations made by Adu, Mereku, Assuah, and Okpoti, (2017) also indicated that in the last eight years, the West Africa Senior School Certificate Examination (WASSCE) mathematics chief examiner's reports have indicated that average Senior High School students who sat for the WASSCE did not perform well (WAEC, 2008, 2011). Studies have indicated that students' failure may be caused by lack of emphasis by teachers on understanding the language of mathematics and the skills needed by the students. This may also result from the failure or inability of teachers to teach them with the right method and also ensure that every student masters the basic skills before moving to new topics (Adu, Mereku, Assuah & Okpoti, 2017).

It is worth stating that, although everything we do contains Mathematics, the principles and methods of Mathematics ensure the efficiency of all the things we do. Everybody can do mathematics but as to whether the problem with mathematics has to do with the subject itself, the teacher's content and pedagogical knowledge, the students' anxiety of mathematics, the inappropriateness of the curriculum, unsuitable books, unconducive classroom environment, insignificance of Mathematics, disturbance of social media or peer pressure are questions that will need to be answered (Boston, and Smith, 2009).

Moyer, (2001), indicated that even during practical mathematics lessons which should be activity-based and involve some hands-on investigations, ineffective and poor ways of solving problems are still employed. Thus, it was necessary to first examine the categories of exercises and steps in mathematical tasks as well as the categories of steps in mathematical tasks in the Ghanaian SHS mathematics textbooks. Hence, this study was an attempt to examine the categories of mathematical tasks in the Ghanaian SHS mathematics textbooks.

1.4 Purpose of the Study

The purpose of the study was to identify, categorize and compare the exercises and steps presented in mathematical tasks in the ACM and those of the ECM textbooks for SHS.

1.5 Objectives of the Study

The objectives of the study were;

1. To identify and categorize the exercises in mathematical tasks presented in the ACM and ECM textbooks for SHS.
2. To categorize the steps presented in mathematical tasks in the ACM and ECM textbooks for SHS.
3. To find out the differences in the categories of exercises in mathematical tasks and the categories of exercises in mathematical tasks presented in the ACM textbooks and the ECM textbooks for SHS.

1.6 Research Questions

In pursuance of the purpose and objectives stated above, the following research questions guided the study:

1. What categories of exercises in mathematical tasks are presented in the ACM and ECM textbooks for SHS?
2. What categories of steps in mathematical tasks are presented in the ACM textbooks and those in the ECM textbooks for SHS?
3. What differences are there between the categories of exercises in mathematical tasks and the categories of steps in mathematical tasks presented in the ACM textbooks and the ECM textbooks for SHS?

1.7 Significance of the Study

This study is significant in a number of ways since it is aimed at investigating the different types of mathematical tasks presented in the ACM and ECM textbooks for SHS. The study will provide a comprehensive picture about how the textbooks used in Ghana‘s educational system provide a curricular environment for students to be exposed to different types of mathematical tasks and explore possible ways of improving the presentation of exercises in mathematical tasks and categories the steps in mathematical tasks in presented in the ACM and ECM textbooks for SHS.

Moreover, since textbooks are an indispensable factor as far as the intended curriculum is concerned, they will also to a large extent reflect the educational philosophy and pedagogical beliefs of the textbook developers. One significant result of Ghanaian participation in TIMSS studies was the comment and debate that followed in the wake of the poor mathematical performances of its representatives, with associated suggestions for improvement.

The findings of this study will

- make a significant contribution by adding to the existing literature.
- determine the emphasis given to problem solving in the Ghanaian SHS mathematics textbook.
- be used to help curriculum developers and teachers to help students in Ghana,
- also form a good basis for teachers, administrators, the Government, Educational policy makers, the curriculum research development division, parents and students to assume a more positive move to ensure that students' problem solving skills are improved effectively and efficiently.

1.8 Delimitations of the Study

This study was restricted to only two Ghanaian SHS mathematics textbook series ACM and ECM textbooks for SHS books (1, 2, 3) due to the constraints of time and finance. In addition to that, the study also covered only eight SHS mathematics teachers in the Akuapem-North District of Ghana due to the constraints of time and finance.

1.9 Limitations of the Study

This study was restricted to only eight senior high school core mathematics teachers from the Akuapem-North Municipality due to the constraints of time and finance.

1.10 Definition of Terms

Textbooks: In this study, a textbook is a manual of instruction in any branch of study. Textbooks are manufactured according to the demands of educational institutions. School books are textbooks and other books used in schools. Thus the ACM textbooks and the ECM textbooks were considered in this study.

Public textbooks: In this study, public textbook is defined as a manual of instruction in any branch of study produced according to the demands of educational institutions by Government intellectuals for use in schools.

Private textbooks: In this study private textbook is defined as a manual of instruction in any branch of study produced according to the demands of educational institutions by private individuals and institutions for use in schools.

Problem solving: In this study, problem solving means the process of finding solutions to difficult or complex questions in mathematics.

Problem solving strategies: In this study, problem solving strategies means plan of action used in finding a solution to a particular problem.

Problem solving procedures: In this study, problem solving procedures means a step by step process of finding solutions to difficult or complex questions in mathematics.

Tasks: In this study, a task means a task that focuses students‘ attention on a particular mathematical concept.

Categories of Mathematical tasks: In this study, a mathematical task is defined as a set of problems or a single complex problem that focuses students‘ attention on a particular mathematical idea. In this study, categories meant classifying various tasks into specified groups. Thus Single step tasks (SST), Double step tasks (DST) and Multiple step tasks(MST) were considered in this study.

Categories of steps in mathematical tasks: In this study, categories of steps in mathematical tasks meant classifying various tasks into specified groups according to the number of steps used in solving the tasks. For example, Single step tasks, Double step tasks and Multiple step tasks.

Exercise: In this study, exercises meant classifying various tasks or questions according to its location or in the textbook into specified groups.

Categories of exercises in mathematical tasks: In this study, categories of exercises in mathematical tasks meant classifying various tasks into specified groups according to the whether is placed under worked examples (WEX), exercises (EXX) or review exercises (REEX).

The following categories of exercises were identified in the textbooks.

i. Worked examples (WEX)

Tasks that have been solved in the textbooks are known as worked examples.

ii. Exercises (EXX)

Tasks that have be placed in the textbooks for students to use in practising various concepts after a particular topic have been treated in the textbooks.

iii. Review Exercises (REEX)

Tasks that have be placed in the textbooks for students to use in practising various concepts in the textbooks after students have been taken through a number of topics.

Categories of Steps in Mathematical Tasks

The various categories of steps in mathematical tasks included Single step tasks (SST), Double step tasks (DST), and the Multiple step tasks (MST). The various tasks were coded after which the tasks in the textbooks were coded, counted and their frequencies recorded. These categories of steps in mathematical tasks are defined below.

i. Single-Step Tasks (SST)

Tasks that can be solved by one direct operation or taken through one direct step before arriving at an answer are defined as single-step tasks. Below is an example of single step task.

ii. Double Step Tasks (DST)

Tasks that can be solved by going through two direct steps before arriving at an answer are defined as double-step tasks. Below is an example of a double step task.

iii. Multiple-Step Tasks (MST)

Tasks that can be solved by two direct operations or taken through one direct step are called multiple-step problems.

SHS: In this study, SHS means Senior high schools

1.11 Organizational Plan of the Study

The study was organized in five chapters. In Chapter 1, the study of the background, Statement of the problem, Purpose of the study, Research questions guiding the study, Significance of the study, Delimitation and the Organizational plan were presented. The Relevant literature review was presented in chapter 2.

The researcher described the Research design and Methodology in chapter 3. Results and discussions were done in chapter 4. Chapter 5 consisted of Summary of the study, the key findings and discussion on findings, limitations of the study, conclusion, recommendations, and areas for further research.

CHAPTER TWO

REVIEW OF RELEVANT LITERATURE

2.0 Overview

This study was on Content analysis of the representation of categories of exercises and the categories of steps in mathematical tasks in the ACM and ECM textbooks. As such the review of relevant literature was done under the following thematic areas:

- Theoretical framework
  - The theory of presentation of knowledge by (Bruner, 1966)
  - The theory of organization of knowledge by (Ausubel, 1968)
- Conceptual framework
  - Categorizations defined
- Mathematics textbooks and their importance,
- The concept of Content analysis of mathematics textbooks
- Comparative content analysis of mathematics textbooks
- Importance of Mathematical tasks
- Mathematical tasks and mathematical textbooks
- Summary and Conclusion

2.1 Theoretical Framework

Two theories of learning were relevant to this study. The theory of presentation of knowledge by Bruner (1966) and the theory of organization of knowledge by Ausubel, (1968).

2.1.1 The theory of presentation of knowledge - (Bruner, 1966)

The theory of presentation of knowledge by Bruner (1966) states that virtually any topic can be organized in certain structural ways to suit learners at various levels of education. He identified three modes of structural presentation of knowledge. These are; the enactive, iconic and symbolic. He believes that learner goes through these three successive cognitive developmental stages. The inactive concept is explained as learner doing an activity repeatedly will enhance the learning of the concept. In his iconic structural presentation of knowledge, he explained that learners acquire knowledge through seeing an image or picture of it and symbolic is one in which learner acquire knowledge through the use of language (Dreyfus & Tsamir, 2004). Mathematics has its own language and symbols. Symbols should be well annotated and adequate (Novak & Cañas, 2008). Authors and publishers should present their information in most appropriate and fascinating way to enhance learning. There should be well structured exercises which are sequentially ordered that can enhance repeated practice for all levels of achievers (Zimmerman, 2000; Zohar, and Dori, 2003).

2.1.2 The theory of organization of knowledge (Ausubel, 1968)

According to Ausubel (1968), organization of knowledge is viewed as organized verbal learning. This knowledge is considered to be what learners should know. Such knowledge should be analytically arranged in hierarchical order from simple to complex (Afolabi, 2013). His concept of knowledge refers to super ordinate concepts which serve as the main building block of ideas while the subordinate ideas are those that are closely linked around the subordinate ideas. Where knowledge is properly arranged and linked, learning becomes easier (Cooper, 2004; Green, 2012). Anderberg (2014) is of the view that Mathematics as one of the most hierarchical structured disciplines has it that if knowledge is not organized and presented in a textbook, it can lead students to frustration and loss of interest and consequently a bad attitude to mathematics. However, if knowledge structures are arranged and linked, learning becomes easier (McNeil, 2013; Schank and Abelson, 2013).

2.2 Conceptual Framework

Borko (2004), opined that solving mathematical tasks is of crucial importance and a major theme of doing mathematics. The stages of solving mathematical tasks are as important as the conceptual frameworks (Borko, 2004). As such it was always expedient and convenient to build a framework that was going to help in the identification of tasks based on the steps involved mathematical problem since most designs of a framework in textbooks indicates some relationship to stages of solving mathematical tasks (Liz, Dreyfus, Mason, Tsamir, Watson and Zaslavsky, 2006).A conceptual framework established for the study was based on the categorization of Fan and Zhu (2004) which began with the definition of tasks from the perspective of content analysis. Thus a task is defined as a situation that requires a decision and or an answer (Stein and Smith, 1998). As far as textbook analysis is concerned this definition is more operational. Based on the above definition, the following classes of tasks were defined and used as follows: Single step tasks (SST), Double step tasks (DST) and Multiple step tasks (MST).

2.2.1 Categorization defined

For convenience, this study used the term ―categorization" to name all the divisions, no matter whether the divisions included two or more categories.

2.2.1.1 Categories of exercises in mathematical tasks

The following categories of exercises were identified in the textbooks.

i. **Worked examples (WEX)**

Tasks that have be solved in the textbooks are known as worked examples.

ii. **Exercises (EXX)**

Tasks that have be placed in the textbooks for students to use in practising various concepts after a particular topic have been treated in the textbooks.

iii. **Review Exercises (REEX)**

Tasks that have be placed in the textbooks for students to use in practising various concepts in the textbooks after students have been taken through a number of topics.

2.2.1.2 Categories of steps in mathematical tasks

There are several categories of steps in mathematical tasks (Leiss, Schukajlow, Blum, Messnerand Pekrun, 2010; Schukajlow, Kolter, & Blum, 2015). Using the mathematical tasks analysis implied analyzing tasks according to certain key descriptions. These may include the number of steps used in solving the tasks (Arbaugh, and Brown, 2005; Özgeldi, and Esen, 2010; Schneider, Beeres, Coban, Merz, Schmidt, Stricker, and De Smedt, 2017). This study included the following key descriptions in the analysis of tasks. The mathematical tasks analysed included Single step tasks, Double step tasks and Multiple step tasks.

Single-Step Tasks (SST)

Tasks that can be solved by one direct operation or taken through one direct step before arriving at an answer are defined as single-step tasks. Below is an example of single step task.

Example of Single step task Given that U = {1, 2, 3, 4, 5, 6}, A ={1, 2, 3, 5}, and B = {1, 4, 5, 7, 8}, Find (i) A^{I}(ii) B

Box 1: Example Single Step Task

This task is a task on sets. Task (i) is on intersection of sets whiles tasks (ii) is on the union of sets.

i. Double Step Tasks (DST)

Tasks that can be solved by going through two direct steps are before arriving at an answer are defined as double-step tasks. Below is an example of a double step task.

Example of double step task A man deposited GH ₵6,000 in a savings account at a rate of 16% per annum, calculate the simple interest on her deposit for 3years.

Box 2: Examples Double Step Task

The task above is on simple interest.

ii. Multiple-Step Tasks (MST)

Tasks that can be solved by two direct operations or taken through one direct step are called multiple-step problems. Below is an example of a multiple step task.

Example of multiple step tasks Ten modern poles are said to be used for pillars and the lengths of the poles form an AP. If the 2^{nd} pole is 2m and the 6^{th} is 5m, write down the lengths of the poles in order.

Box 3: Example of Multiple step tasks

The task above is on Arithmetic Progression.

2.3 The Concept of Curriculum

In defining the concept curriculum, both the content and methods must be considered (Hirst, 2010). According to Yee, (2010), in an article entitled ―Designing a mathematics curriculum ―used observation in examining a decade of Pendidikan Matematika Realistik Indonesia (PMRI) as a curriculum material for mainly secondary schools from Grade 7 to Grade 10 since 1971. Some changes observed and identified in the classroom in some of the primary schools in Indonesia indicated that although the mathematics curriculum changed, its syllabus in Indonesia did not change, under the movement of PMRI. In the article, Yee (2010), used his experience gained through his involvement in designing curricula in identifying some deciding factors, practices and the latest trends. Yee in his conclusion stated that ―a curriculum is a good curriculum only when it has been implemented successfully". To be successful, it has to be considered in connection with teachers, students, and many other determining factors (Özkanal & Arikan, 2011).

Johansson (2006), in her doctoral thesis entitled ―Teaching Mathematics with Textbooks: A Classroom and Curricular Perspective" defined the Curriculum as a sequence of learning opportunities. According to her, aspects of the curriculum can be distinguished by focusing on the gap between the educational goals and what the schools actually accomplish. Further distinctions can be made between the enacted curriculums, e.g. what appears in the teacher‘s guide or textbook and the delivered curriculum, i.e. what is taught, and what the students understand. The latter is occasionally referred to as the experienced or received curriculum (Johansson, 2006).

Johansson (2006) further made distinctions between different aspects of the curriculum. The documents or content standards documents are taken as indicators of the intended curriculum and students textbooks are taken as indicators of the potentially implemented curriculum. The implemented curriculum is represented by content goals and duration of content coverage, stated by the teachers. The TIMSS achievement tests were taken as an indicator of the attained curriculum. According to Özgeldi (2012), curriculum strategies constructed by the Trends in International Mathematics and Science Study (TIMSS) conducted in 1995, 1999, and 2003 brought out three main steps. These included; intended, implemented, and attained curriculum.

The Intended curriculum consisted of and political aims for education whiles the implemented curriculum was about teacher and classroom activities and the attained curriculum reflects the students‘ knowledge which is as the result of classroom activities (Johansson, 2003; Johansson, 2006; Richards, 2013). Johansson, 2003was of the view that textbooks are therefore placed between intended and implemented curriculum, and defined as ―potentially implementable" curriculum in this context.

In addition to that, Mullis, Martin, Ruddock, O'Sullivan, Arora, and Erberber (2005). Indicated in the TIMSS report that teachers interpret and adapt the intended curriculum according to their perceptions of the needs, abilities and interests of their students which changes into the implemented curriculum. The implemented curriculum even in highly regulated educational systems is not identical to the intended curriculum (McNeil, 2002).

Studies conducted by Anamuah-Mensah, Mereku and Asabere Ameyaw (2008), on the classroom context or the implemented curriculum in Ghana revealed that the curriculum has the following uniqueness;

- There seem to be rapid movement from one topic to another suggesting that Ghanaian teaching the subjects is rather superficial with students often failing to acquire deeper understanding of any particular topic.
- Teaching is largely by exposition with little opportunities for learners to engage in practical and problem solving activities.
- Lesson plans are based on the teacher‘s activities and not what the learners will be doing during the lesson.
- Teachers spend more of their assigned time in direct instruction and less in settings that allow for professional development and collaboration.
- When compared to high performing countries in the TIMSS report, the mathematics curriculum in Ghana lacks emphasis on teaching approaches that encourage thinking and reasoning skills such as communicating mathematically, solving non-routine problems and deriving proofs.

2.4 Mathematics Textbooks and their Importance

In supporting teaching and learning in many countries, school textbooks have received amplified attention from the international education community over the last decades. In mathematics education, the growth of researchers‘ interest in this area can be observed from the fact that the Third International Mathematics and Science Study (TIMSS) included an analysis of hundreds of textbooks and other curricular materials from about fifty (50) countries (Fan & Zhu, 2007).

Johansson (2003), in her Licentiate thesis entitled ―Textbooks in mathematics education: It was a study of textbooks as a potentially implemented curriculum" was a content analysis of three editions of a mathematics textbook series used in Sweden. The study was conducted to examine the relationship between textbooks and curriculum change in Sweden. In all, three editions of the textbook series were analysed. The study used the operational definition of a textbook as a book designed to provide a solid academic version of an area of study. Johannson (2003) cited that textbooks are regarded as artefacts that translate policy into pedagogy, the link between the intended and the implemented curriculum. The close relation to classroom instruction that Textbooks have makes them play a central role in mathematics education. They identify the topics and order them in a way students should explore them. They also attempt to specify how classroom lessons can be organized with suiTable exercises and activities. The study concluded in her findings that, the objective of mathematics, formulated in the national curriculum are only partially realized (Prince and Felder, 2006).

Kallada (2014), in an article entitled ―The Textbook need and importance" opined that, textbooks are so important that they do not merely supply information and facts, but also allows the student to understand and appreciate concepts and principles and their relevance in their everyday lives; should stimulate reflective thinking and develop problem solving ability among students; the textbooks should present real learning situations which are thought-provoking and stimulating for the students and should not reduce itself as a means of rote learning (Wiggins, 2011).

Kallada (2014), further outlined the usefulness of mathematics textbook to the teacher in the following ways; The textbook is written according to the syllabus and gives the outline of the course helping the teacher to decide about the limits and depth of the content to be presented to students while teaching; it provides insight to the teacher in planning lesson, in selecting the problems to be worked out, the methods of teaching to be adopted and the teaching aids to be used. The logical and psychological structure followed in textbook aids the teacher in presenting the subject matter in a logical and systematic sequence (Bruner, 2009; Richards and Rodgers, 2014). A good text book presents a variety of worked out examples on each topic. This helps the teacher in getting acquainted with different types of problems and the methods to solve them as well as in building the teachers self-confidence while teaching. The textbook saves a lot of time for the teacher as he need not spend time to prepare problems and the solutions as they are readily available in the textbooks. A textbook is an important aid for learning mathematics because it helps the pupils to relate what they are learning to life, fosters the right study attitude among the students since the textbook presents defined and concrete details in scientific and intensive manner which could arouse the students interest and curiosity. Textbooks encourage self-study and independent work among the students. The well graded exercises given after every topic in the textbook helps the teacher in assigning appropriate homework and assignment to the students. (Valverde, Bianchi, Wolfe, Schmidt & Houang, 2002).

Mullis, Martin, Gonzalez, Gregory, Garden, O'Connor, Chrostowski, (2000), in the Trends in International Mathematics and Science Study (1999), mathematics report indicated that textbooks play a central role in shaping the curriculum experiences of mathematics pupils in the five to fourteen age range. This is particularly apparent in the first few years of formal education, since teachers are usually generalists, rather than mathematics specialists. Although students performing at the lower scale could apply basic operations such as addition, subtraction, division and multiplication of numbers, they could not solve non-routine problems involving connections among fractions, decimals, and percentages; various geometric properties and algebraic rules. It was suggested that educators, curriculum developers and policy makers should understand what students know and can do in mathematics and what areas, concepts and topics need more focus and effort. The report suggested three primary factors; the mathematical operation required the difficulty of the numbers or the number system and the nature of problem situations (Duval, 2006).

