UNIVERSITY OF EDUCATION, WINNEBA

CHEMISTRY TOPIC-DIFFICULTIES PERCEIVED BY SHS STUDENTS AND HOW THEY ARE ADDRESSED BY THEIR TEACHERS AND THE PRESCRIBED TEXTBOOKS

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DECLARATION

CANDIDATE'S DECLARATION

I, Awere Joseph, 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

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

NAME OF SUPERVISOR: PROF. JOHN K. EMINAH (Principal Supervisor)

Signature :…………………………

Date:………………………………

NAME OF SUPERVISOR: PROF. VICTOR ANTWI (Co-Supervisor)

Signature :…………………………

Date:………………………………

DEDICATION

I dedicate this research work to my loving father, Opanin Kwasi Asante.

ACKNOWLEDGEMENT

My heartfelt thanks go to the Almighty God, who gave me the wisdom and strength to go through my studies and whose abundant grace sustained me throughout this study. I would want to put on record my profound appreciation to my academic supervisor, Professor John K. Eminah, who generously lent some of his journals and books to me and also offered constructive criticisms, support and encouragement in completing this work. I say a big thank you and may God richly bless you. I also wish to thank Prof. Victor Antwi (the co-supervisor) for his immense help, patience and contribution to the successful completion of this thesis.

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ACRONYMS /ABBREVIATIONS

S.H.S	-	Senior High School
WAEC	-	West African Examinations Council
WASSCE	-	West African Senior School Certificate Examination
AAAS	-	American Association for the Advancement of Science
CRDD	-	Curriculum Research and Development Division
MoE	-	Ministry of Education
G.E.S	-	Ghana Education Service
TVI	-	Technical and Vocational Institutions
ICT	-	Information and Communication Technology
GAST	-	Ghana Association of Science Teachers
IUPAC	-	International Union of Pure and Applied Chemistry
SSS	-	Senior Secondary School
KOVS SERIES	-	Ultimate Chemistry for West African Senior High Schools authored by Quaitto William Agyapong
SARPS SERIES	-	Comprehensive Notes on Modern Chemistry for West African Senior High Schools & Colleges authored by Sarpong, F. K.
BRIGHTEST & BEST SERIES	-	Elective Chemistry for West African Senior High Schools authored by Asamoah, R.

ABSTRACT

This study investigated chemistry topic difficulty perceived by SHS students and how the available textual materials and teachers help in addressing the difficulties. Five research questions guided the study. The study employed the descriptive survey design. The population comprised all SHS 3 chemistry students in eight schools selected from five administrative districts in Western Region. The sample size was 280 SHS 3 chemistry students and sixteen teachers. It was established that students perceived nine (9) out of the twenty carefully selected topics in the SHS curriculum to be difficult. According to the students, the most difficult topic in the SHS chemistry curriculum was 'Redox Reactions' followed by 'Electrochemistry' and 'Nomenclature of Organic Compounds'. The respondents noted the abstract nature of the topics, lack of practical activities, unavailability of prescribed textbooks, and uninteresting lessons as some of the causes of topic difficulty. The study established no significant difference in the topics perceived to be difficult by both male and female students. Again, it was revealed that the chemistry teachers' instructional strategies contributed to students' perceived topic difficulty in the selected schools. Surprisingly, some of the available textual materials in use by both teachers and students did not meet the requirements of good textbooks. Specifically, the language level of some of the books was above the students, while some of the books did not provide topic summary and learning objectives. Additionally, there were inadequate exercises for students. It was recommended that as much as possible, simple language should be used in writing chemistry books and, more specifically, in explaining difficult concepts. It was recommended that books should be revised often and that worked examples and exercises should be provided after authors had treated the topics.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This is the introductory part of the thesis. It discusses the background to the study, statement of the problem, purpose of the study, research objectives, research questions, research hypothesis, significance of the study, the assumptions that were made in conducting the research, delimitations and limitations and organisation of the study.

1.1 Background to the Study

Chemistry is a popular subject among senior high school science students in Ghana because it is a major requirement for advanced programmes in the natural and applied sciences. It addresses the needs of mankind through its relevance and functionality in content, practice and application. What many nations like Ghana need now is a functional chemistry education that will assist in national development. Chemistry education has been identified to be one of the major bedrocks for the transformation of our national economy. Chemistry education can be seen as the acquisition of knowledge or ideas relevant to chemistry. It is concerned with the impartment of knowledge on properties, components, transformations and interactions of matter. Chemistry education is therefore the systematic process of acquiring fundamental knowledge about the universe. With these indispensable knowledge richly acquired, humans can shape and reshape this world for their benefit. Additionally, the development of a nation is usually measured by the degree and extent of growth brought to it through the enterprise of science education and a gate way to this is chemistry education. Chemistry education is the vehicle through which chemical knowledge and skills reach the people who are in need of capacities and potentials for development. Apart from this, chemical education addresses the social objective of substance development, as education is now the primary means for empowerment, participation, cultural preservation, social mobility and equity (Emmanuel, 2013 as cited in Emendu, 2014).

Chemistry is an essential basis for many facets of our everyday lives, and has many unforeseen potential benefits for our future. An understanding of chemistry allows us the opportunity to make sense of, and explain the world around us. It develops basic knowledge of how to live in this world, to deal with the issues of daily life and how to make decisions concerning our actions as individuals. Examples are: how food changes when we cook it, how cleaning works and which cleaning agent to choose for which purpose, how materials are produced and how we can use them with respect to their different properties. A few more examples are the functioning of medicine, vitamins, supplements, and drugs, or understanding potentials and risks of many modern chemistry related products and technologies. Besides, a lot of chemistry-related topics are essential to our lives and are also fundamental to the society in which we live. For example, responsible use (and consumption) of energy resources, guaranteeing sufficient and healthy nutrition, securing sustainability in drinking water supply, framing sustainable industrial development are areas (topics) that need the knowledge of chemistry for better understanding. Clearly, these developments are important to all citizens who live and operate in a modern society and eventually (in the future) they will be asked to critically reflect upon these issues, to contribute to societal debates and to make important scientifically-based decisions. These reflections and decisions will be made individually or in groups within the society in which we live and operate.

One of the goals of chemistry education is to develop students' learning skills in chemistry. The goal of helping students to acquire scientific knowledge and the required skills may not be achieved due to poor study and irregular habits and ineffective practical lessons among senior high school students in chemistry. Chemistry is essentially a practical oriented subject which demands proper exhibition of good study behaviour effective interpretation of existing phenomena (Orimogunje, Oloruntagbe & Gazi, 2010). Students are seldom exposed to practical work, according to Anamuah-Mensah (1999). This lack of practical activities by chemistry students may have resulted in poor communication and observational skills. The absences of these skills give rise to students' poor performance in chemistry (WAEC, 2006). The impact of chemistry on technology involves the process of bringing manufacturing inventories and sculpturing, designing into reality. Technology can be seen as the application of scientific knowledge, skills, work attitudes, tools and equipment in evaluation of new processes and adoption of these processes to the production of goods and services for the benefit of mankind (Hornby, 2010). Chemistry education plays an important role in enhancing the quality of teaching and research as well as ensuring that students are equipped with good knowledge to produce quality goods and services to meet human needs in food production, health care products and other materials aimed at improving the quality of life (Emendu, 2014).