Johannsson (2006), in her doctoral thesis further discussed the mathematics textbook as an object from different points of view. She outlined some important features and different conceptions of the textbook highlighting the authorization of a textbook and the role of the textbooks as links between the national guidelines and the teaching of mathematics in schools. The empirical study of the use of textbooks in classrooms was made up of two parts; One was mainly quantitative and the other was qualitative. The quantitative part of the classroom study indicated that the textbook influences not only the kind of tasks students are working with during the lessons, but also the examples the teacher gives on the board, what kind of mathematical concepts are introduced and how they are introduced. In substantial parts of the lessons, students are working on an individual basis solving tasks in the textbook.

Hatam, Zeinali, and Hatam (2015), in a study to analyze the content of mathematics textbook of elementary school sixth grade in order to determine the compatibility of the content with the conceptual pattern aims of Iranian‘s national educational curriculum explained that a textbook is in fact the written content of the curriculum. If the content of the textbook is not sufficiently consistent with the aims of the program, it will not be possible to achieve the educational aims. Textbooks reflect a specific and focused image of education. The aim of textbooks is to present content to individuals at a certain age by providing exponential methods. They further explained that a textbook is the focus of attention which serves as a principal tool in projects to modify and expand the educational curricula (Hatam, Zeinali, & Hatam, 2015). Conventionally, a textbook which contains structured subject matter is well-thought-out as a key component between educational media because it guides learners. Text book and training content in focused educational system is in the written form of education. Also, teacher and learner educational experience and activities are organized around the textbooks and needs (Dykman, & Davis, 2008; Marshall & Rossman, 2014).

Mereku (2003), in a study to examine the connection between the teaching methods presented in the curriculum materials and teachers‘ classroom practice reported that the school mathematics curriculum has a powerful influence on classroom practice in a developing country like Ghana, where many teachers with low teaching qualifications do not have enough access to other sources of information and activity for their teaching. The study which used a range of methods such as classroom observation, content and discourse analyses of lessons in mathematics established that, the curriculum materials introduced on the use of discovery teaching methods, although there was rhetoric in the introduction, few learning/teaching activities would encourage the use of such discovery methods in the use of the materials. It was therefore observed that both the curriculum and the teachers who implemented it gave much emphasis to expository teaching methods (Mereku, 2003; Buczynski & Hansen, 2010).

Özgeldi (2005), in a study to compare problem solving approach in Turkish, American, and Singaporean mathematics textbooks for the middle grades opined that textbooks play a critical role as a material in classroom context because they are the major supply for mathematical content and pedagogical approaches. They make possible a connection between the curriculum intentions and classroom activities constructed by the teacher. Therefore, textbooks reflect the curricular aims and objectives and help construct classroom activities and practices (Danielson, 2011; Pepin, Gueudet & Trouche, 2013). Furthermore, textbooks can be discussed as a product of the political and cultural tradition in a country. Thus, to understand the relation between the textbook content and the instructional content which relates to teachers‗ content decisions, some features of textbooks must be clarified (Neuendorf, 2016; Nilsson, 2008). Textbooks direct the choice of teaching topics and enable teachers to organize the learning of subjects and to arrange them in harmony with each topic. Therefore, teachers use textbooks for the mathematics plan and for activities including problems, worked-out examples and assignments for students‗ homework (Johnson, 2002).

Özgeldi (2012), in another study to describe middle school mathematics teachers‗ use of textbooks opined that teachers generally use textbooks as a source of mathematics context and the way of teaching mathematics whiles students usually use them for classroom exercise and homework assignments. Perhaps, every mathematics teacher depends on mathematics textbooks in order to make decisions for routine tasks such as what to teach, how to teach it, and what varieties of exercises to assign to their students‗. Özgeldi (2012) further stressed that textbooks play a key role as a material in classroom context because they are the major supply for mathematical content and pedagogical styles and that textbooks mediate between intended and implemented curriculum as such are significant tools in today‗s classrooms. Özgeldi (2012) was of the view that mathematics textbooks constitute an authoritative part of mathematics learning and teaching serves as mediators between the intentions of the curriculum and classroom instruction as the teachers‗ content decisions are determined by the relation between the textbook content and the instructional content.

2.5 The Concept of Content Analysis

Stemler (2001), cited that Content analysis can be defined as a systematic, replicable method for compressing countless words of text into fewer content categories based on explicit rules of coding. Stemler (2001) further offers a broad definition of content analysis as, "any technique for making implications by objectively and analytically identifying definite characteristics of messages". The technique of content analysis is not restricted to the field of textual analysis, but may be functional to other areas such as coding student drawings or coding of actions observed and captured on tape studies (Krippendorff, 2018).

Scott and Smith (2005), stated that Content analysis allows researchers to examine through large volumes of data with relative ease in a systematic fashion. In order to allow for replication, the procedure can only be applied to data that are durable in nature. Content analysis can be a useful technique for discovery and describing the emphasis of individual, group, institutional, or social attention. This also agrees for inferences to be made which can then be documented using other methods of data collection. Much content analysis research is inspired by the search for techniques to deduce from representative data what would be either too expensive, no longer probable, or too obtrusive by the use of other techniques".

Elo and Kyngas (2008), opined that Content analysis is a research method for making replicable and effective inferences from data to their context, with the purpose of providing knowledge, new perceptions, a representation of facts and a practical guide to action. It is also much more than a simple technique that results in a simplistic narration of data or a counting game. Content analysis accelerates the examination of the textbooks in order to evaluate the presence (or absence) and categories of content area reading strategies in teacher editions of mathematics textbooks. Although Content analysis has a reputable position in research and offers researchers several major benefits, its content-sensitive method and flexibility in terms of research design is paramount, it is extremely well-suited to analysing the sensitive and multifaceted, phenomena. However, an advantage of the method is that large volumes of textual data and different textual sources can be dealt with and used in documenting evidence. (Harwood & Garry, 2003).

According to Elo and Kyngas (2008), Content analysis has been an important way of providing evidence for a phenomenon where the qualitative approach used to be the only way to do this, particularly for complex topics. The disadvantage of content analysis relates to research questions that are ambiguous or too extensive. In addition, extreme interpretation on the part of the researcher poses a threat to successful content analysis. However, Elo and Kyngas states that this applies to all qualitative methods of analysis. Deductive content analysis has been used less than inductive approach. It is likely that in the future, the use of deductive content analysis will become more common, because inductively built strategies or concept systems can be complemented, tested and developed further with the aid of deductive analysis.

Takami (2009), indicated that Content analysis is an unobtrusive, observational research method that is used to systematically evaluate the content of all forms of recorded communications including textbooks. Content analysis provides the methodological structure for examining the textbooks, arriving at thematic patterns, and formulating conclusions for improvement of textbooks (Krippendorff, 2004). Krippendorff (2004), noted that quantification is not an essential criterion of content analysis. He concluded that text is always qualitative to begin with and using numbers is a convenience, but not required for obtaining valid answers to a research question (2004). The aim of content analysis is to achieve a summarized and wide description of the phenomenon and the conclusion of the analysis will be to use concepts or categories to define the phenomenon. The purpose of these concepts or categories will be to build up strategies, conceptual system, conceptual map or categories (Elo, Kääriäinen, Kanste, Pölkki, Utriainen, & Kyngäs, 2014).

Hsieh and Shannon, (2005), stated that the diversity of content analysis has been incomplete to classifying it primarily as a qualitative or a quantitative research method. However, it is possible to attain results by using any approach or both if skills of analysis for one is inadequate (Elo & Kyngas, 2008).

Elo and Kyngas, (2008), explained that a choice must be made between the terms ‗concept' and ‗category' in content analysis based on the purpose of the study. Elo and Kyngas, are of the view that if the purpose of the study is to develop a theory, it is suggested that the term ‗concept' will be used as a proxy for ‗category'. However, if the purpose of the study was to test an existing theory, then the term ‗category' must be used. It is worth stating that since the purpose of this study was to test an existing theory, the researcher used the term ‗category' in describing the process of analysis.

2.5.1 Inductive and deductive content analysis

Content analysis as a research method may be used in either an inductive or deductive way. Lauri and Kyngas (2005), was of the view that the purpose of the study determines whether to use an inductive or deductive approach.

Deductive content analysis was used when the structure of analysis is operationalized on the basis of previous knowledge and the purpose of the study is theory testing or on an earlier theory or strategies and therefore it moves from the general to the specific (Burns & Grove, 2005). Deductive content analysis is often used in cases where the researcher wishes to re-test existing data in a new context (Catanzaro, 1988). This may also involve testing categories, concepts, strategies or hypotheses. If a deductive content analysis is chosen, the next step is to develop a categorization matrix and to code the data according to the categories (Elo, & Kyngäs, 2008).

Krippendorff (2018), states that Inductive content analysis makes use of observation and combines pieces of data into larger whole or general statement. This implies that an approach based on inductive data which moves from the specific to the general. In effect, if there is fragmentation of knowledge about the phenomenon or if there is not enough former knowledge, then inductive content analysis is used. In deductive content analysis, either a structured or unconstrained matrix of analysis can be used, depending on the aim of the study. It is generally based on earlier work such as theories, strategies, mind maps and literature reviews. The categories of the content will be derived from the data in inductive content analysis. After a categorization matrix has been developed, all the data are reviewed for content and coded for correspondence with or exemplification of the identified categories (Elo, & Kyngäs, 2008).

When using an unconstrained matrix, different categories are created within its bounds, following the principles of inductive content analysis. Both the inductive and deductive content analysis have similar preparation, organizing and reporting phases.

2.5.2 Content Analysis of Mathematics Textbooks

Content analysis is much more than a simple technique that results in a simplistic narration of data or a counting game (Elo, & Kyngäs, 2008). Content analysis accelerates the examination of the textbooks in order to evaluate the presence (or absence) and categories of content area reading strategies in teacher editions of mathematics textbooks (Elo, and Kyngäs, 2008). Johansson (2005), reports from a study of textbooks as a possible link between educational goals and classroom activities as the potentially implemented curriculum. The purpose of the study was to make inputs to the discussion about the role of textbooks in mathematics education. The study showed that textbooks identify the topics and order them in a way students should explore them. They also specify how classroom lessons can be structured with appropriate activities and exercises. Hence, textbooks are designed for the purpose to help teachers to organize their teaching.

According to Elo and Kyngas, Content analysis has been an important way of providing evidence for a phenomenon where the qualitative approach used to be the only way to do this, particularly for complex topics. The disadvantage of content analysis relates to research questions that are ambiguous or too extensive. In addition, extreme interpretation on the part of the researcher poses a threat to successful content analysis. However, Elo and Kyngas stated that this applies to all qualitative methods of analysis. In nursing studies, deductive content analysis has been used less than inductive approach. It is likely that in the future, the use of deductive content analysis will become more common, because inductively built models or concept systems can be complemented, tested and developed further with the aid of deductive analysis (Li, 2000). Namey, Guestand & Thairu (2008), stated that during the past few decades, qualitative research has greatly benefited from theoretical and methodological developments in data analysis. Analyses typically fall into one of two categories: content and thematic. In content analysis, the researcher evaluates the frequency and saliency of particular words or phrases in a body of original text data in order to identify. Data collected from the content analysis can be reduced to smaller volumes. According to Johannsson (2003) as cited in Afolabi (2014), the most common type of existing studies on content analysis on mathematics textbooks are in three folds. These are; the study of the structure and content of the textbook; Content analysis of the mathematics textbooks; and studies on the use of mathematics textbooks. On the study of the structure and content of the textbook (Li, 2000). Johansson (2003) stated that the structure of most mathematics textbooks is exposition –examples –exercises' strategies. This is known as ―3es" according to Afolabi, (2014); In addition to that, Johansson (2003) as cited in Afolabi (2014) identified three different types of Mathematics textbook content analysis: First of all, mathematics textbooks were distinguished according to their countries (such as Third International Mathematics and Science Studies- TIMSS (1994/95).

Secondly, Mathematics concepts examined in Restricted Areas of study such as the work of Özgeldi (2005) and thirdly the supportive nature of the textbooks in the direction of the goals and objectives of Mathematics education (e.g. works of Chandler and Brosnan (1995)). Afolabi (2014), was of the view that, the work of Johanson (2003) also brought out a fourth type of Mathematics textbook content analysis. This was Content analysis of a series of Mathematics textbooks over a trend of time. The study which was based on the three different curriculum reforms over twenty-seven (27) years in Sweden, brought about a series of Mathematics textbooks been reformed. The reforms of the curriculum was then compared to discover the variations in the series of the textbooks, by using ten characterizing features (ten blocks) among those already mentioned above. She found out that; the books progressively increased in pages and not much in variation in number of exercises and in word problems. The books were comparable and old ones could still be used.

Prasad (2008), however noted that inferences from content analysis are about the attributes of the messages in the texts, whether they are the senders‘ message, the message itself, or the audience of the message. Content analysis is extremely well-suited to analyzing the sensitive and multifaceted, phenomena. An advantage of the method is that large volumes of textual data and different textual sources can be dealt with and used in documenting evidence. Li (2000) concluded that the subject of content analysis of mathematics textbooks is of very essential educational significance. The researcher observed that different methods were used in all the studies stated in the review which were limited to the researchers‘ capabilities and resources.

2.5.3 Comparative content analysis

Comparative content analysis is an item by item comparison of two or more comparable alternatives, processes, products, qualifications, sets of data or systems presented to detect the emerging trends in a particular field of study. Comparative content analysis is important because it is aimed at achieving a summarized and wide description of the phenomenon in two textbooks or articles and drawing further conclusion of the analysis that will make use of concepts or categories to define the phenomenon. The purpose of these concepts or categories will be to build up a model, conceptual system, conceptual map or categories for further clarifications. In this study, comparative content analysis of two Ghanaian mathematics textbooks was done.

Erbas, Alacaci, and Bulut, (2012), in a Comparative study of Mathematics Textbooks from Turkey, Singapore, and the United States of America had the purpose of the study to compare 6th grade Turkish, Singapore and American mathematics textbooks in terms of certain features of textbook design. Textbooks were compared based on their visual design, text density, internal organization, weights of curriculum strands, topics covered, and content presentation. The results revealed varied assumptions for student learning and choices of design. Singapore books reflected simple features of text density and enriched use of visual elements, fewer number of topics, and an easier inner organization to follow. American books were mainly designed as reference books. Turkish books reflected a measured middle way between the two and reflected a design that valued active student learning. However, Turkish books could use ideas to improve visual design and presentation of certain topics.

Sood and Jitendra (2007), in a study compared number sense instruction in three first-grade traditional mathematics textbooks and one reform-based textbook (*Everyday Mathematics* [EM]). Textbooks were evaluated with regard to their adherence to principles of effective instruction (e.g., big ideas, conspicuous instruction). The results indicated that traditional textbooks included more opportunities for number relationship tasks than did EM; in contrast, EM emphasized more real-world connections than did traditional textbooks. However, EM did better than traditional textbooks in (a) promoting relational understanding and (b) integrating spatial relationship tasks with other more complex skills. Whereas instruction was more direct and explicit and feedback was more common in traditional textbooks than it was in EM, there were differences among traditional textbooks with respect to these two criteria. Although EM excelled in scaffolding instruction by devoting more lessons to concrete and semiconcrete activities, traditional textbooks provided more opportunities for engaging in all three representations. However, EM emphasized a variety of models to develop number sense concepts, a concrete or semi-concrete, to symbolic representational sequence, and hands-on activities using real-world objects to enhance learner engagement. Finally, even though traditional textbooks excelled over EM in providing more opportunities to practice number sense skills, this finding may be an artifact of the worksheet format employed in traditional textbooks. At the same time, adequate distribution of review in subsequent lessons was evident in EM and in only one of the traditional textbooks.

Sağlam, and Alacacı, (2012), in a comparative study to compare the contents of the chapters on quadratics in three mathematics textbooks selected from Turkey, Singapore, and the International Baccalaureate Diploma Program (IBDP). The purpose of this study was to analyze and compare the contents of the chapters on quadratics in three mathematics textbooks selected from Turkey, Singapore, and the International Baccalaureate Diploma Program (IBDP) through content analysis. The analysis of mathematical content showed that the three textbooks have different approaches and priorities in terms of the positions of chapters and weights of the quadratics units, and the time allocated to them within the respective curricular programs. It was also found that the Turkish textbook covers a greater number of learning outcomes targeted for quadratics among the three mathematics syllabi, showing a detailed treatment of the topic compared to the other two textbooks.

Fan and Zhu (2006), in a study compared how selected mathematics textbooks from Mainland China and the United States at the lower secondary grade level represent various types of problems for classroom teaching and learning. The examination of problems was carried out based on the classifications of problem types established in the study, including routine problems versus non-routine problems, open-ended problems versus close-ended problems, traditional problems versus non-traditional problems, and application problems versus non application problems, single step tasks versus multiple step tasks.

In their study to examine the performance of eighth graders in mathematics and science as well as the appropriate factors that resulted in the performance of the six African countries (Ghana, Egypt, Tunisia, Morocco, Botswana and South Africa) that took part in the international assessment programme in science and mathematics, known as TIMSS, 2003, Anamuah-Mensah and Mereku, (2005), indicated from the analyses of data that although there was significantly better performance by countries in the north of Africa than those in sub-Saharan Africa, the general performance of the African countries in TIMSS, 2003 was very poor on items that involved solving non routine problems and reasoning. Contextual examination for learning science and mathematics revealed that several weaknesses in the curricula of the participating African countries were identified. In addition to that, extensive proportion of the content assessed in the TIMSS was not introduced to majority of the students for them to have the opportunity to learn even though these were part of their intended curricula.

Although several studies including the TIMSS have established that teaching aids such as textbooks and other resources for exercises, remain important documents for use in classrooms in today‘s classrooms. The researchers observed that the Ghanaian curriculum textbook experienced by the students, who took part in the TIMSS-2003, placed excessive importance on number work and knowledge of facts and procedures. The researchers further argued from their analyses that the poor performance of the

Ghanaian students in the TIMSS-2003, was largely a true reflection of the nature of school mathematics curriculum that students had experienced in Ghana in the last two decades which was the outcome of the content of the textbooks and examinations which continue to be dominated by commonalities of ―new math". It was further indicated that Ghana is the only nation in the world today that has not moved its mathematics curriculum away from positions adopted in the 1960s. It was attributed mainly to the lack of correspondence between what is emphasized in the mathematics curriculum in Ghana and what is presently valued worldwide in school mathematics which the TIMSS was intended to measure.

In a study to compare problem solving approach in Turkish, American, and Singaporean mathematics textbooks for the middle grades, Özgeldi, (2005) opined that textbooks play an important role as a material in classroom context because they are the major supply for mathematical content and pedagogical approaches creating possible connection between the curriculum intentions and classroom activities constructed by the teacher. Therefore, textbooks reflect the curricular aims and objectives and help construct classroom activities and practices. Furthermore, textbooks can be discussed as an outcome of the political and cultural tradition in a country.

Another comparative study by Yang and Lin, (2015), to examine the differences of linear systems between Finnish and Taiwanese Textbooks, the researchers employed the content analysis method to examine five specific areas of the textbook; These areas were the teaching sequence, application types, representation forms, response types and level of cognitive demand. The major difference between the Finnish and Taiwanese textbooks was that the Finnish textbooks introduced the topic of linear systems using a graphical approach, while the Taiwanese textbooks used an algebraic approach. The outcome of the research also indicated that the Taiwanese textbooks had fewer but more thought-provoking problems requiring a higher level of cognitive demand than the Finnish textbooks; the Finnish textbooks had more authentic application problems, and even more problems were displayed in visual forms. In addition, the Taiwanese textbooks had more open-ended problems, particularly problems testing students to explore or explain, whereas the Finnish textbooks did not have exploration problems.

Fan and Zhu, (2007), in a comparative study to examine how some selected school mathematics textbooks represent problem-solving procedures at the lower secondary grade level in China, Singapore and USA indicated that the majority of the solved problems were routine and traditional. Thus, most of these problems could be solved in a straightforward way, without using specific problem-solving heuristics. The analysis of problem-solving procedures was carried out in two layers of general strategies. These were Pólya‘s four-stage problem-solving model and some specific strategies. Both similarities and differences in the representation of problem-solving procedures in the textbooks across the three countries revealed that the three textbook series displayed strengths in the representation of problem-solving procedures, in terms of both modeling various problem-solving steps and using a wide range of specific heuristics. However, there were also weaknesses in all the textbook series in certain aspects, some of which were common across the countries while some were unique to one or two countries. The study revealed that there exists considerable gaps between national syllabuses, curriculum standards and textbooks developed following these documents.

It was revealed that the Singapore textbooks failed to demonstrate the heuristic _thinking of a related problem,' which was required in Singapore mathematics syllabus. The study further indicated that there was also little illustration of the stage of _looking back' in problem-solving procedures in the Singapore series, although the syllabus placed much importance on developing students' ability in metacognition.

It is worth stating that there are numerous unanswered issues about the instruction and assessment of problem-solving. There is the need to seek answers to questions concerning what actually takes place in problem-centered classrooms. Since problem solving contributes to the use of different solutions and development of strategies, students are encouraged after problem solving process.

2.6 Importance of Mathematical Tasks

A task in problem solving can only be defined with an understanding of what a problem is. According to Fan and Zhu (2000), "a task is defined generally as a situation in which a goal is to be attained and a direct route to the goal is blocked".

The definition stresses the point that the solution to the task is not readily available in problem solving. Fan and Zhu (2006), again explained that a mathematical task is a situation that requires a decision and/or an answer, no matter if the solution is readily available or not to the potential problem solver. A task can be said to be a task for which the person confronting it wants or needs to find a solution or the person has no readily available procedure for finding the solution or the person must make an attempt to find a solution.

Ersoy (2016), in a study to determine problem solving skills of primary mathematics pre-service teachers in mathematics teaching carried out using the qualitative method with the third year students studying in the department of elementary mathematics, taught the students for 13 weeks (39 hours) after they were introduced to four stage problem solving model in order to improve their problem solving skills. The study was a case study in which Ersoy was of the view that focusing on problem solving in lessons develops the students' high level thinking causing students to perform self-learning in mathematics lessons with problem solving processes. Problem solving is an integral part of all mathematics learning and so it should not be isolated from mathematics program (NCTM, 2000).

Ersoy (2016) cited Polya (1945) describing the process of problem solving at four stages. These include understanding the problem, determining the strategy, implementing the selected strategy and assessment. At the stage of understanding the problem, the student is expected to state what he understood from the problem and to determine what are the given and unknown in the problem and also to suggest clearly the condition of the problem. At the stage where the strategy of problem solving is to be determined, the student is expected to determine which steps to follow in order to reach the desired result. These include calculation, drawing, etc. The teacher, in this process, can promote the use of different problem solving strategies by writing out all the strategies on the board which can enable the student to choose the suitable strategy. The following stage includes the application of selected strategy by the student. At the stage of application the selected strategy, the solution should be checked step by step. At the stage of assessment, on the other hand, the student should control whether the solution he made is right and meaningful. During the process of control, it must be fully put forth what has been done and where it has been done.

In the study, by Posamentier and Krulik (1998), two problems and semi-structured interview form were developed by the researcher and used as a data collection tool. In the analysis of the data, solutions of the problems applied were examined considering (1945) problem solving steps. The findings of the study indicated that the subject of problem solving has a positive effect on the development of mathematics teachers�टproblem solving skills and that mathematics concepts and procedures must be taught through problem solving.

Fan and Zhu (2007), in a study to examine how some selected school mathematics textbooks represent problem-solving procedures at the lower secondary grade level in China, Singapore and USA indicated that the majority of the solved problems were routine and traditional. Thus most of these problems could be solved in a straightforward way, without using specific problem-solving heuristics. The analysis of problem-solving procedures was carried out in two layers of general strategies. These were Pólya‘s four-stage problem-solving strategies and some specific strategies. Both similarities and differences in the representation of problem-solving procedures in the textbooks across the three countries were revealed and compared.

In all, the three textbook series displayed strengths in the representation of problem-solving procedures, in terms of both strategizing various problem-solving steps and using a wide range of specific heuristics. However, there were also weaknesses in all the textbook series in certain aspects, some of which were common across the countries while some were unique to one or two countries. The study revealed that there exist considerable gaps between national syllabuses, curriculum standards and textbooks developed following these documents. It was revealed that the Singapore textbooks failed to demonstrate the heuristic ‗thinking of a related problem,‘ which was required in Singapore mathematics syllabus. The study further indicated that there was also little illustration of the stage of _looking back' in problem-solving procedures in the Singapore series, although the syllabus placed much importance on developing students' ability in metacognition.

It is worth stating that there are numerous unanswered issues about the instruction and assessment of problem-solving. There is the need to seek answers to questions concerning what actually takes place in problem-centered classrooms. Since problem solving contributes to the use of different solutions and development of strategies, students are encouraged after problem solving process.

2.7 Importance of Mathematical tasks in the Mathematics Curriculum

Grootenboer (2009), observed that rich mathematical tasks will have academic and intellectual quality because they facilitate deep mathematical learning. These sorts of tasks require students to work mathematically by inviting them to rationalise and make conjectures, to hypothesize and then test their ideas, and to justify their findings and represent them in meaningful ways. In short, Grootenboer (2009) explained that these are the activities of mathematicians that are central to mathematical practice and as such are essential for a task to be deemed appropriate for mathematical pedagogy.

Arbaugh and Brown (2005), in a study investigated a strategy for engaging high school mathematics teachers in an *initial* examination of their teaching in a way that is non-threatening and at the same time effectively supports the development of teachers' pedagogical content. Based on the work undertaken with middle school mathematics teachers, were engaged a group of seven high school mathematics teachers in learning about the Levels of cognitive demand, a set of criteria that was used to examine mathematical tasks critically. The study made use of qualitative methods of data collection and analysis, which sought to understand how focusing the teachers on critically examining mathematical tasks influenced their thinking about the nature of mathematical tasks as well as their choice of tasks to use in their classrooms. The research indicated that the teachers showed growth in the ways that they considered tasks and that some of the teachers changed their patterns of task choice. Furthermore, the study provided a new research instrument for measuring teachers' growth in pedagogical content knowledge.

Asiedu-Agyem (2014) outlined several reasons why teaching mathematics through solving mathematical tasks is important. He is of the view that primarily, presenting a task and developing the skills needed to solve that task is more motivational than teaching the skills without a context which enhances logical reasoning, helping students to be able to decide what rule, if any, a situation requires, or if necessary to develop their own rules in a situation where an existing rule cannot be directly applied. This helps in developing the steps in mathematical tasks.

Solving mathematical tasks further allows the whole person to develop by experiencing the full range of emotions associated with various stages of the solution process. Thus, students are challenged to think about what mathematics they know and how to use them when students of mathematics are taught through the steps in mathematical tasks. Furthermore, teaching mathematics through problem-solving approach is valuable based on its aesthetic form (Asiedu-Agyem, 2014). This allows students to experience a range of emotions associated with various steps in the solution process. Mathematicians who successfully solve problems are of the view that the experience of having solved problems successfully contributes to the appreciation for the 'power and beauty of mathematics' (NCTM, 2000) as well as the willingness or even having a greater desire to engage with a task for a length of time which causes the task to cease being a 'puzzle' and allows it to become a problem.

Taplin, (2014) explains that solving mathematical tasks encourages students to simply engage in problem solving by providing opportunities to discuss, share ideas and visualize and then convince an observer of a strategy. Moreover, solving mathematical tasks brings about cooperative and collaborative learning emphasizing on group work in which increases enjoyment, learning and social skills such as communication making students more willing to solve challenging problems as a group and are often able to explain things to each other in ways that make more sense than the teacher‘s original explanation. Students are more willing to ask questions and take risks in small groups rather than being passive and they always want to invest in mathematics discourse (Abedi & Lord, 2001). Members of each group support and relied on each other to achieve an agreed-upon goal. More interactive and team-building skills are developed through questioning making the classroom an excellent place for insights and solutions, influencing learning in a positive way, expanding the range of details, bringing about multiplicity of students‘ perspectives and understanding as well as experiencing an increase in opportunities for problem solving (Abedi & Lord, 2001).

Taplin (2014) further outlined that new ideas are constructed based on personal and past experiences are shared making understanding so relative to the principles of constructivism which are naturally applied. Learners also investigate significant, real-world problems through good explorative questions, and as a result these groups can easily be used for an inquiry-based approach. This enables all students have the opportunity to learn within their zone of proximal development when classrooms achieve this balance.

Leikin (2014), in a study, analyzed multiple solution tasks (MSTs) and mathematical investigations (MIs) and the interplay between them. He argued that MSTs and MIs are effective instructional tools for balancing the level of mathematical challenge in the mathematics classroom and, thus, for realizing students' mathematical potential at different levels. Additionally, these tasks lead to the development of mathematical knowledge, mental flexibility and critical thinking. They also deepened mathematical understanding since they promote the design of mathematical connections of different types. Leikin (2014), presented several examples of MSTs and MIs and analyze these mathematical tasks from the perspective of their conventionality, the mathematical connections embedded in the tasks and their potential for developing learners' mathematical creativity. MIs was presented in this paper in connection to MSTs. Particular emphasis was placed on analyzing the relationships between production of multiple solutions, mathematical investigations, and varying levels of mathematical challenge.

2.8 Conclusion

In conclusion, although the more traditional approach to teaching mathematics sees the student as an empty vessel that has to be filled. Students also see a reason for learning mathematics hence the question of why are we learning this for? Where are we going to apply this concept will be answered and allow student to become more deeply involved in learning it.

Incorporating mathematical tasks meaningfully in the mathematics curriculum helps students' ability to give intellectual challenges that can enhance students' mathematical development. Such tasks foster students' ability to reason, promote their conceptual understanding, communicate mathematically and capture their interests and curiosity. Though the teaching of solving mathematics tasks is time consuming, it is to be noted that solving mathematical tasks helps students to think critically, being flexible and creative ensuring that lots of work is done.

Solving mathematical tasks are mostly open-ended, thus; they do not provide factual answers bringing about a certain amount of limitations on students guessing answers which causes them to think deeply before tackling the problems. This means that students are given the opportunity to explore their ideas so as to extend their creative abilities. This helps in identifying the relevance and importance of ideas by reflecting on the justification of one's own beliefs and values. Currently much credence is being given to a theory of learning called constructivism. In constructivism, knowledge construction is emphasized rather than knowledge reproduction. Knowledge construction helps the learners to remember what they have learned. This proposes that students construct their own knowledge through their experience rather than absorbing what they are told. The constructivist views the student as an active learner whiles the traditional approach to teaching mathematics sees the student as an empty vessel that has to be filled. It is worth stating that if mathematical tasks in the Ghanaian mathematics textbooks are of the form that demands the challenging tasks, then mathematics teaching will enable students to become active and not passive learners.

2.9 Summary

This chapter of the study concentrated on the review of related literature. It dealt with the conceptual framework, the concept of curriculum, importance of mathematics textbooks, content analysis of mathematics textbooks, Mathematics tasks and Problem solving. In the conceptual framework, the tasks were categorized into Single step tasks; Double step tasks; and multiple step tasks.

In addition to that, problem solving strategies were used in analyzing the worked examples found in the textbooks. The literature looked at the concept of curriculum, the importance of Mathematics textbooks, content analysis of mathematics textbooks and finally what mathematics tasks and Problem solving are. The problem solving procedures indicated a well described goal of which the problem solver desires to solve.

A challenging process that the problem solver has not yet encountered and an awareness of the problem. It is worth noting that students are not able to develop their own problem solving strategies and skills when tasks in textbooks are represented in a rule based form. However, the integration of problem solving strategies become important in problem solving when problems involve genuine and reliable tasks.

To a certain extent, textbooks give an interpretation of mathematics to teachers, students and parents and have a prominent position as far as curriculum reforms are concerned and are considered as an important tool for the implementation of a new curriculum in many countries including Ghana.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.0 Overview

This chapter describes the research process that informed the study. The chapter was articulated in terms of the research design, study population, sample and sampling techniques, Content analysis, the process of content analysis, the process of textbook selection, processes of inductive and deductive content analysis, phases of the content analysis process (preparation phase, organizing phase and reporting phase), units of analysis, categorization of contents of the textbooks, and research instruments. These were followed by reliability and validity, administration of instrument and intervention, data collection procedure, content analysis of the Ghanaian SHS mathematics textbooks and summary of the chapter.

3.1 Research Design

Flick (2009), defines Research designs as the means for attaining the goals of the research. As such it is the realization of the research design which is the result of decisions reached in the research process (Flick, 2009). In this study, the research design used was mixed method design. However, the study used largely descriptive statistics. Mixed methods research design is the type of research design in which a researcher or team of researchers combine elements of qualitative and quantitative research approaches (e.g. use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purpose of breadth and depth of understanding and corroboration (Harrison and Reilly, 2011). Using a mixed-method design is considered to be appropriate to gain a more comprehensive picture of the phenomena.

In this design although there are different types of mixed methods, Sequential explanatory design is a design that involves the collection and analysis of quantitative data followed by the collection and analysis of qualitative data. The priority is given to the quantitative data and the findings are integrated during the interpretation phase of the study. To help explain, interpret or contextualize quantitative findings. To examine in more detail unexpected results from a quantitative study. Sequential explanatory asy to implement because the steps fall into clear separate stages. The design is easy to describe and the results easy to report (Flick, 2009).

In this study, Sequential explanatory design was used in order to find out the categories of mathematical task in the senior high school core mathematics textbooks. The observation checklist was used in finding out whether there were different categories of mathematical tasks in ACM and the ECM textbooks. The study used a combination of both quantitative and qualitative methodology to explain or describe the situation which gave an in-depth analysis of one or more events, settings, programs, social groups, communities, individuals, or other bounded systems.

3.2 Research Method

The research method was Content analysis. According to Elo and Kyngas (2008), Content analysis as a research method is a systematic and objective means of describing and quantifying phenomena where by written, verbal or visual communication messages are analyzed. Content analysis allowed the researcher to test theoretical issues to enhance understanding of the data. In this study, Content analysis was used to facilitate the examination of the contents of the two SHS mathematics textbooks in order to evaluate the presence or absence of the categories of mathematics content tasks in the mathematics textbooks at the SHS level.

LaBelle (2010), is of the view that, content analysis is used as a research method because it most effectively reviews the frequency and variation of types of mathematical task, problem solving procedures and strategies. LaBelle (2010), indicated that ―Content analysis is a research method that uses a set of procedures to make valid inferences from text"(p. 12). As simple as that may sound, it must be noted that content analysis enjoys a wide range of techniques and applications in the social sciences. Content analysis is a more quantitative approach, while others view it as necessarily qualitative due to its tendency to use induction in drawing conclusions and recommendations for further research. Krippendorff (2004) noted that quantification is not a defining criterion of content analysis and that text is always qualitative to begin with and using numbers is a convenience, but not required for obtaining valid answers to a research question. In this study, quantitative data was used only as a means of coding the data, recording frequency of various categories of mathematical tasks in the textbooks whiles qualitative analysis was used to examine and report the results to further explore the research questions.

3.3 Study Population, Sample and Sampling Technique

There are several mathematics textbooks used by teachers and students in the teaching and learning of mathematics at the SHS level in Ghana. These include both public and private textbooks namely Enriched mathematics textbook series, AKIOLA series, Approachers' series and the Ultimate guide for SHS 1, 2, 3. However, in this study, the researcher selected two Ghanaian SHS mathematics textbook series classically used in teaching and learning mathematics by teachers and students in the SHS. These textbooks were selected based on their relevance in the study of mathematics.

Thus the ECM textbooks for SHS 1, 2, 3 and the ACM textbooks were analyzed. These textbooks were selected based on the fact that these textbooks are commonly used in the teaching and learning of mathematics by both students and teachers. Additionally, Convenience sampling was used in this study to sample eight (8) core mathematics teachers from two SHS.

Convenience and purposive sampling were employed due to inadequate logistics, financial constraints and ease of accessibility. In studies of this nature, sampling is usually, convenient/purposeful, and small (Apawu, 2009; Amoah, 2010). According to Saumure and Given (2008), a convenience sample is one in which a group of participants are selected because of availability and the researcher is of the view that the eight SHS core mathematics teachers were sampled from two senior high schools in the Akuapem-North Municipality based on their availability and accessibility to the researcher.

3.4 Research Instruments

Considering the nature of research questions examined, the instruments used for the collection of data were a content analysis guide and codebook (see Appendix A), an observational checklist (see Appendix H and Appendix I), a task analysis codebook (see Appendix C) and an interview guide (see Appendix B).

Content analysis guide and codebook (see Appendix A), Observation checklists for categories of exercises in mathematical tasks (see Appendix H), Observation checklists for categories of steps in mathematical tasks (see Appendix I), interview guide (see Appendix B and Appendix F) and a task analysis codebook (see Appendix C) were used. The content analysis guide and codebook was also used to collect data from the textbooks. Eight core mathematics teachers from two senior high schools were also made to answer some interview questions. On the categories of steps in mathematical tasks, data were collected by observing, coding and counting using the Content analysis guide (see Appendix A) and codebook (see Appendix C) and the task analysis codebook (see Appendix C). On the categories of steps in mathematical tasks, data was collected by observing, coding and counting. The Content analysis guide and codebook (see Appendix A) and the task analysis codebook (see Appendix C) were used in collecting data from the ACM textbook and the ECM textbooks. On the differences, data from research question 1 and 2 were compared.

The interview guide was given to some MPhil Mathematics Education students who read through the observation checklist and interview guide after which suggestions were made and incorporated. The interview guide was further cross-checked and corrections made by the researcher‘s supervisor after which they were administered. The advantage of the written interview is that the interviewer is in control of the process of obtaining information from the interviewee, but is free to follow new leads as they arise (Amoah, 2010).

3.5 The process of Content Analysis

3.5.1 The process of selection of textbooks

Krippendorff (2004), pointed out that it was necessary to use a sampling plan to ensure that the textual units sampled does not bias the answers to the research questions. Purposive sampling was used in selecting two of the textbooks for this study. This reduced the number of textbooks that were needed to be considered for the analysis. The researcher used purposive sampling for the selection of textbooks by looking at all the mathematics textbooks for teaching and learning of mathematics and narrowing the sample down to two major textbook series that had the needed characteristics. The SHS content materials that were analyzed were two of the Ghanaian SHS mathematics textbooks namely the ACM by Asiedu (2016) and ECM textbooks by Oppong, Ansong and Klagba (2009). The purpose was to find out the categorize of exercises and the categories of steps in mathematical tasks in the textbooks and whether there were differences in the two textbooks in terms of the categories of exercises and categories of steps in mathematical tasks.

To do this, a content analysis guide, an observation checklist, an interview guide for teachers were designed and used for the analysis. The SHS mathematics textbook series analyzed were the ACM textbooks 1, 2 and 3 and the ECM textbooks for SHS 1, 2 and 3. The purpose was to find out the categories of exercises and the categories of mathematical tasks in terms of the number of steps used in the solving questions in the two textbooks. To do this, a conceptual framework was established.

3.5.2 Phases of the process of content analysis

There were three main phases of the content analysis process. These were; preparation, organizing and reporting phases.

3.5.2.1 Preparation phase of content analysis

Content analysis as a research method may be used in either an inductive or deductive way (Elo and Kyngas, 2008). Lauri and Kyngas (2005), was of the view that the purpose of the study determines whether to use an inductive or deductive approach. However, this study made use of the Deductive approach. Elo and Kyngas (2008) opine that the deductive approach in content analysis is useful if the general aim was to test a previous theory in a different situation or to compare categories at different time periods. In this study, the preparation phase started by deciding on what to analyze, in what detail, coding protocols to be used and the sampling considerations after which the selection of the unit of analysis were also identified. Graneheim and Lundman (2004) pointed out that the most suitable unit of analysis is whole interviews or observational protocols that are large enough to be considered as a whole and small enough to be kept in mind as a context for meaning unit during the analysis process. The content analysis was started by deciding on whether to analyze only the manifest content or analyze both the manifest and the latent content as well. The aim with latent content is also to notice silence, sighs, laughter as well as posture (Burns and Grove 2005). According to Robson (1993), researchers are guided by the aim and research question of the study in choosing the contents they analyze. In this study, only the manifest content which was specifically the mathematical tasks was analyzed. This was to ensure that key features of the textbook content were classified into much smaller content categories. The preparation phase also involved the preparation of interview guide, content analysis guides, two observational checklists two coding protocols and a task analysis codebook. The coding protocols that were prepared were for the categories of exercises in mathematical tasks (see Appendix H) and that of the categories of steps in mathematical tasks (see Appendix I). These helped in identifying each mathematical task in terms of the exercises. These categories were Worked examples (WEX), general exercises (EXX) and Review exercises (REEX). The various tasks were coded in the textbooks after which the various codes were counted in their categories and their frequencies recorded.

The second sets of categories were according to the number of steps used in solving the tasks. The coding protocol for the categories of steps in mathematical tasks (see Appendix E) was prepared. These helped in identifying each mathematical task in terms of the steps in mathematical tasks. These were Single step tasks (SST), Double step tasks (DST), and Multiple step tasks (MST).

3.5.2.2 Organizing phase of content analysis

The second phase of the content analysis process was the organizing phase. In the organizing phase, the researcher coded the textbooks and collected from the margins on to coding sheets and categorized freely all tasks in the textbooks. This was known as open coding. After this open coding, the lists of categories were grouped. The grouping of data helped in reducing the number of categories by collapsing those that were similar or dissimilar into broader higher order categories. Creating categories means classifying data as ‗belonging' to a particular group and this implies a comparison between these data and other observations that do not belong to the same category. The purpose of creating categories was to provide a means of describing the phenomenon, to increase understanding and to generate knowledge.