Chemistry is one of the science subjects from which technological breakthroughs emerge and is the pivot on which the wheel of science rotates. It is one of the basic pre-requisites for functional science education-yet it has not been given adequate attention. Education, particularly science and technology education is one of the fundamental requirements for the production of the needed technologists, technicians and craftsmen as well as skilled artisans whose combined contribution is necessary to turn the country's economy around and usher in the defined technological advancement which is very much required for the elevation of the nation from a consumer nation to a developed nation (National Policy on Science and Technology Education, 2014). The importance of chemistry in the scientific and technological development of any nation has been widely reported (Agogo & Orda, 2014). It was as a result of the recognition given to chemistry in the development of the individual and the nation that it was made a compulsory subject for Visual Arts, Agriculture and Home Economics students at the senior high level in Ghana in 2008. Also, it is due to the achievements and contributions of chemistry to the well-being of mankind, that the United Nations General Assembly declared 2011 as the International Year of Chemistry (IYC 2011) with a broad theme "Chemistry-our life, our Future" (Nweze-Akpa, 2011).

In spite of the relevance of chemistry to our nation, the study of the subject in our schools is bedevilled with poor performance. There has been consistent decline in the performance of students in public examinations conducted by the West African Examinations Council (WAEC) in chemistry across the country over the years (WAEC 2006, 2014). Researchers have assigned a number of reasons to this phenomenon. Some reasons adduced as to the cause of students' poor performance included the abstract nature of chemistry (Samba & Eriba 2012 as cited in Uchegu, Anozioh, Mbadingo, Ibe and Njoku (2015), while some hinged it on students and teachers related factors (Mailumo, Agogo & Kpagh, 2007). Others think it is due to concepts difficulty (Agwai, 2008). The ability of chemistry teachers to comprehend and internalise concepts and skills are determined not only by individual differences, but also by the teachers' effectiveness in terms of his/her teaching experience and qualifications. Educators therefore emphasise on the qualification of teachers in the proper execution to their professional mandate. Such teachers are expected to perform academic roles as well as leadership roles that are related to the successful and meaningful teaching and learning of their specialised subjects. The qualification of chemistry teachers will therefore enable them to competently handle all concepts in chemistry (Mailumo et al, 2007).

Perception is one of the mental processes or skills human beings engage in. It is a cognitive activity in learning which is seen as the process of making sense out of something (Agogo, Ogbeba & Darmkor-Ikpa, 2013). Ortese, Yaweh and Akume (2006) posited that learners' perceptions are often affected by a given number of factors, such as interest, motivation, attention, self-concept as well as thinking and creativity. This is why Agogo (2003) observed that what may appear difficult to someone may be easy to another person because the concepts of easiness or difficulty as perceived by people are dynamic. Whatever is the case, concept difficulty invariably affects students' performance in a subject.

Curriculum has been defined in various ways. Ugwu (2008) defined curriculum as the experience a school system provides for its students. According to Agusiobo (2003) curriculum is an organised framework that sets out the content that children are to learn and the process through which the curriculum sets for them. Therefore, curriculum can be seen as all experiences students have under the guidance of the school in a school system. The Ministry of Education (2007), based on the importance of the chemistry curriculum, revised the SHS chemistry curriculum to reflect in-depth appropriateness and interrelatedness of curricula contents. Also, emerging issues/areas such as petro-chemistry, oil and gas were infused into the relevant contents of the new SHS chemistry curriculum. The objective of the revised edition of the senior secondary education chemistry curriculum is expected among other things to enable students develop interest in the subject of chemistry and acquire basic theoretical and practical knowledge in order to meet the demands of the subject. To achieve these objectives, chemistry teachers have very important roles to play, because the chemistry teacher is the bridge between the curriculum and the students. Indeed, chemistry teachers are responsible for the effective implementation of the chemistry curriculum.

Textbooks stand out at the heart of educational enterprises. Teachers rely on them to set the parameters for instruction and to impart basic educational content. In schools, students' school work often begins (and in some schools ends) with the textbook. Textbooks constitute the base of knowledge, particularly in the third world countries where there is a chronic shortage of qualified teachers and online educational services (Naize, 2001). Since textbooks are very important in the teaching and learning process they need to be critically evaluated to see whether they meet the expected educational goals.

It is an undeniable fact that for any curriculum objectives to be achieved, the role of teachers as well as textbook quality cannot be ruled out. The teacher organises all learning experiences that must go on for the stated objectives in the curriculum to be achieved. The available textbooks support whatever information that the teacher has on the curriculum. Students (learners) also make references to the available textbooks for information. It is quite clear that a teacher's strategies could have effect on the learning outcome of students. Also, good teaching strategies will enhance students' learning while bad or poor teaching methods affect the performance of learners. Good quality textbooks play significant role in the realisation of the objectives in every school curriculum. The achievement of any school curriculum depends largely on the role played by teachers and the prescribed textbooks.

1.2 Problem Statement

Chemistry is a central science subject as credit score in it is required at the senior high school certificate level for entry into nearly all basic and applied science courses at the tertiary level of education in Ghana. Students' performances in Chemistry at the senior high school level have been of great concern to most science educators. Ghanaian students have, for many decades, performed very poorly in chemistry at the West African Senior Secondary School Certificate Examination (WASSCE) Level (West African Examinations Council (WAEC), 2006, 2014). According to Ampiah (2001), SSSCE chemistry results over the years have been consistently below average. These students carry the same poor performances to the tertiary institutions. Studies have shown that students' underperformance in chemistry at the undergraduate level was due to reasons such as poor background of chemistry from the pre-university level. The students found chemistry concepts very complicated and that the students did not want to put in effort themselves but rather believed in spoon-feeding by their instructors (Mahajan & Singh, 2005).

In recent studies to find out hindrances to chemistry teaching in secondary schools in Imo State, Nigeria, Uchegu, et al (2015) found that sometimes practical activities were not organised for students due to unavailability of equipment and materials. They also discovered that one of the causes of students' poor performance in chemistry resulted from students perceiving chemistry as a difficult subject with many theories. This is also supported by Agogo and Orda, (2014) who pointed out that students' anxiety for chemistry learning could be attributed to students' perceived difficult nature of chemistry and abstract nature of chemistry concepts. Tajudeen (2005), in his study on students' perception of difficult topics in the chemistry curriculum in Nigerian Secondary Schools found that students perceived thirteen (13) topics out of twenty (20) major topics in the secondary school chemistry curriculum as difficult topics. Perhaps the low performance of chemistry students at the WASSCE level may not be surprising since the study found most of the topics in the curriculum difficult to comprehend.

This persistent poor achievement in chemistry could undermine the attainment of a national policy of having 60% of students enrolled in tertiary institutions as students in science and science-based courses, while 40% would be students in Arts and Humanities by the year 2020 (National Science and Technology Education Policy, 2008). Chemistry, being one of the most important branches of science enables learners to understand what happens around them. Due to the fact that chemistry topics are generally related to or based on the structure of matter, it proves to be a difficult subject for many students. Chemistry curricula commonly incorporate many abstract concepts, which are central to further learning in both chemistry and other sciences (Taber, 2002). Though several factors have been identified for students' poor performance in the sciences and for that matter chemistry, and efforts have been made toward tackling some of the challenges during seminars, conferences and workshops, students' performances are still not encouraging as expected. Again, most researchers have concentrated on the identification of difficult topics and their causes in the secondary school chemistry syllabus but have not found out how the available textual materials and teachers address the difficulties identified. If students find the topics in chemistry difficult, then they may find it difficult to pass chemistry. Based on this, a critical assessment of the curriculum, the textual materials available for use by teachers and students, as well as teachers' teaching skills and strategies employed in teaching chemistry have to be researched into. Hence, the need for this study.

1.3 Purpose of the Study

The purpose of this study was to determine the topics SHS students in the Western region perceived to be difficult in the senior high school chemistry curriculum and how the available textual materials and teachers addressed the difficulties identified.

1.4 Research Objectives

Generally, the study sought to investigate the topics senior high school students perceived to be difficult in the chemistry curriculum in the selected schools in Western Region and also to determine how the available textual materials and teachers address the difficulties perceived by the students. Specifically, the following objectives were outlined:

1. Identify topics in the senior high chemistry curriculum students perceived to be difficult to learn
2. Find out the causes of the topic difficulties perceived by the selected senior high school chemistry students.
3. Investigate how the available textual materials addressed the difficulties perceived by the selected senior high school chemistry students
4. Investigate how the teachers addressed the difficulties perceived by the selected senior high school chemistry students
5. Find out whether there were differences in the chemistry topic difficulty perceived by male and female SHS students.