When formulating categories by Deductive content analysis, the researcher came to a decision, through interpretation, as to which things to put in the same category. The next stage in the organizing phase is Abstraction. Abstraction means formulating a general description of the research topic through generating categories (Elo and Kyngas, 2008). Each category was examined and named using content-characteristic words. Subcategories with similar events and incidents were then grouped together as categories and categories were grouped as main categories. All the coded tasks were then counted according to the categories of exercises in mathematical tasks. These categories were Worked examples (WEX), general exercises (EXX) and Review exercises (REEX). The second sets of categories were according to the number of steps used in solving the tasks. These were Single step tasks (SST), Double step tasks (DST), and the Multiple step tasks (MST).

Categories of exercises in mathematical tasks

Each of the mathematical tasks was assigned one code based on the categorizations stated in Appendix H. These codes helped in identifying the various exercises tasks. All the tasks were then counted according to the categories of exercises in mathematical tasks.

3.5.2.3 Reporting phase of the analysis

The third phase of the content analysis process was the reporting phase. In the reporting phase, the researcher made defensible extrapolations based on the collection of valid and reliable data. To increase the reliability of the study, the researcher demonstrated the link between the results and the data. This helped the researcher in describing the analyzed process in as much detail as possible when reporting the results. Appendices, Tables (see Appendix J and Appendix M) and graphs were used to demonstrate links between the data and results. To facilitate transferability, the researcher gave a clear description of the context, selection and characteristics of participants, data collection and process of analysis. Demonstration was used for the reliability of the findings and interpretations to enable someone else to follow the process and procedures of inquiry.

The differences between the categories of exercises in mathematical tasks and the categories of steps in mathematical tasks in the ACM textbooks and the ECM textbooks were found by establishing the relationship between the two variables. in the ACM textbooks and the ECM textbooks.

3.6 Administration of Instruments

In order to find out the categories of exercises and steps in mathematical tasks in the SHS mathematics textbooks, the researcher prepared a content analysis guide (see Appendix A), observation checklist (see Appendix I) and an interview guide(see Appendix B). The observation checklist was used to determine the categories of exercises used in the textbooks. The researcher afterwards conducted a written interview for the teachers using a set of semi-structured interview questions. Reponses from the interview sessions was analyzed.

The content analysis guide also helped the researcher to categorize the mathematical tasks into the two major categories of tasks (Tasks that are grouped according to exercise and tasks that are grouped according to the number of steps used in solving them.

The following research instruments were used in addressing the research questions.

Research question 1

The Content analysis guide, Content analysis codebook, interview guide, Observational checklists for categories of exercises in mathematical tasks. Data collected was analyzed using qualitative methods such as descriptive statistics (Tables, graphs and percentages)

Research question 2

The Content analysis guides, Tasks analysis codebook, interview guide, Observational checklists for categories of steps in mathematical tasks were used in analyzing the data. Data collected was analyzed using qualitative methods such as Tables, graphs and descriptive statistics.

Research question 3

Data collected from the ACM textbooks and ECM textbooks were compared in Tables and graphs by comparing the exercises in mathematical tasks and the steps in mathematical tasks to find the difference between the ACM textbooks and ECM textbooks 1, 2 and 3.

3.8 Data collection procedure

The study examined, coded and counted all the mathematical tasks in the ACM and ECM textbooks according to categories of exercises in mathematical tasks and the categories of steps in mathematical tasks. The coded mathematical tasks were counted according to categories of exercises in mathematical tasks (Worked examples (WEX), general exercises (EXX) and Review exercises (REEX)) and the categories of steps in mathematical tasks (Single step tasks (SST), Double step tasks (DST), and the Multiple step tasks (MST)) in the ACM and ECM textbooks. The results were analyzed using descriptive statistics such as frequencies, percentages, Tables, charts and graphs. Additionally, to determine the differences between the ACM and ECM textbooks in the categories of exercises in mathematical tasks, data collected was analyzed using descriptive statistics by comparison.

3.9 Summary

The study was a Content analysis research which made use of both qualitative and quantitative research approaches. The study also made use of the deductive approach in content analysis to analyze the ACM and ECM textbooks for SHS in Ghana. The content analysis of the two textbooks was to determine the categories of exercises in mathematical tasks and the categories of steps in the mathematical tasks in the ACM and ECM textbooks. The study made use of content analysis guide, interviews, a task analysis codebook and an observational checklist to examine the categories of tasks in the textbooks after which all the tasks were coded and the data was counted and recorded.

The study further involved eight SHS core mathematics teachers from two SHS in the Akuapem-North Municipality. The mathematics teachers responded to interview items. It was observed that all the multiple step tasks were under the profile dimension of application of knowledge whiles the Single step tasks and Double step tasks were testing knowledge and understanding. This results from the two textbooks emphasized the two profile dimensions of knowledge and understanding (30%) and Application of knowledge (70%) in the mathematics syllabus (CRDD, 2010).

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter focused on the analyses of the results of the data and discussion of the findings. The data was organized and presented using largely descriptive statistics. The results were presented under the following themes:

- Categories of exercises in mathematical tasks
    - Categories of exercises in mathematical tasks presented in the ACM textbooks1, 2 and 3.
    - Categories of exercises in mathematical tasks presented in the ECM textbooks1, 2 and 3.
    - Discussion on Categories of exercises in mathematical tasks presented in the ECM textbooks1, 2 and 3 and ACM textbooks1, 2 and 3.
- Categories of steps in mathematical tasks
    - Categories of steps in mathematical tasks presented in the ACM textbooks 1, 2 and 3.
    - Categories of steps in mathematical tasks presented in the ECM textbooks 1, 2 and 3.
    - Discussion on Categories of steps in mathematical tasks presented in the ECM textbooks1, 2 and 3 and ACM textbooks1, 2 and 3.
- Differences in the Categories of exercises and steps in mathematical tasks in the ACM and ECM textbooks 1, 2 and 3.
    - Discussions on Categories of steps in mathematical tasks in the ACM and ECM textbooks 1, 2 and 3.

- General findings in the ACM and ECM Textbooks 1, 2 and 3
  - General findings in the ACM textbooks 1, 2 and 3.
  - General findings in the ECM textbooks 1, 2 and 3.

4.1 Categories of exercises in Mathematical Tasks

The first research question raised for the study was to find out the categories of mathematical tasks in the ACM textbooks 1, 2 and 3 and the ECM textbooks 1, 2 and 3. To achieve these, all the exercises in the textbooks were examined, coded and counted according to the conceptual framework.

4.1.1 Categories of exercises in mathematical tasks in the ACM textbooks 1, 2 and 3.

In line with the research question one to find out the categories of mathematical tasks in the ACM textbooks 1, 2 and 3, it was observed that the textbook 1, 2 and 3 had three specific exercise areas. These were worked examples (WEX), exercises (EXX) and review exercises (REEX).

Figure 1 shows the chart of the categories of exercises in mathematical tasks in the ACM textbooks 1, 2 and 3. Figure 1 shows the three specific exercise areas in terms of worked examples (WEX), exercises (EXX) and review exercises (REEX).

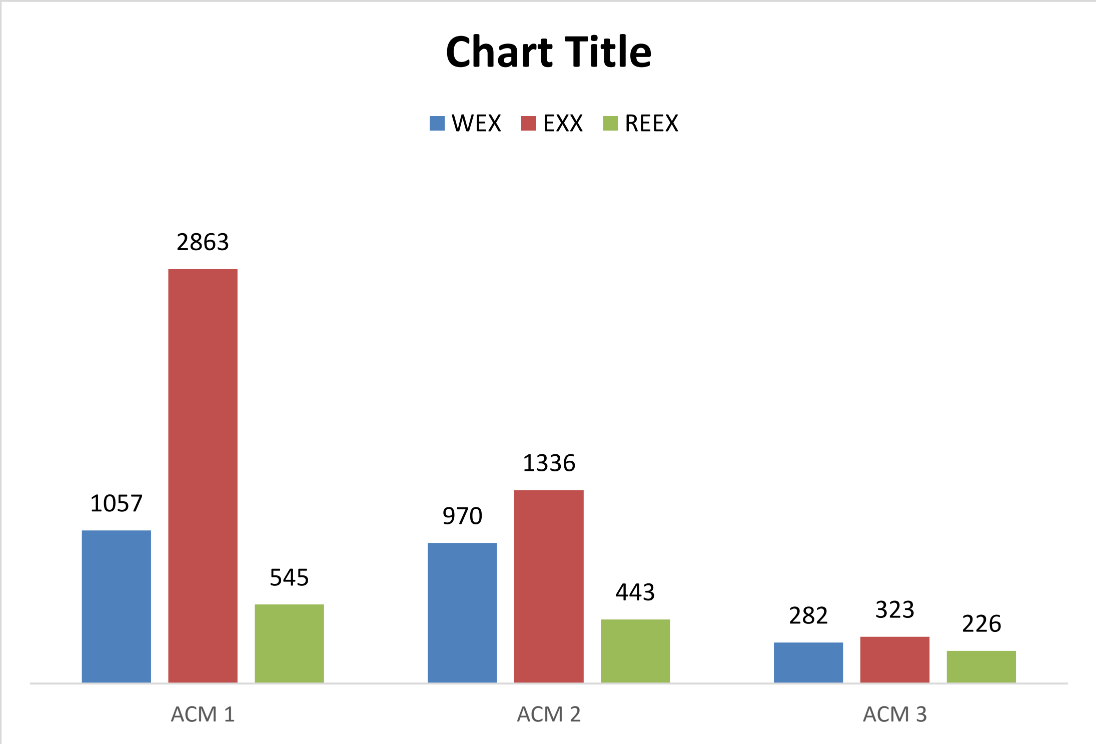

Figure 1: A chart showing the categories of exercises in mathematical task in the ACM textbooks 1, 2 and 3

From Figure 1, it can be seen that the ACM textbook 1 had more categories of exercises in mathematical tasks than ACM 2 and ACM 3. This indicates that the work load of form 1 students was much more than form 2 and 3 students. Additionally, form 1 students entering into form 2 should continue working with ACM 1 so as to help them build a solid foundation for the three year SHS course. Comparing the categories of exercises in mathematical tasks, Figure 1 further indicates that there are more exercises in terms of EXX in ACM 1, ACM 2 and ACM 3 than WEX and REEX.

Figure 2 shows that the categories of exercises in mathematical tasks in the ACM textbooks 1, 2 and 3.

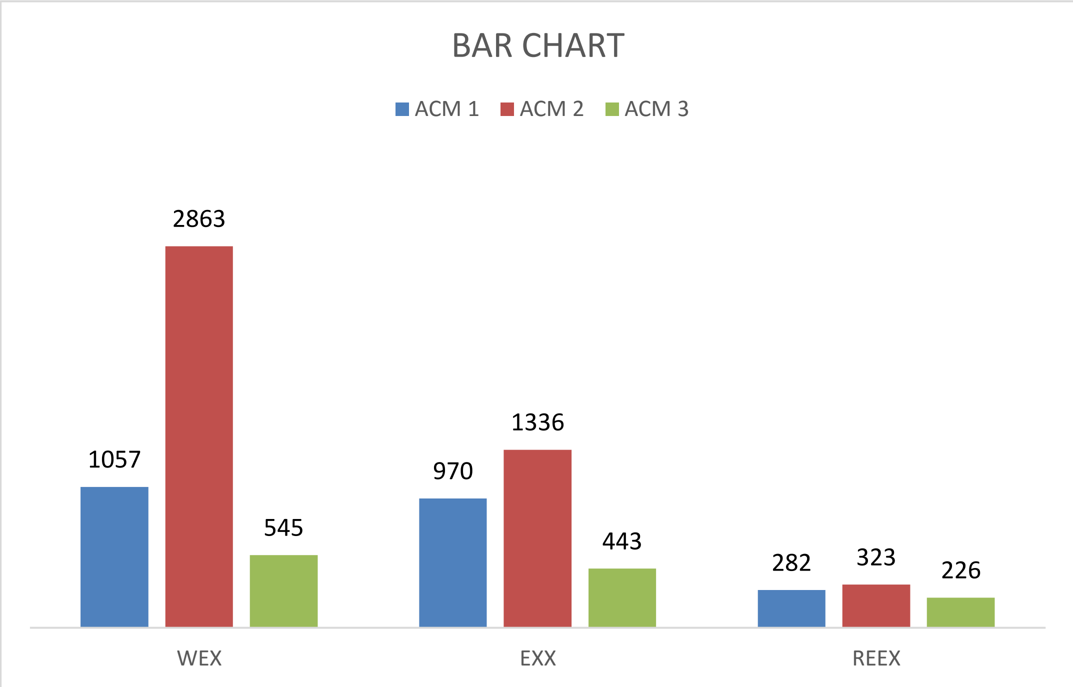

Figure 2: A chart showing the categories of exercises in mathematical task in the ACM textbooks 1, 2 and 3

From Figure 2, further examination of the ACM 1, ACM 2 and ACM 3 indicated that there were less REEX in ACM 1, ACM 2 and ACM 3 textbooks whiles WEX had the greatest number of exercises across all three years.

Table 1 shows the Descriptive statistics of the categories of exercises in mathematical tasks.in the ACM textbooks 1, 2 and 3.

Table 1: Descriptive statistics of the categories of exercises in mathematical tasks in the ACM textbooks 1, 2 and 3

TASKS	Book 1		Book 2		Book 3	
	N	%	N	%	N	%
Worked Examples (WEX)	1057	24	970	35	282	34
Exercises (EXX)	2863	64	1336	49	323	39
Review Exercises (REEX)	545	12	443	16	226	27
Total	**4465**	**100**	**2,749**	**100**	**831**	**100**

From Table 1, it was observed that the total number of tasks contained in ACM 1 far exceeds the sum of tasks of ACM 2 and ACM 3. However, all three textbooks had more than double of EXX than WEX and REEX. From Table 1, it can be deduced mathematically that the;

Total number of tasks in ACM 1 = (Total number of tasks in ACM 2 + Total number of tasks in ACM 3 + 885 tasks)

But ACM 3 = 831 tasks

885 tasks = 831 tasks + 54 tasks

885 tasks = ACM 3 + 54 tasks

Total number of tasks in ACM 1 = Total number of tasks in ACM 2 + ACM 3 + ACM 3 + 54 tasks

Total number of tasks in ACM 1 = Total number of tasks in ACM 2 + 2 ACM 3 + 54 tasks

It can therefore be concluded that the total number of tasks in ACM 1 is equal to the total number of tasks in ACM 2 plus twice the total number of tasks in ACM 3 plus 54 tasks.

4.1.2 Categories of exercises in mathematical tasks presented in the ECM textbooks1, 2 and 3.

In line with the research question two (2) to find out the categories of exercises in mathematical tasks presented in the ECM textbooks 1, 2 and 3, it was observed that each of the ECM textbooks had three specific exercise areas. These were worked examples (WEX), exercises (EXX) and review exercises (REEX).

Figure 3 shows the categories of exercises in mathematical tasks presented in the ECM textbooks 1, 2 and 3.

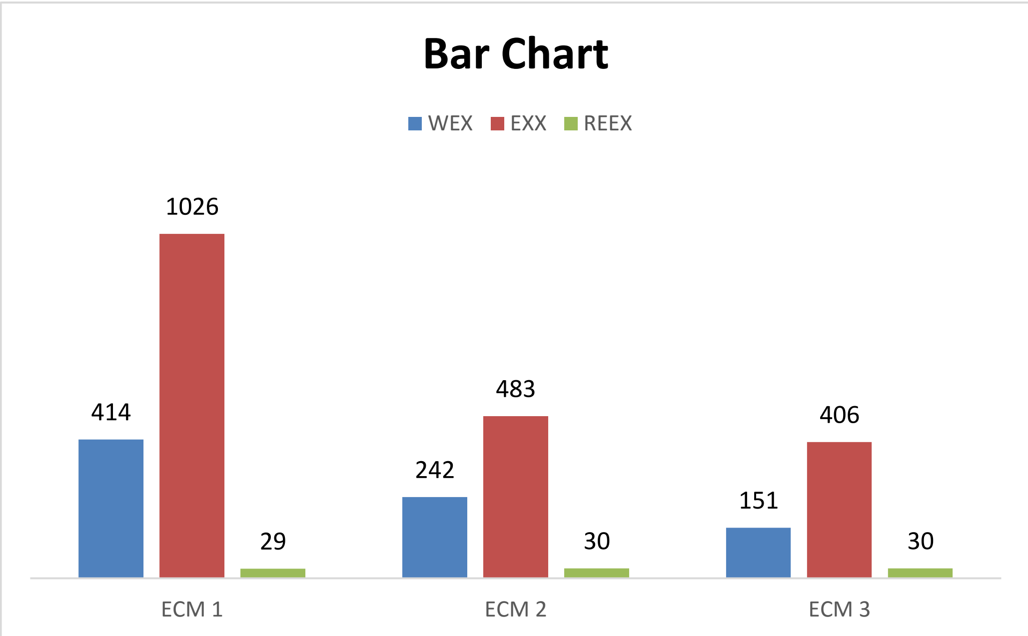

Figure 3: A chart showing the categories of exercises in mathematical task in the ECM textbooks 1, 2 and 3.

From Figure 3, it can be seen that the ECM textbook 1 had more categories of exercises in mathematical tasks than ECM 2 and ECM 3 with the exception of REEX which had less tasks in the ECM 2 and ECM 3. This indicated that the work load of form 1 students was much more than form 2 and 3 students. In addition to that, form 1 students entering into form 2 should continue working with ECM 1 so as to help them get a consolidated foundation for the three year SHS course. Comparing the categories of exercises, Figure 3 further indicates that there are more EXX in ECM 1, ECM 2 and ECM 3 than WEX and REEX.

Figure 4 further shows the categories of exercises in mathematical tasks presented in the ECM textbooks 1, 2 and 3. The categories of exercises in mathematical tasks in the ECM textbooks 1, 2 and 3 were worked examples (WEX), exercises (EXX) and review exercises (REEX).

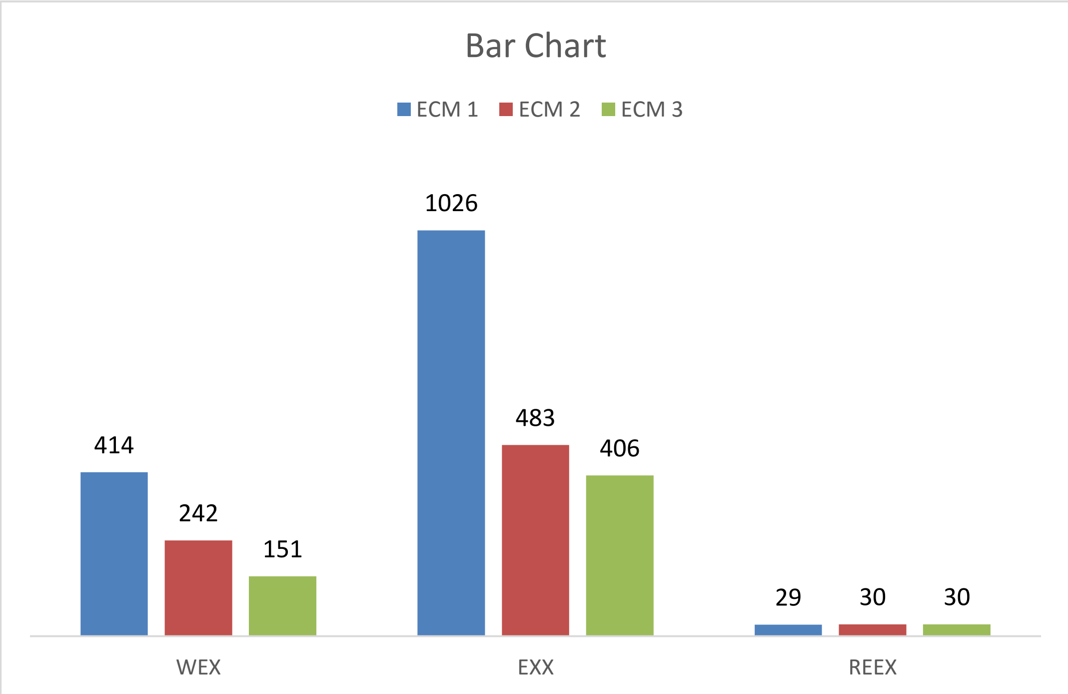

Figure 4: A chart showing the categories of exercises in mathematical task in the ECM textbooks 1, 2 and 3.

From Figure 4, further examination of the ECM 1, ECM 2 and ECM 3 indicated that there were less REEX in all three years of the textbooks whiles there were more EXX across all three years of the ECM textbooks.

Table 2 shows the categories of exercises in mathematical tasks in the ECM textbooks 1, 2 and 3.