1.5 Research Questions

The research questions that guided this study were as follows:

1. What chemistry topics do senior high school students perceive as difficult?
2. What are the causes of the topic difficulties perceived by the senior high school students in chemistry?
3. To what extent do the available textual materials help in addressing students' perceived topic difficulties in chemistry?
4. How do the chemistry teachers help in addressing students' perceived topic difficulties in the SHS chemistry?
5. Do differences exist in the chemistry topic difficulties perceived by male and female SHS students?

1.6 Null Hypothesis

The following null hypothesis was tested at the end of the research:

There is no significant difference in the chemistry topic difficulty perceived by male and female SHS students.

1.7 Significance of the Study

The main objective of this study was to identify the topics in the S.H.S chemistry syllabus that students perceive to be difficult and examine how teachers and the available textbooks address these difficult topics. It is expected that the study will identify the topics in the S.H.S chemistry syllabus that students perceive to be difficult and the reasons for their perceptions. Also, the in-depth examination that will be made into teachers' approach toward teaching these difficult topics as well as the available textual materials on chemistry will indicate the extent to which the teachers and the available textbooks address students perceived topic difficulty in the S.H.S chemistry syllabus.

The outcome of the study will therefore serve as a material (literature) for researchers who will be doing further studies into this topic or a similar one.

The study will also help teachers of chemistry to review and adopt teaching strategies that are result-oriented so as to help students in overcoming their learning difficulties which will eventually improve their performance in the WASSCE.

Again, the study will make suggestions to the Curriculum Research and Development Division (CRDD) of the Ghana Education Service (G.E.S) in the design and development of textual materials for S.H.S chemistry for use by students. That is, to design and develop textbooks that are user friendly and also help in addressing students' perceived topic difficulties in the S.H.S chemistry syllabus.

1.8 Assumptions of the Study

In conducting this research, two main assumptions were made. It was assumed that schools selected for the study used the GES approved syllabus for the teaching and learning of chemistry at the SHS level. Secondly, it was also assumed that teachers followed the sequential order in which the topics had been arranged in the syllabus to ensure that students had been taught on the topics selected for the research.

1.9 Delimitations

Many factors were considered in addressing students' learning difficulties in chemistry in schools in Ghana. For the purpose of this work, the researcher concentrated on how teachers and the available textbooks address students' difficulties in learning chemistry.

Ideally, the study should have covered the entire country. However, due to financial and time constraints, the researcher limited his study to some selected schools in the Western Region of Ghana.

Again, the target population comprised all elective chemistry students in public senior high schools in the Western Region of the Republic of Ghana. However, the sample consisted of S.H.S 3 students in the selected schools.

1.10 Limitations

The researcher encountered some problems in conducting this investigation or research. One of the problems was financial constraints. Due to the geographical nature of the Western Region, the researcher had to travel far distances to visit the schools selected for the collection of the data. This led to a situation where the researcher had to spend more than what was budgeted. The researcher had to exceed the budgeted amount for the collection of data. Again, at the time of collecting the data, the students were doing their mock examination. The researcher had to wait for hours for them to finish their examination before getting them to respond to the questionnaire. Some students (respondents) were not willing to respond to the questionnaire due to the fact that their identity could be disclosed. The researcher had to assure them of anonymity and confidentiality. Again, the attitude of some of the respondents (teachers) undermined the credibility of the data collected. The researcher asked some teachers to assist in organising the students for the collection of the data in some of the schools. It was observed that their presence influenced students' responses to some aspect of the questionnaire. However, since this did not happen in all the schools visited, it did not affect the credibility of the result so much.