Table 2: Distribution of categories of exercises in mathematical tasks in the ECM textbooks 1, 2 and 3

TASKS	Book 1		Book 2		Book 3	
	N	%	N	%	N	%
Worked Examples	414	28	242	32	151	26
Exercises	1026	70	483	64	406	69
Review Exercises	29	2	30	4	30	5
Total	1469	100	755	100	587	100

From Table 2, it was observed that the ECM textbook 1 contained more categories of WEX and EXX than the textbooks 2 and 3. In addition to that, the total number of tasks contained in ECM 1 far exceeds the sum of tasks of ECM 2 and ECM 3. However, all three textbooks had more than double of EXX than WEX and REEX. It can therefore be mathematically deduced that;

Total number of tasks in ECM 1 = Total number of tasks in ECM 2 + Total number of tasks in ECM 3 + 127 tasks

Thus ECM 1 = ECM 2 + ECM 3 + 127 tasks

4.2 Categories of steps in mathematical tasks

The second research question raised for the study was to determine the categories of steps in the mathematical tasks in the ACM textbooks 1, 2 and 3 and the ECM textbooks 1, 2 and 3. To do this, the mathematical tasks were examined, coded and counted. All the tasks were categorised into three main tasks as stated in the conceptual framework. The categories used were Single step tasks (SST), Double step tasks (DST), and Multiple step tasks (MST). Below are some examples of the three categories of tasks in Boxes 1, 2 and 3.

Box 1 contains two examples of Single step task

Example of Single step task

Simplify each of the following

a. $\frac{\log 9}{\log 3}$

b. Log 3 + log 4

Box 1: Example of single step tasks

Single-step tasks (SST) **are** tasks that can be solved by one direct operation or taken through one direct step before arriving at an answer are defined as single-step tasks.

Box 2 contains an example of Double step task

2. **Examples of double step tasks**

Given that A = {2, 3, 4, 5, 6} and B = {1, 4, 5, 7, 8},

Find (i) $A \cap B$ (ii) $A \cup B$

Box 2: Examples of Double step tasks (DST)

Double step tasks are tasks that can be solved by going through two direct steps or using two direct operations before arriving at an answer.

Box 3 contains two examples of Multiple-step tasks (MST)

3. **Examples of multiple step tasks**

a. A certain car covers 10km at a certain speed. If the average speed is reduced by 30km/hr, the car takes the same time to cover a distance of 6km. Find the speed of the car in the first part of the journey.

b. The following Table gives the marks obtained by 50 students in a quiz that contains 10 questions. 7, 4, 6, 8, 5, 7, 7, 8, 9, 5, 6, 6, 4, 5, 5, 5, 6, 6, 7, 8, 9, 8, 5, 6, 4, 7, 8, 6, 5, 5, 4, 5, 8, 6, 9, 7, 6, 8, 4, 5, 5, 6, 7, 3, 5, 7, 7, 3, 5, 6

   i. Form a frequency Table for the data.

   ii. Draw a bar chart for the data.

Box 3: Example of Multiple-step tasks (MST)

Multiple-step tasks are tasks that can be solved by three or more direct operations or taken through three direct steps before arriving at the answer.

4.4.1 Categories of steps in mathematical tasks in the ACM textbooks 1, 2 and 3

To find out the categories of steps in mathematical tasks in the ACM textbooks 1, 2, and 3 the ACM textbooks were further examined, coded and counted according to the categorisation of tasks stated in the conceptual framework which included Single step tasks (SST), Double step tasks (DST) and Multiple step tasks (MST). The results of the categories of steps in mathematical tasks in the ACM textbooks 1, 2 and 3 is shown in Figure 5 and presented in Table 3.

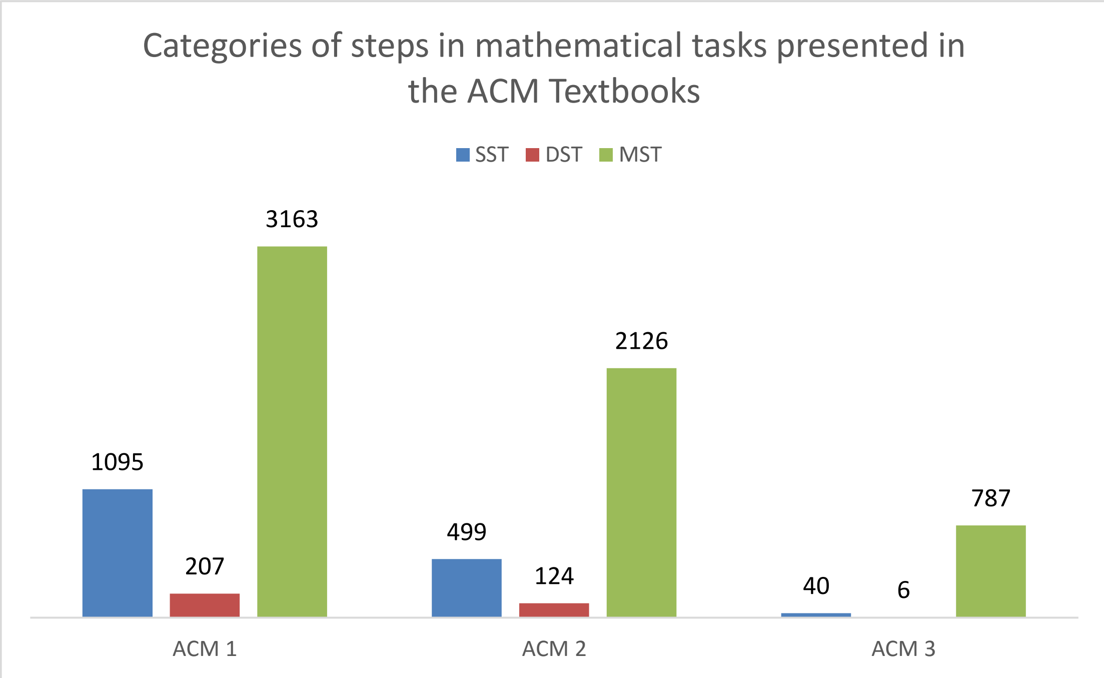

Figure 5: A Chart showing the categories of steps in mathematical tasks presented in the ACM textbooks 1, 2 and 3.

From Figure 5, the chart shows that there are more MST in the ACM 1, ACM 2 and ACM 3.than SST and DST. In addition to that, the SST, DST and MST in ACM 1 were more than the SST, DST and MST in ACM 2 and ACM 3.

Table 3 shows the distribution of categories of steps in mathematical tasks in the ACM textbooks 1, 2, and 3. From Table 3, all the ACM textbooks were categorised into three main areas. These are SST, DST and MST.

Table 3: Distribution of categories of steps in mathematical tasks in the ACM Textbook 1, 2 and 3 for SHS

TASKS	Book 1		Book 2		Book 3	
	N	%	N	%	N	%
Single step tasks	1095	25	499	18	40	5
Double step tasks	207	4	124	5	6	1
Multiple step tasks	3163	71	2126	77	787	94
Total	**4,465**	**100**	**2,749**	**100**	**831**	**100**

From Table 3, the ACM textbook 1 had four thousand, four hundred and sixty-five (4465) mathematical tasks of which 1095(25%) are SST, 207(4%) are DST and 3163(71%) are MST whilst the ACM textbook 2 had two thousand, seven hundred and forty-nine (2749) mathematical tasks of which 499(18%) are SST, 124(5%) are DST and 2126(77%) are MST and 831 tasks were found in the textbook 3, of which 40 (5%) were SST, 6 (1%) were DST, 787 (94%) were MST.

From Table 3, the following mathematical equations were deduced from ACM textbooks 1, 2 and 3 results.

From ACM textbook 1, $MST = 2\ (2SST + DST) + 145$ (1)

From ACM textbook 2, $MST = 3(SST + 5DST) + 9$ (2)

From ACM textbook 3, $MST = 17\ (SST + DST) + 5$ (3)

From Table 3, it was observed that the textbook 1 was very loaded with much more tasks than the textbooks 2 and 3. All the three equations for the textbooks 1, 2 and 3 indicates that textbooks 1, 2 and 3 contained much more MST than SST and DST. This is indicative of the fact that more than 70% of the SHS textbooks display the profile dimension of application of knowledge from the SHS syllabus. The results of the study is consistent with the expectations of the syllabus in terms of the profile dimension which outlines two main components (Knowledge and understanding (30%) and Application of knowledge (70%)) (CRDD, 2010).

4.4.2 Categories of steps in mathematical tasks presented in the ECM textbooks 1, 2 and 3

The ECM textbooks tasks were examined, coded and counted according to the categorisation of tasks stated in the conceptual framework. This was to find out the categories of steps in mathematical tasks in the ECM textbooks 1, 2, and 3. The categories of steps in mathematical tasks of the ECM textbooks were included Single step tasks (SST), Double step tasks (DST) and Multiple step tasks (MST). The results of the categories of steps in mathematical tasks are displayed in Figure 6.

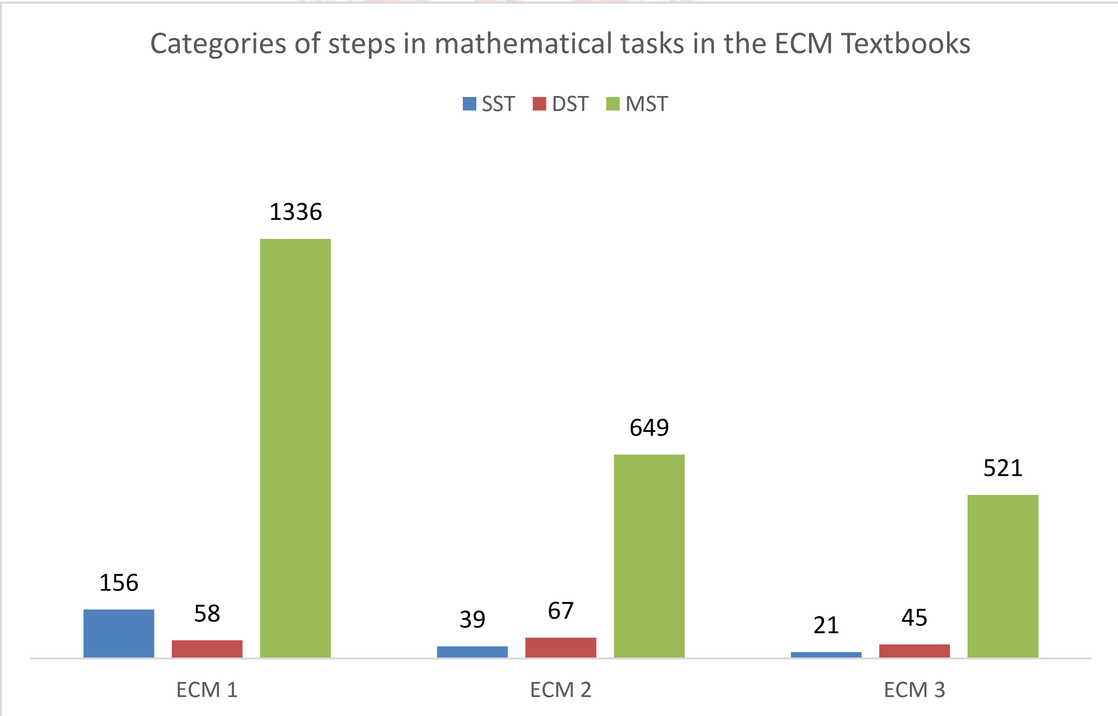

Figure 6: A Chart of the categories of steps in mathematical tasks in ECM textbooks 1, 2 and 3

From Figure 6, the chart shows that there were more MST in ECM 1, ECM 2 and ECM 3 than SST and DST. Furthermore, the SST, DST and MST in ECM 1 were more than the SST, DST and MST in ECM 2 and ECM 3. Additionally, there were less DST in ECM 1 than DST in ECM 2.

Table 4 shows the distribution of categories of steps in mathematical tasks in the ECM textbooks 1, 2, and 3.

Table 4: Distribution of Categories of steps in mathematical tasks in the ECM textbook 1, 2 and 3

TASKS	Book 1		Book 2		Book 3	
	N	%	N	%	N	%
Single step tasks	156	11	39	5	21	4
Double step tasks	58	4	67	9	45	8
Multiple step tasks	1356	85	649	86	521	88
Total	**1469**	**100**	**755**	**100**	**587**	**100**

From Table 4, each textbook was identified with three specific categories of tasks. These were Single step tasks (SST), Double step tasks (DST) and Multiple step tasks (MST). Table 4 further indicates that the ECM textbook 1 had one thousand, four hundred and sixty-nine (1469) mathematical tasks of which 156(11%) were SST, 58(4%) were DST and 1356(85%) are MST. The ECM textbook 2 had seven hundred and fifty-five (755) mathematical tasks of which 39(5%) are SST, 67(9%) are DST and 649 (86%) are MST. Out of the five hundred and eighty-seven (587) tasks in the textbook 3, 21 (4%) were SST, 45 (7%) were DST, 521 (89%) were MST. From Table 4, the ECM textbooks indicate that there are more MST than SST and DST.

From Table 4, the following mathematical equations were deduced for the ECM textbooks 1, 2 and 3 results;

From ECM 1, MST = 6SST + 7 (DST + 2) (1)

From ECM 2, MST = 6 (SST + DST) + 13 (2)

From ECM 3, MST = 2 (5SST + 4DST) + 17 (3)

From Table 4, it was observed that the ECM textbook 1 was very loaded with much more tasks than the ECM textbook 2 and ECM textbook 3. All these three equations for the textbooks 1, 2 and 3 indicated that the textbooks 1, 2 and 3 contain much more MST than SST and DST. This is indicative of the fact that more than 70% of the SHS textbooks displayed the profile dimension of application of knowledge from the SHS syllabus whiles 30% display the profile dimension of Understanding and Knowledge. The results of the study is consistent with the expectations of the SHS syllabus in terms of the two profile dimensions which outlines two main components (Knowledge and understanding (30%); and Application of knowledge (70%))(CRDD, 2010).

4.3 Differences in the Categories of Exercises in Mathematical tasks Presented in the ACM and ECM textbooks 1, 2 and 3.

The third research question raised for the study was to find out whether there are differences in the Categories of exercises in mathematical tasks presented in the ACM and ECM textbooks 1, 2 and 3. In order to achieve these, the results of the categories examined, coded and counted from the ACM and ECM textbooks were subjected to further analysis.

4.2.1 Categories of exercises in mathematical tasks presented in the ACM and ECM textbook 1

In line with the research question 2 to determine whether there was a difference between the categories of exercises in mathematical tasks presented in the ACM textbook 1 and the ECM textbook 1,

Figure 7 shows the Categories of exercises in mathematical tasks presented in the ACM textbook 1 and the ECM textbook 1

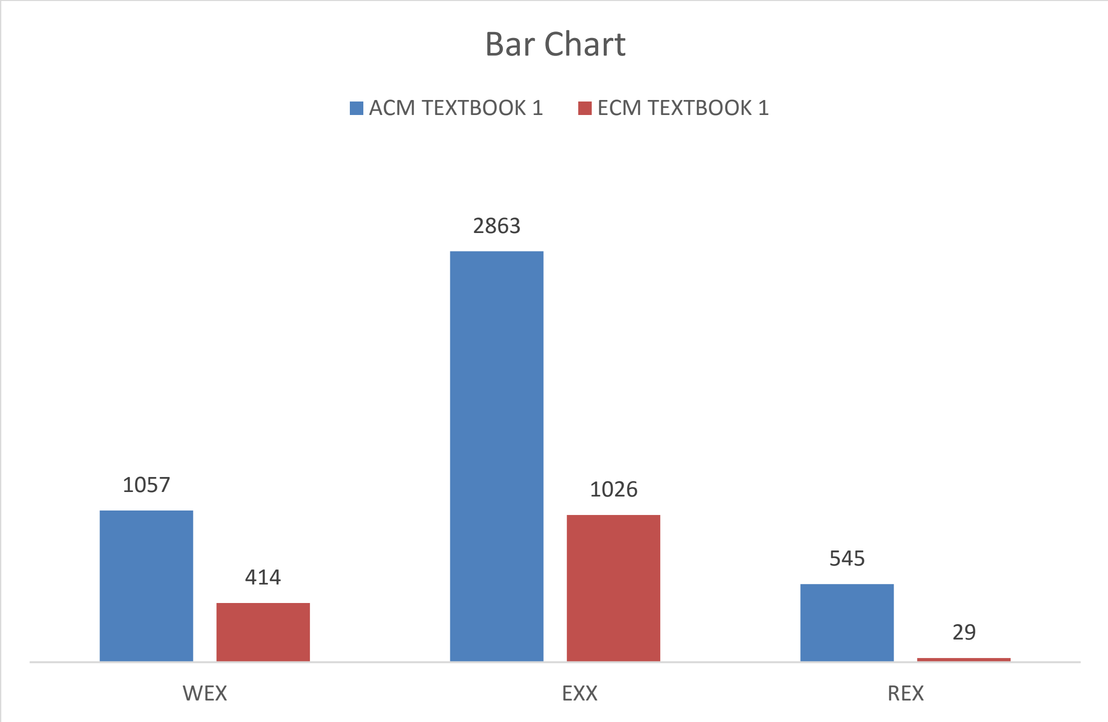

Figure 7: A Chart showing the differences between the categories of exercises in mathematical tasks in the ACM textbook 1 and the ECM textbook 1

The chart in Figure 7 shows that the ACM textbook 1 contained more WEX, EXX and REEX than the ECM textbook 1. There was a difference between the categories of exercises in mathematical tasks presented in the ACM textbook 1 and the ECM textbook 1. It can therefore be argued that there was a difference between the categories of exercises in mathematical tasks in the ACM textbook 1 and the ECM textbook 1.

Descriptive statistics of the categories of exercises in mathematical tasks in the textbook 1

Table 5 shows the descriptive statistics and chi-square test results between the categories of exercises in mathematical tasks in the ACM textbook 1 and the ECM textbook 1.

Table 5: Descriptive statistics on categories of exercises in mathematical tasks between ACM and ECM textbooks 1, 2 and 3

TEXTBOOKS	WEX	%	EXX	%	REEX	%	TOTAL
ACM textbook 1	1057	24	2863	64	545	12	4465
ECM textbook 1	414	28	1026	70	29	2	1469
ACM textbook 2	970	35	1336	49	443	18	2649
ECM textbook 2	242	32	483	64	30	4	755
ACM textbook 3	282	34	323	39	226	27	831
ECM textbook 3	151	26	406	69	30	5	587

Table 5 shows that the observed frequencies of categories of exercises in mathematical tasks and their corresponding percentages for the two textbooks (ACM textbook 1 and ECM textbook 1). Table 5 further indicates that there were differences in the categories of exercises in mathematical tasks with respect to the observed frequencies and their corresponding percentages with the ACM textbook 1 ((i.e. with WEX = 1057(24%); EXX = 2863 (64%) and REEX =545(12%)) being higher than the ECM textbook 1 (WEX = 414(28%), EXX = 1026(70%) and REEX = 29(2%)).

Further analysis was conducted to find out whether the observed differences between the categories of exercises in mathematical tasks in the ACM textbook 1 and the ECM textbook 1 indicated that the observed differences were significant. As can be seen by the frequencies and percentages cross tabulated in Table 5, a difference between ACM textbook 1 and ECM textbook 1 was found (ACM 1: ECM 1 was 4465:1469).

There was a difference between the categories of exercises in mathematical tasks in the ACM textbook 1 and the ECM textbook 1. The results showed that there was difference between the categories of exercises in mathematical tasks presented in the ACM textbook 1 and the ECM textbook 1.

In summary, the study showed that there is a difference between the categories of exercises in mathematical tasks presented in the ACM and the ECM textbook 1. Hence, there was a difference between the categories of exercises in mathematical tasks presented in the ACM textbook 1 and the ECM textbook 1.

4.2.2 Categories of exercises in mathematical tasks presented in the ACM textbook 2 and the ECM textbook 2

In order to determine whether there is a difference between the categories of exercises in mathematical tasks presented in the ACM textbook 2 and the ECM textbook 2,

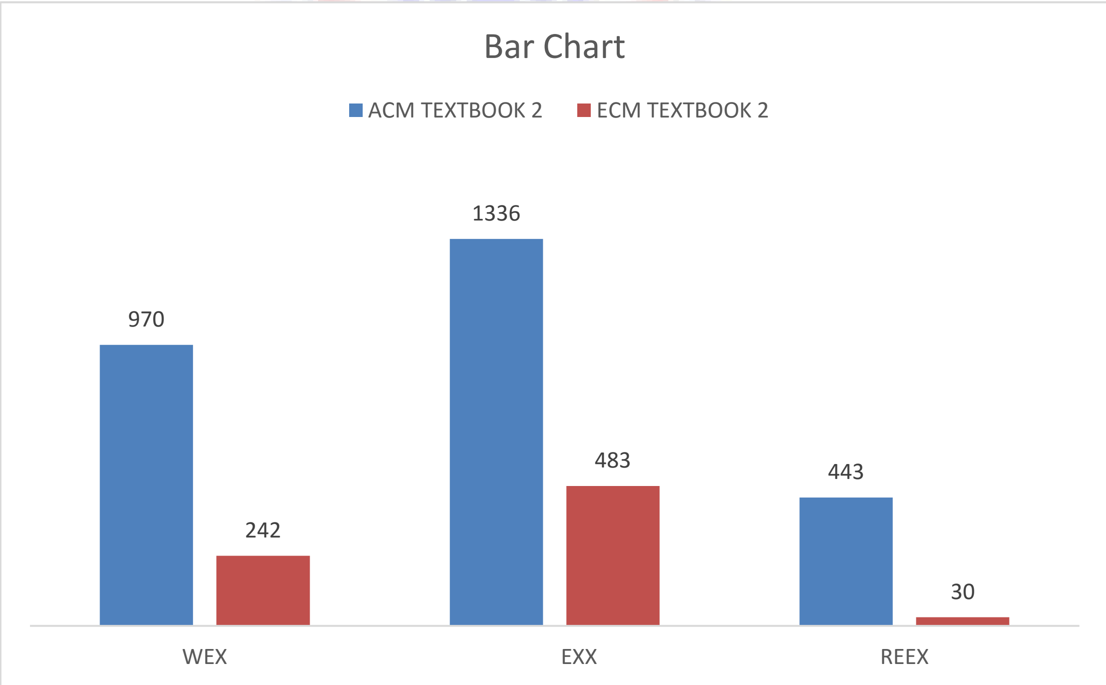

Figure 8: A Chart showing the categories of exercises in mathematical tasks presented in the ACM textbook 2 and ECM textbook 2

Figure 8 shows the differences between categories of exercises of mathematical tasks in the ACM textbook 2 and ECM textbook 2. Figure 8 indicates that the ACM textbook 2 contained more of WEX, EXX and REEX than the ECM textbook 2.

Descriptive statistics of the categories of exercises of Mathematical tasks in the ACM textbook 2 and that of the ECM textbook 2

Table 5 shows the descriptive statistics of the categories of exercises in mathematical tasks in the ACM textbook 2 and ECM textbook 2. Table 5 indicates that there was a difference in the categories of exercises in mathematical tasks with respect to the observed frequencies and their corresponding percentages with the ACM textbook 2((i.e. with WEX = 970(35%); EXX = 1336 (49%) and REEX = 443(16%)) being higher than the categories of exercises in mathematical tasks in the ECM textbook 2 (WEX = 242(32%), EXX = 483(64%) and REEX = 30(4%)).

To find out whether the observed differences were significant, the frequency of categories of exercises in mathematical tasks in the ACM textbook 2 and ECM textbook 2 compared indicated that the observed differences were significant. As can be seen by the frequencies cross tabulated in Table 5, a difference between ACM textbook 2 and ECM textbook 2 was found ((ACM 1: ECM 1 was 2649:755). There was a difference between the categories of exercises in mathematical tasks presented in the ACM textbook 2 and the ECM textbook 2. Hence there was difference between ACM textbook 2 and ECM mathematics textbook 2. It can therefore be argued that there was difference between the categories of exercises of mathematical tasks in the ACM textbook 2 and that of the ECM textbook 2.

In summary, the study showed that there was a difference between the categories of exercises in mathematical tasks presented in the ACM and the ECM textbook 2. Hence, there was a difference between the categories of exercises in mathematical tasks presented in the ACM and the ECM textbook 2.

4.2.3 Categories of exercises in mathematical tasks presented in the ACM textbook 3 and the ECM textbook 3

In line with the research question two (2), for the study to determine whether there was a difference between the categories of exercises in mathematical tasks in the ACM textbook 3 and the ECM textbook 3, the categories of exercises were compared in terms of numbers.

Figure 9 is a chart showing the categories of exercises in mathematical presented in the ACM textbook 3 and ECM textbook 3

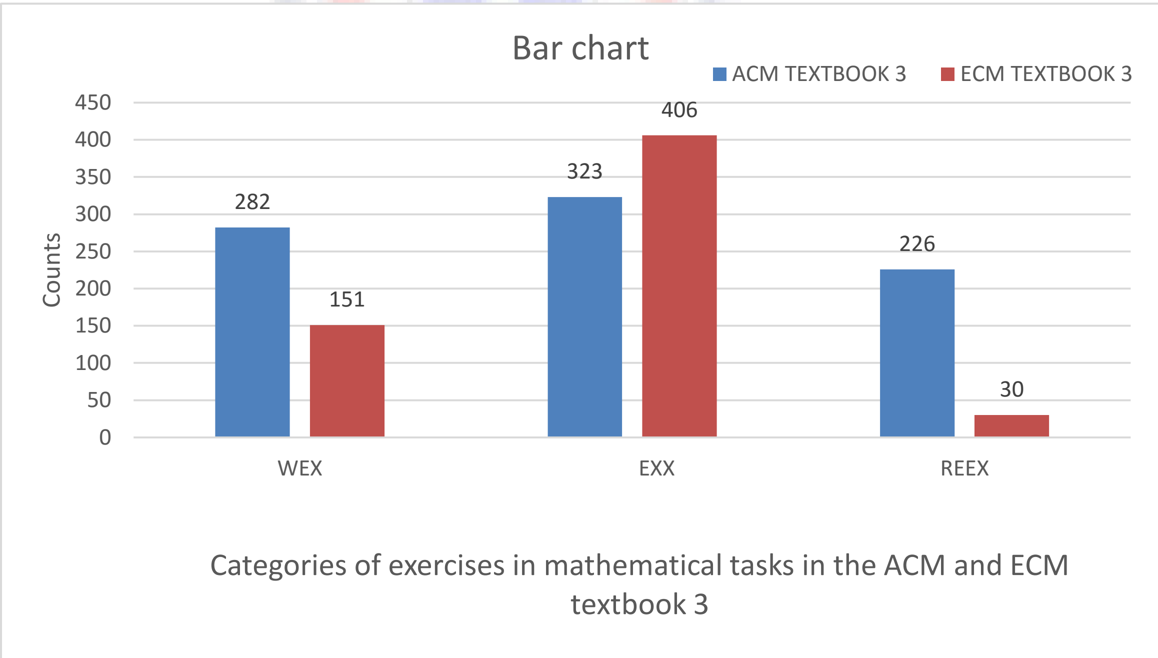

Figure 9: A Chart showing the categories of exercises in mathematical tasks in the ACM textbook 3 and ECM textbook 3

From Figure 9, although the ACM textbook 3 contained more REEX than the ECM textbook 3, it was however observed that the ACM textbook 3 contained more WEX, and REEX than the ECM textbook 3.

Descriptive statistics of the categories of exercises in mathematical tasks presented in the ACM textbook 3 and ECM textbook 3.

Table 5 indicates that there was a difference in the categories of exercises in mathematical tasks in ACM textbook 3 and ECM textbook 3 with respect to the observed frequencies with the ACM textbook 3((i.e. with WEX = 282(34%); EXX = 323 (39%) and REEX =226 (27%)) being higher than the categories of exercises in mathematical tasks in the ECM textbook 3 (WEX = 151(26%), EXX = 406(69%) and REEX = 30(5%)).

Further analysis was conducted to find out whether the observed differences between the categories of exercises in mathematical tasks presented in the ACM textbook 3 and the ECM textbook 3 were significant. The results indicated that the observed differences were significant comparing the frequency of categories of exercises in mathematical tasks in the ACM textbook 3 and ECM textbook 3. As can be seen by the frequencies and percentages cross tabulated in Table 5, a difference between the categories of exercises in mathematical tasks presented in the ACM textbook 3 and ECM textbook 3 was found (ACM 3: ECM 3 was 831:587). There was a difference between the categories of exercises in mathematical tasks presented in the ACM and the ECM textbook 3 in favour of the ACM textbook 3.

In summary, the study showed that there was a difference was found between the categories of exercises in mathematical tasks presented in the ACM textbook 3 and the ECM textbook 3.

4.3 Discussion on Differences between the Categories of Exercises in Mathematical tasks Presented in the ACM Textbooks and the ECM Textbooks

The analysis of the results indicated that the categories of exercises in mathematical tasks in the ACM textbooks and the ECM textbooks collaborates the findings on the study of the structure and content of the mathematics textbooks, stated that the structure of most mathematics textbooks is exposition –examples –exercises' strategies. This is known as ―3es" (Johansson, 2003; Afolabi, 2014). The analysis of the results indicated that the categories of exercises in mathematical tasks in the ACM textbook 1 in terms of WEX, EXX and REEX was far higher than that in the ECM textbook 1. This was emphasized by all the mathematics teachers interviewed who stated that there were more categories of exercises in mathematical tasks in the ACM textbook 1 than in the ECM textbook 1. The number of exercises in the ACM textbook 2 was also far higher than the number of exercises in the ECM textbook 2. The analysis of the results indicated that ACM textbook 2 had much more categories of all other exercises (WEX, EXX and REEX) than the ECM textbook 2. The total number of tasks in the ACM textbook 3 was far higher than the number of tasks in the ECM textbook 3. The analysis of the results from further analysis indicated that the ACM textbook 3 had more WEX and REEX than the ECM textbook 3. This was further indicated by the mathematics teachers in the interview that there were more categories of mathematical tasks in the ACM textbook3 than in the ECM textbook 3. The deduced equations further indicated that the exercises in the ACM 1, 2 and 3 differ from the exercises in the ECM 1, 2 and 3 in terms of the number of tasks.

The analysis of the results indicated that the categories of exercises in mathematical tasks in the ACM textbook 1, 2 and 3 in terms of WEX, EXX and REEX was far higher than that in the ECM textbook 1, 2 and 3. This was emphasized by all the mathematics teachers interviewed who stated that there were more categories of exercises in mathematical tasks in the ACM textbook 1 than in the ECM textbook 1. The analysis of the results indicated that the ACM textbook 3 had more WEX and REEX than the ECM textbook 3. This was further indicated by the mathematics teachers in the interview that there were more categories of exercises in mathematical tasks in the ACM textbook 3 than in the ECM textbook 3.

The study further indicated that there were also differences between the categories of exercises in mathematical tasks presented in the ACM and the ECM textbooks 1, 2 and 3. The difference indicated that all the categories of exercises in mathematical tasks presented in the ACM and ECM textbooks 1, 2 and 3 had differences accordingly.

The usefulness of categories of exercises in mathematical tasks, particularly those recommended in the curriculum documents determines why some teachers appear to impact on textbook choice of tasks (Anderson, 2003). Lithner, (2004), explained that when students have time with mathematics textbooks, it is important to guide them in understanding the kind of mathematical tasks they are handling and the kind of thinking that goes on in their minds. The category of mathematical tasks posed indicates the kind of concepts introduced and the analysis of the exercises used in the textbook according to the categories of exercises in the textbooks. Furthermore, the examples the textbooks presented should be adequate and helpful for students to follow so as to be able to solve other mathematical tasks (Jablonka and Johansson, 2010).

4.4 Categories of Steps in Mathematical Tasks

To determine the differences in the categories of steps in the mathematical tasks in the ACM textbooks 1, 2 and 3 and the ECM textbooks 1, 2 and 3. To do this, the mathematical tasks were examined, coded and counted. All the tasks were categorised into three main tasks as stated in the conceptual framework. The categories used were Single step tasks (SST), Double step tasks (DST), and Multiple step tasks (MST).

4.4.1 Categories of steps in mathematical tasks in the ACM textbooks 1, 2 and 3

To find out the categories of steps in mathematical tasks in the ACM textbooks 1, 2, and 3 the ACM textbooks were further examined, coded and counted according to the categorisation of tasks stated in the conceptual framework which included Single step tasks (SST), Double step tasks (DST) and Multiple step tasks (MST). The results of the categories of steps in mathematical tasks in the ACM textbooks 1, 2 and 3 is shown in Figure 10 and presented in Table 6.

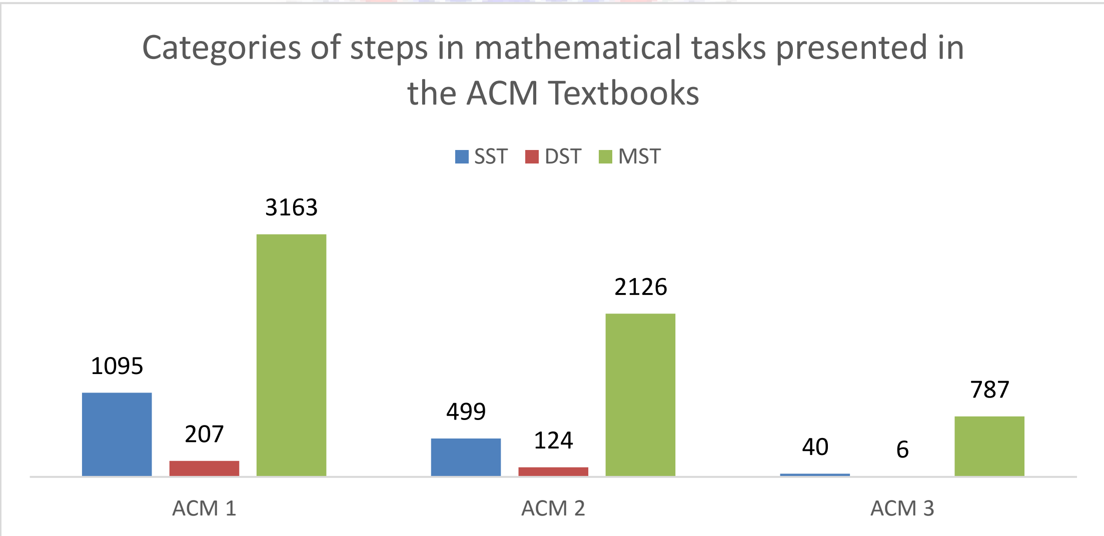

Figure 10: A Chart showing the categories of steps in mathematical tasks presented in the ACM textbooks 1, 2 and 3.

From Figure 10, the chart shows that there are more MST in the ACM 1, ACM 2 and ACM 3.than SST and DST. In addition to that, the SST, DST and MST in ACM 1 were more than the SST, DST and MST in ACM 2 and ACM 3.

Table 6 shows the distribution of categories of steps in mathematical tasks in the ACM textbooks 1, 2, and 3. From Table 6, all the ACM textbooks were categorised into three main areas. These are SST, DST and MST.

Table 6: Distribution of categories of steps in mathematical tasks in the ACM Textbook 1, 2 and 3 for SHS

TASKS	Book 1		Book 2		Book 3	
	N	%	N	%	N	%
Single step tasks	1095	25	499	18	40	5
Double step tasks	207	4	124	5	6	1
Multiple step tasks	3163	71	2126	77	787	94
Total	**4,465**	**100**	**2,749**	**100**	**831**	**100**

From Table 6, the ACM textbook 1 had four thousand, four hundred and sixty-five (4465) mathematical tasks of which 1095(25%) are SST, 207(4%) are DST and 3163(71%) are MST whilst the ACM textbook 2 had two thousand, seven hundred and forty-nine (2749) mathematical tasks of which 499(18%) are SST, 124(5%) are DST and 2126(77%) are MST and 831 tasks were found in the textbook 3, of which 40 (5%) were SST, 6 (1%) were DST, 787 (94%) were MST.

From Table 6, the following mathematical equations were deduced from ACM textbooks 1, 2 and 3 results.

From ACM textbook 1, MST = 2 (2SST + DST) + 145 (1)

From ACM textbook 2, MST = 3(SST + 5DST) + 9 (2)

From ACM textbook 3, MST = 17 (SST + DST) + 5 (3)

From Table 6, it was observed that the textbook 1 was very loaded with much more tasks than the textbooks 2 and 3. All the three equations for the textbooks 1, 2 and 3 indicates that textbooks 1, 2 and 3 contained much more MST than SST and DST. This is indicative of the fact that more than 70% of the SHS textbooks display the profile dimension of application of knowledge from the SHS syllabus. The results of the study is consistent with the expectations of the syllabus in terms of the profile dimension which outlines two main components (Knowledge and understanding (30%) and Application of knowledge (70%)) (CRDD, 2010).

4.4.2 Categories of steps in mathematical tasks presented in the ECM textbooks 1, 2 and 3

The ECM textbooks tasks were examined, coded and counted according to the categorisation of tasks stated in the conceptual framework. This was to find out the categories of steps in mathematical tasks in the ECM textbooks 1, 2, and 3. The categories of steps in mathematical tasks of the ECM textbooks were included Single step tasks (SST), Double step tasks (DST) and Multiple step tasks (MST). The results of the categories of steps in mathematical tasks are displayed in Figure 11.

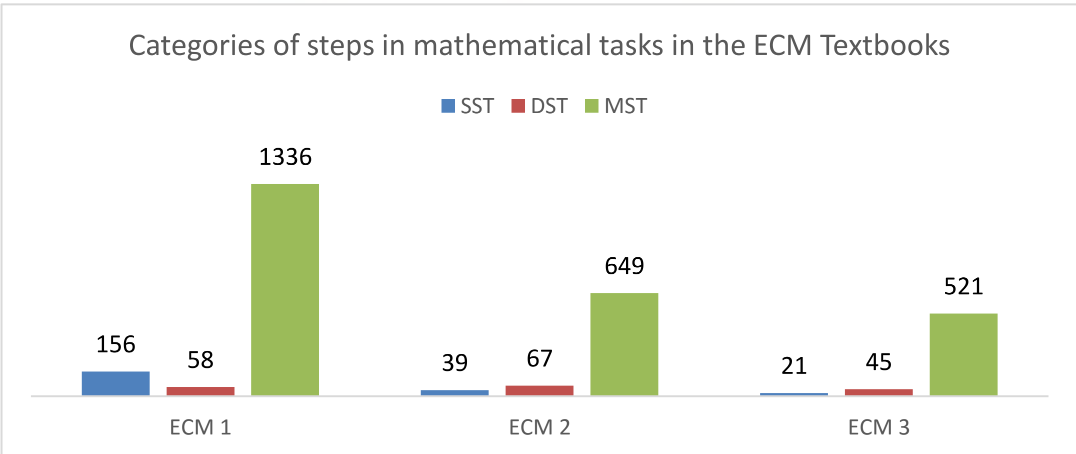

Figure 11: A Chart of the categories of steps in mathematical tasks in ECM textbooks 1, 2 and 3

From Figure 11, the chart shows that there were more MST in ECM 1, ECM 2 and ECM 3 than SST and DST. Furthermore, the SST, DST and MST in ECM 1 were more than the SST, DST and MST in ECM 2 and ECM 3. Additionally, there were less DST in ECM 1 than DST in ECM 2.

Table 7 shows the distribution of categories of steps in mathematical tasks in the ECM textbooks 1, 2, and 3.

Table 7: Distribution of Categories of steps in mathematical tasks in the ECM textbook 1, 2 and 3

TASKS	Book 1		Book 2		Book 3	
	N	%	N	%	N	%
Single step tasks	156	11	39	5	21	4
Double step tasks	58	4	67	9	45	8
Multiple step tasks	1356	85	649	86	521	88
Total	**1469**	**100**	**755**	**100**	**587**	**100**

From Table 7, each textbook was identified with three specific categories of tasks. These were Single step tasks (SST), Double step tasks (DST) and Multiple step tasks (MST). Table 7 further indicates that the ECM textbook 1 had one thousand, four hundred and sixty-nine (1469) mathematical tasks of which 156(11%) were SST, 58(4%) were DST and 1356(85%) are MST. The ECM textbook 2 had seven hundred and fifty-five (755) mathematical tasks of which 39(5%) are SST, 67(9%) are DST and 649 (86%) are MST. Out of the five hundred and eighty-seven (587) tasks in the textbook 3, 21 (4%) were SST, 45 (7%) were DST, 521 (89%) were MST. From Table 7, the ECM textbooks indicate that there are more MST than SST and DST.

From Table 7, the following mathematical equations were deduced for the ECM textbooks 1, 2 and 3 results;

From ECM 1, MST = 6SST + 7 (DST + 2) (1)

From ECM 2, MST = 6 (SST + DST) + 13 (2)

From ECM 3, MST = 2 (5SST + 4DST) + 17 (3)

From Table 7, it was observed that the ECM textbook 1 was very loaded with much more tasks than the ECM textbook 2 and ECM textbook 3. All these three equations for the textbooks 1, 2 and 3 indicated that the textbooks 1, 2 and 3 contain much more MST than SST and DST. This is indicative of the fact that more than 70% of the SHS textbooks displayed the profile dimension of application of knowledge from the SHS syllabus whiles 30% display the profile dimension of Understanding and Knowledge. The results of the study is consistent with the expectations of the SHS syllabus in terms of the two profile dimensions which outlines two main components (Knowledge and understanding (30%); and Application of knowledge (70%))(CRDD, 2010).

4.4.3 Discussion on the categories of steps in mathematical tasks between the ACM and ECM textbooks 1, 2 and 3

The analysis of the results indicated that the categories of steps in mathematical tasks in the ACM textbook 1 was far higher than that of the ECM textbook 1. Although ACM textbook 1 had more SST, DST and MST than the ECM textbook 1. This was emphasized by all the mathematics teachers interviewed who stated that there were different categories of steps in mathematical tasks in the ACM textbook 2 than in the ECM textbook 2. In addition to that they stated that there was more MST in the textbooks.

The observed frequencies in the categories of steps in mathematical tasks in the ACM textbook 2 were far higher than that of the ECM textbook 2. The analysis of the results indicated that ACM textbook 2 had much more categories of all other tasks (SST, DST, MST) than the ECM textbook 2.