1.11 Definition of Terms:

Chemistry Curriculum: This refers to the elective chemistry syllabus designed in 2010 for use in senior high schools by the GES.

Teacher: Refers to a person who provides education for pupils (children) and students (adults)

Student: Refers to a learner or someone who attends an educational institution to acquire knowledge and skills

Academic Performance: Students' achievement/result in West African Senior High School Certificate Examination at the end of an academic programme in a school.

1.12 Organisation of the Study

The first part of the report of this study was on the introduction which was devoted to the background to the study, statement of the problem, the purpose of the study, research objectives/questions, research hypothesis, significance of the study, assumptions of the study, delimitations, limitations, definition of terms and organisation of the study.

The second chapter provides the review of related literature to the study. The relevant literature that were reviewed in this study included: empirical review, perception and its influence on students' performance, the concept of chemistry education in Ghana, perceived difficulties of chemistry topics, the relevance of chemistry in national development, design and development of chemistry textbooks for students, S.H.S chemistry teachers' teaching approach, students' interest in chemistry, and the S.H.S chemistry curriculum.

The third chapter gives a detailed description of the methodology used for the study. This includes research design, population, sample and sampling technique, research instruments, data collection procedures and data analysis method.

The fourth chapter is devoted to the presentation of the data collected. In-depth data analysis was done to answer the research questions as well as the hypothesis.

Chapter five is the concluding chapter. In this chapter, a summary of the analysed results and conclusion are presented. The final part in this chapter is the recommendations made at the end of the study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

The literature related to this study was reviewed under the following headings:

- ✓ Conceptual Framework
- ✓ The Concept of Perception and its Influence on Learning
- ✓ Areas of Topic-Difficulties in Chemistry
- ✓ The Role of Chemistry Education in National Development
- ✓ Teachers Role in Achieving Curriculum Objectives in Chemistry
- ✓ The Role of Curriculum Materials (Textbooks) in Achieving Curriculum Objectives
- ✓ Students' Attitude towards the Study of Chemistry
- ✓ Influence of Gender on the Learning of Chemistry at the S.H.S Level
- ✓ Factors Influencing the Teaching and Learning of Chemistry
- ✓ Effective Approach to the Teaching of Chemistry
- ✓ Students' Interest in Science (Chemistry) Education
- ✓ The Nature of the S.H.S Chemistry Curriculum(Syllabus)
- ✓ Textbook Development and Distribution Policy for Pre-Tertiary Education in Ghana
- ✓ Empirical Framework

2.1 Conceptual Framework

Allport (1966) discussed the psychological concept of perception as the way through which we evaluate people we are familiar with. This study adopts the view of Allport as the theoretical basis for students' perception of topic difficulties in the S.H.S chemistry curriculum and how teachers and the available textual materials address them. For convenience, Allport conceived that in a persons' perception, the perceiver is the "judge" and the person perceived the "other". In this study therefore, the S.H.S chemistry students are to serve as judges judging their teachers teaching effectiveness and how the available/prescribed textbooks address the perceived difficulty they face in learning some of the topics in the S.H.S chemistry curriculum. The judgment outcome will be scored and juxtaposed with the existing literature on the topic in order to answer the research questions and test the hypothesis.

The Allport theory on perception was found appropriate to be used as the theoretical basis for this study because of his explanation on the process involved in a person's perception. He explained three concepts.

Common judgment sets: In evaluating a person, there must always be a special reason in view. The reason will define the boundaries within which the judgement is done and the rules to be followed. The reason for this study is to determine how the prescribed textbook and teachers address students' perceived topic difficulty in S.H.S chemistry curriculum

Categorisation tendency: Allport asserted that one of the most important things to do in perceiving any object is to place it in a familiar category. So, the first assignment that is carried out is to place the person/object being judged in the category of the generalized order. This study seeks to evaluate the S.H.S chemistry teachers teaching effectiveness and how the prescribed textbooks address the perceived topic difficulty by students. Also, the selected variables and the instruments to be used in gathering the data for the study shall be presented in a way that will be familiar to the respondents.