The categories of steps in mathematical tasks in the ACM textbook 3 were far higher than the categories of steps in mathematical tasks in the ECM textbook 3. The analysis of the results from further analysis indicated that the ACM textbook 3 had more SST and MST than the ECM textbook 3. This was further indicated by the mathematics teachers in the interview that there were more categories of steps in mathematical tasks in the ACM textbooks than in the ECM textbooks.

Multiple step tasks are high quality mathematical tasks which shows that asking the right questions requires more than substitution into formulas; signifying authentic, intricate, interesting and powerful solutions employing multi-step procedures, appealing to the interest of large number of students and offering multiple means of solutions (Steen, Turner and Burkhardt, 2007). The domain of mathematics is so ordered that it is propitious for unsupervised learning since it is easy to check an answer by using different methods hence finding solutions to mathematical tasks for the zealous which brings about an intrinsic reward (Butterworth, 2006). This may be especially relevant to the mathematics experts as this is why parallels between categories of steps in mathematical tasks were noticed.

4.5 Differences in the Categories of steps in Mathematical tasks between the ACM and ECM Textbooks 1, 2 and 3

The third research question raised for the study was to find out whether there were differences in the categories of steps in mathematical tasks between the ACM textbooks and the ECM textbooks. In order to achieve these, the results of the categories were examined, coded and counted on the ACM and ECM textbooks and were further subjected to further analysis.

Categories of steps in mathematical tasks presented in the ACM textbook 1 and the ECM textbook 1

The research question three (3) for the study was to determine whether there were differences between the categories of steps in mathematical tasks in the ACM textbooks and the ECM textbooks 1. To do this, the categories of steps in mathematical tasks presented in the ACM textbook 1 and the ECM textbook 1 were compared in graphically and numerically.

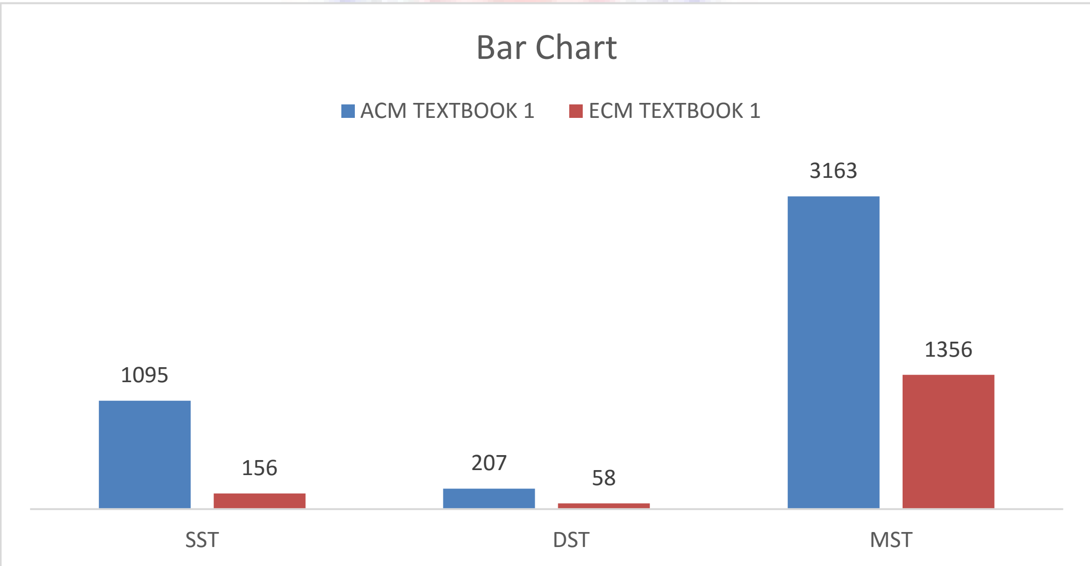

Figure 12: A Chart showing the categories of steps in mathematical tasks presented in the ACM textbook 1 and the ECM textbook 1

The chart in Figure 10 shows that the ACM textbook 1 contained more SST, DST and MST than the ECM textbook 1. Hence that there is no difference between ACM textbook 1 and ECM textbook 1. It can therefore be argued that there was difference between the categories of steps in mathematical tasks in the ACM textbook 1 and the ECM textbook 1.

Descriptive statistics of the categories of steps in mathematical tasks in the ACM textbook 1 and the ECM textbook 1

Table 6 shows the descriptive statistics and chi-square test results between the categories of steps in mathematical tasks in the ACM textbook 1 and the ECM textbook 1. Table 6 shows that the observed frequencies of categories of steps in mathematical tasks and their corresponding percentages for the two textbooks (ACM textbook 1 and ECM textbook 1).

Table 8 shows the descriptive statistics of the categories of steps in mathematical tasks in the ACM textbook 3 and ECM textbook 3.

Table 8: Descriptive statistics on categories of steps in mathematical tasks between ACM and ECM textbooks 1, 2 and 3

TEXTBOOKS	SST	%	DST	%	MST	%	TOTAL
ACM textbook 1	1095	25	207	4	3136	71	4465
ECM textbook 1	156	11	58	3	1356	86	1469
ACM textbook 2	499	25	124	5	2126	70	2649
ECM textbook 2	39	5	67	9	649	86	755
ACM textbook 3	40	5	6	1	787	94	831
ECM textbook 3	81	4	45	8	521	88	587

Table 8 indicates that there was a difference in the categories of steps in mathematical tasks with respect to the observed frequencies and their corresponding percentages with the ACM textbook 1((i.e. with SST = 1095; DST = 207 and MST =3136) being higher than the ECM textbook 1 (SST = 156, DST = 58 and MST = 1356).

Further analysis conducted to find out whether the observed differences between the categories of steps in mathematical tasks in the ACM textbook 1 and the ECM textbook 1 indicated that the observed differences were significant. By comparing the frequency of categories of steps in mathematical tasks in the ACM textbook 1 and ECM textbook 1 it can be seen by the frequencies cross tabulated in Table 6, that a difference between ACM textbook 1 and ECM textbook 1 was found. It can therefore be concluded that there was a difference between the categories of steps in mathematical tasks presented in the ACM and the ECM textbook 1.

In summary, the study showed that there was a difference between the categories of steps in mathematical tasks presented in the ACM and the ECM textbook 1.

4.5.2 Categories of steps in mathematical tasks in the ACM textbook 2 and the ECM textbook 2

In line with the research question four (4) for the study to determine whether there was a difference between the categories of steps in mathematical tasks in the ACM textbook 2 and the ECM textbook 2, Figure 11 is a chart showing the differences between categories of steps in mathematical tasks in the ACM textbook 2 and ECM textbook 2

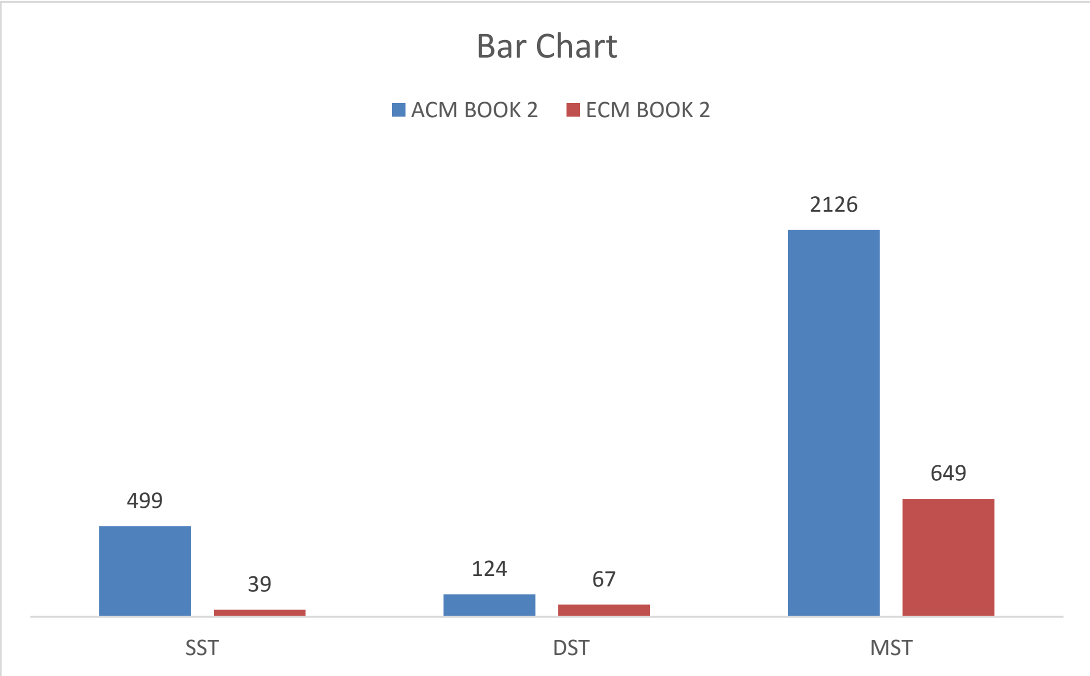

Figure 13: A chart showing the categories of steps in mathematical tasks in the ACM textbook 2 and ECM textbook 2

Figure 13 shows that there were differences in the categories of steps in mathematical tasks in the ACM textbook 2 and ECM textbook 2 in terms of numbers. Figure 13 shows that the ACM textbook 2 contained more single step tasks, double step tasks and multiple step tasks than the ECM textbook 2. Hence there was a difference between categories of steps in mathematical tasks in the ACM textbook 2 and ECM textbook 2 in favour of the ACM textbook 2.

Descriptive statistics of the categories of mathematical tasks in the textbook 2

Table 8 shows the descriptive statistics and chi-square test results of the categories of steps in mathematical tasks presented in the ACM textbooks 2and ECM textbook 2. Table 8 shows that the observed frequencies of categories of steps in mathematical tasks and their corresponding percentages for the two textbooks (ACM textbook 2 and ECM textbook 2) indicates that there was a difference in the categories of steps in mathematical tasks with respect to the observed frequencies and their corresponding percentages with the ACM textbook 2((i.e. with SST = 499; DST = 124 and MST =2126) being higher than the categories of steps in mathematical tasks in the ECM textbook 2 (SST = 39, DST = 67 and MST = 649). In summary, the study showed that there was a difference between the categories of exercises in mathematical tasks presented in the ACM and the ECM textbook 2. Hence, the study concluded that there was a difference between the categories of steps in mathematical tasks presented in the ACM and the ECM textbook 2.

Categories of steps in mathematical tasks presented in the ACM textbook 3 and the ECM textbook 3

To determine whether there is a difference between the categories of steps in mathematical tasks in the ACM textbook 3 and the ECM textbook 3,

Figure 14 is a bar chart showing the differences between types of tasks in the ACM textbook 3 and ECM textbook 3.

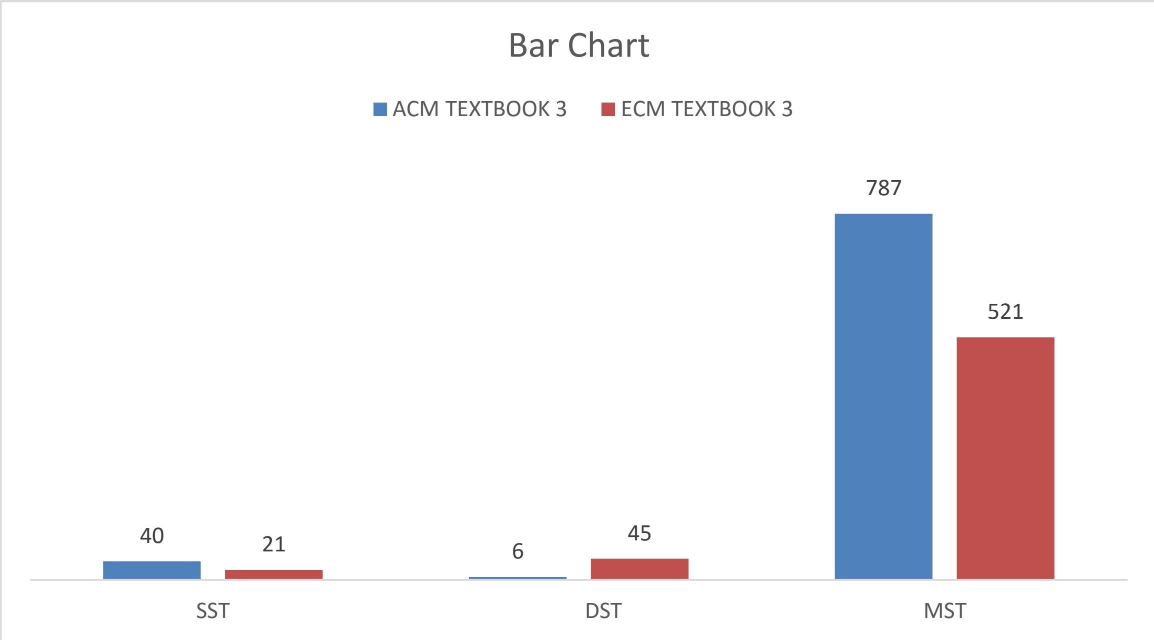

Figure 14: A Chart showing the Categories of steps in mathematical tasks in the ACM textbook 3 and ECM textbook 3

From Figure 14, although the ACM textbook 3 contained less double step tasks than the ECM textbook 3, it was however observed that the ACM textbook 3 contained more SST and MST than the ECM textbook 3.

Descriptive statistics of the categories of steps in mathematical tasks in the textbook 3

Table 8 further shows the categories of steps in mathematical tasks in ACM textbook 3 and ECM textbook 3. Table 8 indicates that there was a difference in the categories of steps in mathematical tasks in ACM textbook 3 and ECM textbook 3 with respect to the observed frequencies with the ACM textbook 3((i.e. with SST = 40 ; DST = 6 and MST =787) being higher than the categories of steps in mathematical tasks in the ECM textbook 3 (SST = 21, DST = 45 and MST = 521).

Further analysis conducted to find out whether the observed differences between between the categories of steps in mathematical tasks in the ACM textbook 3 and the ECM textbook 3 indicated that the observed differences were significant. Comparing the frequency of categories of steps in mathematical tasks presented in the ACM textbook 3 and ECM textbook 3, it can be seen by the frequencies cross tabulated in Table 8 shows that a difference between ACM textbook 3 and ECM textbook 3 was found. It can therefore be concluded that there was a difference between the categories of steps in mathematical tasks presented in the ACM textbook 3 and the ECM textbook 3. The results showed that there was a difference between the categories of steps in mathematical tasks presented in the ACM and the ECM textbook 3.

In summary, the study showed that there was a weak positive difference between the categories of exercises in mathematical tasks presented in the ACM and the ECM textbook 3. Hence, there was a difference between the categories of steps in mathematical tasks presented in the ACM and the ECM textbook 3.

Discussion on the differences between the categories of steps in mathematical tasks in the ACM textbooks and the ECM textbooks

The analysis of the results indicated that the categories of steps in mathematical tasks in the ACM textbooks 1, 2 and 3 were far higher than that of ECM textbooks 1, 2 and 3. The ACM textbooks 1, 2 and 3 had more SST, DST and MST than the ECM textbook 1, 2 and 3. This was emphasized by the core mathematics teachers interviewed who stated that there were different categories of steps in mathematical tasks in the ACM textbook 2 than in the ECM textbook 2. In addition to that, they stated that there were more MST in the textbooks.

In terms of the number of steps required in the solutions to tasks, the study revealed that tasks in the ACM textbooks were more challenging than those in the ECM textbooks. It was found that over 71% of the tasks in the ACM textbook 1 only needed one step to solve, whereas such tasks in the ECM textbook 1 were around 85%. It was found that over 77% of the tasks in the ACM textbook 2 were solved using three or more steps to solve, whereas such tasks in the ECM textbook 1 were around 86%. The study also revealed that 94% of the tasks in the ACM textbook 3 needed three or more steps to solve, whereas such tasks in the ECM textbook 3were 88%. The frequent exposure to multiple-step tasks for student users of ACM 1, 2 and 3 and ECM 1, 2 and 3 causes students to experience a very low level of difficulty in solving multiple-step tasks. It was found that over 77% of the tasks in the ACM textbook 2 were solved using three or more steps to solve, whereas such tasks in the ECM textbook 1 were around 86%.

The frequent exposure to multiple-step tasks for student users of ACM 1, 2 and 3 and ECM 1, 2 and 3 causes students to experience a very low level of difficulty in solving multiple-step tasks (Fan and Zhu, 2006). The results of the study have consistently revealed that tasks in the ACM textbooks and ECM textbooks were both challenging, in terms of the steps involved in the tasks solutions and exercises. ACM textbooks further provided considerably more tasks in absolute numbers which were presented using visual information than the ECM textbooks 1, 2 and 3. The observations made in this study is consistent with the study by Fan and Zhu (2006). The study further indicated that that there was also difference between the categories of steps in mathematical tasks presented in the ACM and the ECM textbooks 1, 2 and 3.

4.6 General Findings

4.6.1 General findings in the ACM textbooks 1, 2 and 3

The examination of the ACM textbooks revealed that the textbook had all the three years put into one but each had its own demarcations. It was further observed in the first year textbook that there were thirteen (13) units covering the following topics; ―Sets", "Real number system", ―algebraic expression", ―Number bases", ―Plane geometry", ―Linear equations and inequalities", ―Relations and functions", "Vectors in a plane", ―Simultaneous linear equations in two variables", ―Rigid motion", ―Statistics", ―Ratio and rates" and ―Percentages" with each unit ending with exercises and review exercises. (see Appendix J).

The examination of the ACM textbook 2 indicated that there are also thirteen (13) units covering the following topics; ―Modulo Arithmetic", "Indices and Logarithms", ―Simultaneous Linear Equations in two Variables", ―Percentages II", ―Variation", ―Statistics II", ―Probability", ―Quadratic functions and Equations", Mensuration", ―Plane Geometry 2", " ―Trigonometry 1", ―Sequences and Series",and ―Rigid motion and enlargement" with each unit ending with exercises(see Appendix J).

The examination of the ACM textbook 3 indicated that the textbook contained four (4) units covering the following topics; ―Constructions", ―Mensuration II", "interpretations of Linear and Quadratic graphs", ―Review exercise 1", ―Logical reasoning" and ―Trigonometry II". The textbook 3 also had general review exercises, multiple choice questions and answers to the review exercises. Each chapter had its own chapter summary. (see Appendix J).

4.6.2 General findings in the ECM textbooks

The examination of the ECM textbook 1 indicated that there are thirteen (13) units covering the following topics; “Sets”, ”Real number system”, “algebraic expression”, “Number bases”, “Plane geometry”, “Linear equations and inequalities”, “Relations and functions”, ” Vectors in a plane”, “Simultaneous linear equations in two variables”, “Rigid motion”, “Statistics”, “Ratio and rates” and “Percentages” with each unit ending with exercises. (see Appendix K).

The examination of the ECM textbook 2 indicated that there were ten (10) units covering the following topics; “Modulo Arithmetic”, ”Indices and Logarithms”, “Surds”, “Percentages 2”, “Variations”, “Quadratic functions / Equation”, “Plane Geometry 2”, ” Mensuration”, “Trigonometry 1” and “Probability” with each unit ending with exercises. (see Appendix K).

The examination of the ECM 3 indicates that the textbook contains nine (9) chapters covering the following topics; ”Sequences and series”, “Bearings”, “Constructions”, “Statistics II”, ”interpretations of Linear and Quadratic graphs”, “Review exercise 1”, “Mensuration”, “Logical reasoning”, “Percentages II”, “Rigid motion and Enlargement”, “Trigonometry II” and “review exercises 2” with each chapter having a chapter summary(see Appendix J).

CHAPTER FIVE

SUMMARY, DISCUSSION AND CONCLUSION

5.0 Overview

This chapter provides the conclusion of the whole research project. It includes a summary of the study and highlights the discussion of the findings. It further outlines some of the limitations, recommendations and avenues for further research studies.

5.1 Summary

This study was an attempt to find out the categories of exercises in mathematical tasks and the categories of steps in mathematical tasks in the ACM and ECM textbooks. The researcher carried out a content analysis on the ACM and ECM textbooks. The content analysis on the ACM and ECM textbooks (for SHS 1, 2, and 3) was to determine the categories of exercises in mathematical tasks and the categories of steps in mathematical tasks presented in the two textbook series. It specifically sought to find out the categories of exercises in mathematical tasks, the categories of steps in mathematical tasks presented in the ACM and ECM textbooks and their differences. In all, eight (8) core mathematics teachers were involved in the study. The researcher adapted and conducted written interviews for some mathematics teachers ACM and ECM textbooks 1, 2 and 3.

5.2 Findings

The findings of the study revealed that the ACM textbook 1 had four thousand, four hundred and sixty-five (4465) mathematical tasks of which 1057(24%) were WEX, 2863(64%) were EXX and 545(12%) were REEX whiles the ECM textbook 1 had 1469 mathematical tasks of which 414 (28%) are WEX, 1026 (70%) were EXX and 29 (2%) were REEX. This indicated that there was a difference in the categories of exercises in mathematical tasks presented in the ACM and the ECM textbook 1. There was a difference between the categories of exercise in mathematical tasks presented in the ACM textbook 1 and ECM textbook 1. It was therefore concluded that there was a difference between the categories of exercise in mathematical tasks in the ACM textbook 1 and that of the ECM textbook 1.

The ACM textbook 2 had 2,749 mathematical tasks of which 970(35%) were WEX, 1336(49%) were EXX and 443(16%) were REEX whiles the ECM textbook 2, had 755 mathematical tasks of which 242 (32%) were WEX, 483 (64%) were EXX and 30 (4%) were REEX. This indicated that there was a difference in the categories of exercises in mathematical tasks presented in the ACM and the ECM textbook 2. It can therefore concluded that there was a difference between the categories of exercise in mathematical tasks in the ACM textbook 2 and that of the ECM textbook 2.

On the categories of exercises in mathematical tasks, the ACM textbook 3 had 831 mathematical tasks of which 282(34%) are WEX, 323(39%) are EXX and 226(27%) were REEX whiles the ECM textbook 3 had five hundred and eighty-seven (587) mathematical tasks of which 151 (26%) were WEX, 406 (69%) were EXX and 30 (5%) were REEX. This indicated that there was a difference in the categories of exercises in mathematical tasks presented in the ACM and the ECM textbook 3. It was therefore concluded that there was a difference between the categories of exercise in mathematical tasks in the ACM textbook 3 and that of the ECM textbook 3.

On the categories of steps in mathematical tasks presented in the ACM textbook 1, out of the four thousand, four hundred and sixty-five (4465) mathematical tasks in the textbook one (1), 1095(25%) were SST, 207(4%) were DST and 3163(71%) were MST whiles the ECM core mathematics textbook 1 had one thousand, four hundred and sixty-nine (1469) mathematical tasks of which 156(11%) were SST, 58(4%) were DST and 1356(85%) were MST.

Further analysis conducted to determine whether there was a difference in textbook 1 indicated that there was a difference in textbook 1 with respect to the observed frequencies and percentages with the ACM textbook 1((i.e. with SST = 1095(25%); DST = 207 (4%) and MST =3136(71%)) being higher than the categories of tasks in the ECM textbook 1 (SST = 156(11%), DST = 58(4%) and MST = 1356(85%)). This was further established by a bar graph.

Further analysis conducted to find out whether the observed differences between the categories of tasks in ACM textbook 1 and ECM textbook 1 indicated that the observed differences were significant. It was therefore concluded that there was a difference between the categories of steps in mathematical tasks in the ACM textbook 1 and that of the ECM textbook 1.

The ACM textbook 2 had two thousand, seven hundred and forty-nine (2749) mathematical tasks of which 499(18%) are SST, 124(5%) are DST and 2126(77%) are MST whiles the ECM textbook 2 had seven hundred and fifty-five (755) mathematical tasks of which 39(5%) are SST, 67(9%) are DST and 649 (86%) are MST. The results of the descriptive statistics of the observed frequencies and their corresponding percentages indicated that there was a difference in textbook 2 with the ACM textbook 2 ((i.e. with SST = 499(25%); DST = 124 (5%) and MST =2126(70%)) being higher than the tasks of tasks in the ECM textbook 2 (SST = 39(5%), DST = 67(9%) and MST = 1356(86%)). A bar graph further indicated that there was a difference in categories of steps in mathematical tasks between the two textbooks.

It was therefore concluded that there was a difference between the categories of tasks in the ACM textbook 2 and that of the ECM textbook 2.

The ACM textbook 3 had 831 tasks in the textbook 3, 40 (5%) were SST, 6 (1%) were DST, 787 (94%) were MST whiles out of the five hundred and eighty-seven (587) tasks in the textbook 3, 21 (4%) were SST, 45 (7%) were DST, 521 (89%) were MST.

The results from the descriptive statistics indicated that there was a difference in textbook 3 with respect to the observed frequencies with the ACM textbook 3((i.e. with SST = 40 (5%); DST = 6 (1%) and MST =787 (94%)) being higher than the ECM textbook 3 (SST = 21(4%), DST = 45(8%) and MST = 521(88%)). This was confirmed by the bar graph.

It was therefore concluded that there was difference between the categories of steps in mathematical tasks in the ACM textbook 3 and that of the ECM textbook 3.

5.3 Discussions on Findings

The results of the study indicated that the contents of the ACM textbooks 1, 2 and 3 and the ECM textbooks 1, 2 and 3 to a contained three main categories of exercises in mathematical tasks which included WEX, EXX and REEX. The results further indicated that there were more EXX in both books than WEX and REEX. The results further indicated that there were differences between the categories of exercises in mathematical tasks presented in the ACM textbooks 1, 2 and 3 and ECM textbooks 1, 2 and 3.

The results of the descriptive statistics and chi-square test indicated that there was a difference in the categories of exercises in mathematical tasks presented in the ACM textbook 1 and ECM textbook 1 (ACM textbook 1: WEX = 1057(24%); EXX = 2863

(64%) and REEX =545(12%)) being higher than the ECM textbook 1 (WEX = 414(28%), EXX = 1026(70%) and REEX = 29(2%)). It was therefore concluded that there was a difference between the categories of exercises in mathematical tasks presented in the ACM textbook 1and ECM textbook 1.

The results of the descriptive statistics and chi-square test indicated that there was a difference in the categories of exercises in mathematical tasks presented in the ACM textbook 2 and ECM textbook 2 (ACM textbook 2: (WEX = 970(35%); EXX = 1336 (49%) and REEX = 443(16%)) being higher than the categories of exercises in mathematical tasks in the ECM textbook 2 (WEX = 242(32%), EXX = 483(64%) and REEX = 30(4%)). It was therefore concluded that there was a difference between the categories of exercises in mathematical tasks presented in the ACM textbook 2 and ECM textbook 2.

The results of the descriptive statistics and chi-square test indicated that there was a difference in the categories of exercises in mathematical tasks presented in the ACM textbook 3 and ECM textbook 3 (ACM textbook 3: WEX = 282(34%); EXX = 323 (39%) and REEX =226 (27%)) being higher than the categories of exercises in mathematical tasks in the ECM textbook 3 (WEX = 151(26%), EXX = 406(69%) and REEX = 30(5%)). It was therefore concluded that there was a difference between the categories of exercises in mathematical tasks presented in the ACM textbook 3and ECM textbook 3.

The results of the descriptive statistics and chi-square test indicated that there was a difference in the categories of steps in mathematical tasks presented in the ACM textbook 1 and ECM textbook 1 (ACM textbook 1: (SST = 1095(25%); DST = 207 (4%) and MST =3136(71%)), (ECM textbook 1: (SST = 156(11%), DST = 58(4%)

and MST = 1356(85%)).. It was therefore concluded that there was a difference between the categories of steps in mathematical tasks presented in the ACM textbook 1and ECM textbook 1.

The results of the descriptive statistics indicated that there was a difference in the categories of steps in mathematical tasks presented in the ACM textbook 2 and ECM textbook 2 types (ACM textbook 2: ((SST = 499(25%), DST = 124 (5%), MST =2126(70%)), and (ECM textbook 2: (SST = 39(5%), DST = 67(9%), MST = 1356(86%)). It was therefore concluded that there was a difference between the categories of steps in mathematical tasks presented in the ACM textbook 2 and ECM textbook 2.

The results of the descriptive statistics indicated that there was a difference in the categories of steps in mathematical tasks presented in the ACM textbook 3 and ECM textbook 3 (ACM textbook 2: ((SST = 499(25%), DST = 124 (5%), MST =2126(70%)), and (ECM textbook 2: (SST = 39(5%), DST = 67(9%), MST = 1356(86%)). It was therefore concluded that there was a difference between the categories of steps in mathematical tasks presented in the ACM textbook 3and ECM textbook 3.

The content analysis indicated that the content of the ACM textbooks 1, 2 and 3 and the ECM textbooks 1, 2 and 3 to a large extent contained more MST that requires higher order thinking skills, more problem solving strategies and procedures as far as mathematical tasks were concerned. This means that the modeling of the Ghanaian SHS core mathematics textbooks was done in a more explicit way. This is viewed as an advantage for teaching and learning as the instruction of tasks in the ACM and the ECM textbooks were in a more explicit way.

The observations made in this study, collaborates with the two profile dimensions and the scope of the content of the Ghanaian SHS core mathematics syllabus which have been specified for teaching, learning and testing at the SHS level. These constitutes 30% for Knowledge and Understanding and 70% for Application of Knowledge (CRDD, 2010). Each dimension weighted reflects in teaching, learning and testing and indicates the relative emphasis that the teacher should give in the teaching, learning and testing processes at the SHS (CRDD, 2010). The SST and DST reflects the dimensions of Knowledge and Understanding in the textbooks whiles the MST also reflects the dimension of Application of Knowledge in the textbooks.

The observation of this study further collaborates the scope of the content of the syllabus which states that ―Problem solving and application" has not been made a topic by itself in the syllabus since nearly all topics include solving word problems as activities. As such teachers and textbook developers should incorporate appropriate tasks that requires higher ordered mathematical thinking rather than mere recall and use of standard algorithms (CRDD, 2010).

The observation of this study further collaborates earlier findings by Fan and Zhu (2007), who also observed that the instruction of problem-solving should not be treated as an isolated topic and that it should be integrated into regular mathematics teaching and learning and in the textbooks. This was further emphasised by Asiedu-Agyem, (2014), who also outlined that teaching how to solve mathematics tasks through problem solving is important because presenting a problem and developing the skills needed to solve that problem is more motivational than teaching the skills without a context which enhances logical reasoning, helps students to be able to decide what strategy to use, if a situation requires and helps students to develop their own rules in a situation where an existing rule cannot be directly applied. It can therefore be argued that Ghanaian SHS textbooks make use of different categories of steps in mathematical tasks with much more emphasis being placed on MST. It can therefore be concluded that there is congruence between what is emphasized in the mathematics syllabus and the Ghanaian SHS core mathematics textbooks.

5.4 Limitations of the Study

The results of this research study could not be generalized due to the following set of reasons:

- The research should have been conducted for all SHS core mathematics textbooks but due to time factor only two core mathematics textbooks were used in the study.
- The research should have been conducted for all SHS 3 core mathematics teachers but due to accessibility and convenience only eight (8) SHS core mathematics teachers took part in the study.
- Only two schools in the Akuapem-North municipality were sampled and this limited the scope of the research.

5.5 Conclusion

In conclusion, it is not enough to be proficient at computation or at memorizing rote procedures to solve mathematical tasks. These skills are important, but even more important are the abilities to recognize and define tasks, generate multiple solutions or paths toward solution, reason, justify conclusions, and communicate results. These are not abilities that one is born with and they do not generally develop on their own. Many students cut class and are truant, so many admit to cheating to get through, so many lose interest because they cannot keep up and so many are bored by the lack of appropriate challenge. So many do not learn that ability is not enough and effort is crucial. About half of students who drop out say their classes were not interesting, and about two-thirds say not one teacher cared about their success in learning at school. Not all is rosy with teachers, teaching, and school (Tomlinson, 2014). For students to become gifted, promising, and creative mathematicians, these talents must be cultivated and nurtured. As such these textbooks used by students should contain more multiple step tasks so as to help our students develop their abilities to solve mathematical tasks.

5.6 Recommendations

The senior high school mathematics curriculum has seen two major revisions in 2003 and 2007. The latter was in view of the current reforms and the former, as indicated earlier, was in response to moves to ensure that the curriculum meets the requirements of the changes introduced as a result of Ghana joining the WASSCE (Mereku, 2010). Over the last few years, attempts have been made by the Ministry of Education and Sports to encourage the development and purchase of textbooks that match the revised syllabuses. Several textbooks are now available for teaching mathematics at the primary and junior high school level, though not adequate

(Anamuah-Mensah, Mereku & Asabere-Ameyaw, 2004). Mathematics at the Senior High School level is more abstract and theoretical, and heavily founded on the basis of deductions. For this reason, any student who enters these institutions of higher learning is expected to think and use the core mathematics textbooks that are available so as to be able to solve mathematical tasks. From the results of the content analysis of the two core mathematics textbooks, it emerged that majority of the tasks in the ACM textbook 1, 2, and 3 and the ECM textbooks were MST. This situation gives the Ghanaian SHS students more opportunities with other students in the rest of the world where MST are emphasized in their textbooks and used in solving mathematical problems. Therefore the following recommendations were made for the improvement of the Senior High school core mathematics textbooks:

- Curriculum developers and policy makers should therefore consider revisiting the SHS mathematics textbooks to ensure that there are much more challenging tasks that are MST in nature to lay a solid foundation on student‘s problem solving abilities.
- Curriculum developers and policy makers should consider revisiting the SHS mathematics textbooks to ensure that there are indicators of problem solving strategies used in the worked examples for students to have a firm grip of the problem solving strategies and procedures. This will further aid teachers to teach problem solving strategies in their mathematics classes.
- Curriculum developers and policy makers should consider revisiting the SHS mathematics textbooks to ensure that problem solving strategies and procedures are integrated into the regular mathematics teaching and learning and in the textbooks. This will further aid teachers to teach problem solving strategies in their mathematics classes.

- The teaching and learning of the use of mathematics should involve much more MST that will actively engage students. This will enhance students' conceptual understanding of mathematical concepts and build them up in application of knowledge.

5.6 Areas for Further Research

This research forms a useful platform for future research in the following areas:

It would be of much benefit to see further research studies.

a. undertaken on other categories of mathematical tasks such as routine and non-routine tasks, application and non-application tasks as well as traditional and non-traditional tasks on two Ghanaian SHS core mathematics textbooks and the results compared with each other at the doctoral level.

b. Undertaken on the effectiveness of SHS students' problem solving abilities and implementing an intervention at the doctoral level.

c. undertaken on three Ghanaian SHS core mathematics textbooks and the results compared with each other at the doctoral level.

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APPENDIX A

CONTENT ANALYSIS GUIDE

1. Does the SHS mathematics textbook contain different categories of mathematical tasks?
2. Are the different categories of mathematical tasks used in the SHS mathematics textbooks good enough in emphasizing problem solving procedures?

APPENDIX B

CONTENT ANALYSIS CODEBOOK

INTERVIEW GUIDE FOR SHS MATHEMATICS TEACHERS

1. What is a mathematical task?

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2. Are there enough mathematical tasks in the textbooks you use?

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3. What are some of the categories of exercises in mathematics tasks in the textbooks?

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4. What are some of the categories of steps in mathematics tasks in the textbooks?.

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APPENDIX C

TASK ANALYSIS CODEBOOK

TEXTBOOK	CHAPTER /UNIT	TASKS	CATEGORIES OF STEPS IN MATHEMATICAL TASKS
TOTAL NUMBER OF TASKS			

APPENDIX D

CODING PROTOCOL OF CATEGORIES OF EXERCISES IN MATHEMATICAL TASKS AND THEIR CODES

CATEGORISE OF STEPS IN MATHEMATICAL TASKS	CODE	CATEGORISATION DEFINED
Worked Examples	**WEX**	• Tasks that have be solved in the textbooks are known as worked examples
Exercises	**EXX**	• Tasks that have be placed in the textbooks for students to use in practising various concepts after a particular topic have been treated in the textbooks.
Review Exercises	**REEX**	• Tasks that have be placed in the textbooks for students to use in practising various concepts in the textbooks after students have been taken through a number of topics.

APPENDIX E

CODING PROTOCOL OF CATEGORIES OF STEPS IN MATHEMATICAL TASKS AND THEIR CODES

CATEGORISE OF STEPS IN MATHEMATICAL TASKS	CODE	CATEGORISATION DEFINED
Single step tasks	**SST**	• Tasks that can be solved by going through only one direct step before arriving at the answer are defined as single-step tasks
Double step tasks	**DST**	• Tasks that can be solved by going through only two different steps before arriving at the answer are defined as Double-step tasks
Multiple step tasks	**MST**	• Tasks that can be solved by going through more than two different steps before arriving at the answer are defined as multiple-step tasks

APPENDIX F

INTERVIEW EVALUATION FORM

QUESTION	NO. OF RESPONSES

APPENDIX H

OBSERVATIONAL CHECKLIST FOR CATEGORIES OF EXERCISES IN MATHEMATICAL TASKS

Key: WEX: Worked Examples; EXX: Exercises; REEX: Review Exercises

	Yes	No
WEX		
EXX		
REEX		

APPENDIX I

OBSERVATIONAL CHECKLIST FOR CATEGORIES OF STEPS IN MATHEMATICAL TASKS

Key: SST: Single step tasks; DST: Double step tasks ; MST: Multiple step tasks

	Yes	No
SST		
DST		
MST		

APPENDIX J

AKIOLA CORE MATHEMATICS TEXTBOOK 1

UNIT	TOPIC	WORKED EXAMPLES	EXERCISES	REVIEW EXERCISES
1	Sets and operations on sets	64	175	60
2	Real Number System	82	419	30
3	Algebraic expression	113	437	22
4	Surds	59	40	17
5	Number Bases	60	338	46
6	Relations and Functions	90	173	35
7	Plane Geometry	72	242	42
8	Formulas, Linear Equations and inequalities	113	512	125
9	Bearings and Vectors in a Plane	138	88	46
10	Statistics 1	67	89	17
11	Rigid Motion 1	27	30	9
12	Ratio and Rates	97	133	44
13	Percentages	75	187	49
	TOTAL	**1057**	**2863**	**545**

AKIOLA CORE MATHEMATICS YEAR 2

UNIT	TOPIC	WORKED EXAMPLES	EXERCISES	REVIEW EXERCISES
1	Modular Arithmetic	92	74	32
2	Indices and Logarithms	215	226	55
3	Simultaneous Linear Equations in two Variables	27	70	41
4	Percentages II	61	77	32
5	Variation	45	61	33
6	Statistics 2	53	79	31
7	Probability	90	68	30
8	Quadratic Functions and Equations	88	136	30
9	Mensuration	74	157	70
10	Plane Geometry 2 (circle theorems)	27	56	6
11	Trigonometry 1	60	198	27
12	Sequences and Series	47	99	29
13	Rigid motion and enlargement	91	35	27
	TOTAL	**970**	**1336**	**443**

AKIOLA CORE MATHEMATICS YEAR 3

UNIT	TOPIC	WORKED EXAMPLES	EXERCISES	REVIEW EXERCISES
1	Construction	36	66	35
2	Mensuration 11	199	210	58
3	Logical reasoning	15	47	14
4	Trigonometry II	32		6
5	General review exercises			113
6	Multiple choice questions			
	Answers to review exercises			
	TOTAL	**282**	**323**	**226**

APPENDIX K

ENRICHED MATHEMATICS TEXTBOOK 1

UNIT	TOPIC	WORKED EXAMPLES	EXERCISES	REVIEW EXERCISES
1	Sets	14	59	
2	Real Number System	52	83	
3	Algebraic Expressions	89	175	
4	Number bases	38	64	
	Review Exercises 1			10
5	Plane Geometry	28	80	
6	Linear Equations/ Inequalities	38	83	
7	Linear Equations/ Inequalities	42	106	
8	Vectors in a Plane	17	79	
9	Simultaneous Linear Equations and Two Variables	9	43	
	Review Exercise 2			10
10	Rigid Motion	19	94	
11	Statistics	23	45	
12	Ratio and Rates	29	39	
13	Percentages	16	76	
	Review Questions 3			9
	TOTAL	**414**	**1026**	**29**

ENRICHED MATHEMATICS TEXTBOOK 2

UNIT	TOPIC	WORKED EXAMPLES	EXERCISES	REVIEW EXERCISES
1	Modulo Arithmetic	23	53	
2	Indices and Logarithms	69	129	
3	Surds	27	60	
4	Percentages 2	11	14	
5	Variations	14	41	
	Review Exercise			15
6	Quadratic functions / Equation	17	50	
7	Plane Geometry 2	22	51	
8	Mensuration	30	30	
9	Trigonometry 1	29	55	
10	Probability	14	29	
	Review Exercise 2			15
	TOTAL	**256**	**512**	**30**

ENRICHED MATHEMATICS BOOK 3

UNIT	TOPIC	WORKED EXAMPLES	EXERCISES	REVIEW EXERCISES
1	Sequences and Series	25	51	
2	Bearings	28	56	
3	Constructions	8	60	
4	Statistics 2	16	29	
5	Interpretation of Linear and Quadratic Graphs	7	37	
	Review Exercise 1			15
6	Mensuration	22	56	
7	Logical Reasoning	19	41	
8	Percentages 3	10	19	
9	Rigid Motion and Enlargement	12	49	
10	Trigonometry	4	8	
	Review Exercise 2			15
	TOTAL	**151**	**406**	**30**

APPENDIX L

CONTENT ANALYSIS CODEBOOK

TEXT BOOK	CHAPTER /UNIT	WORKED EXAMPLES	EXERCISES	REVIEW EXERCISES	TOTAL NUMBER OF TASKS
TOTAL NUMBER OF TASKS					