Combining cues: Allport claimed that judging people involves putting together many bits of information. This study therefore will determine the reliability of students/perception of topic difficulty in the S.H.S chemistry curriculum using a statistical measure of their responses on how the available textbooks and their teachers address the perceived topic difficulty. Also, other information from the documents that shall be analysed will complement those of the respondents.

2.2 The Concept of Perception and its Influence on Learning

The concept of perception may be defined from physical, psychological and physiological perspectives. But for the purpose of this study, it shall be limited to its scope as postulated by Allport (1996), which is the way we judge or evaluate others. That is individuals evaluate people with whom they are familiar every day. Eggen and Kauchak (2001) gave a cognitive dimension of perception; they see perception as the process by which people attach meaning to experiences. They explained that after people attend to certain stimuli in their sensory memories, processing continues with perception. Perception is critical because it influences the information that enters one's working memory.

Schunk and Meece (1992) defined student perception as involving perceptions of students' own ability, self-concepts, goals, competence, effort, interest, attitudes, values and emotions. Perception therefore has been defined in this study as how students perceive, distinguish or make sense of the chemistry topics they are taught in class. According to Schunk and Meece (1992), perception can assist teachers by showing how students think which is useful for teaching. These theories are related to the impact of current reform and emphasise the need to consider the importance of knowing what students perceive educationally and socially. They considered that, there are many types of student perception that operate in the classroom.

The term "apperception" can also be used for the term under study. Apperception is an extremely useful word in pedagogy, and offers a convenient name for a process to which every teacher must frequently refer. It means the act of taking a thing into the mind. The relatedness of this view of perception to the present study is further explained that every impression that comes in from/forms without-be it a sentence or vision sooner enters our consciousness. This impression is drafted off in some determinate directions or others, making connection with other materials already present in our consciousness and finally producing what we call our reaction. From this it is clear that perception is the reaction elicited when an impression is perceived from without after making connection with other materials in the consciousness (memory). From this point of view two implications could be deduced.

Firstly, perception cannot be done in vacuum; it depends on some background information that will trigger a reaction. This is consistent with the view of researchers such as Glover, Ronning and Brunning (1990) and the overall research problem of this study. Students' perception of topic-difficulties and how the prescribed textbooks and teachers address them is absolutely dependent on the fact that they have been taught of most of the topics in the chemistry curriculum, have used some of the prescribed textbooks and have also experienced the teaching strategies of their teachers and are familiar with most of the topics. They therefore, have minds already pre-occupied with memories and reactions that inventory for data collection will measure. Secondly, studies have confirmed possible influences on apperception. Perception may be energised by both the present and past experiences on particular moments, the physical state of the sense organ, the interest of the person, the level of attention, and the interpretation given to the perception.

In addition, Goodlad (1984) and Schneider (1996) independently noted that students' perceptions about learning are seldom sought, and students seldom make decisions about their own learning. According to Barell (1995), the principle of effective learning is that students are in charge of their own learning process. Beane (1993) summarised that appreciated curriculum begins with relevant, accurate, and up to date concept of which much could be learned from knowing what students perceive. A student's perception provides him or her with tools to be used to translate, construct, and make sense out of any given concept.

2.3 Areas of Topic Difficulty in Chemistry

2.3.1 Curriculum content

The advent of revised school syllabus in the 1960s in many countries saw a move towards the presentation of school chemistry in a logical order; the logic usually being that of the experienced academic chemist. Similarly, early chapters in almost all textbooks for first level higher chemistry education course start with topics like atomic theory, balancing ionic equations, hybridisation, bonding, chemical equations, calculations and stoichiometry. This is the grammar and syntax (Jenkins, 1992) of chemistry but is daunting for the student. Johnstone (2000) has made arguments against this 'logical' presentation cogently. The logical order may well not be psychologically accessible to the learner.

Teaching of chemistry in the past laid much emphasis on descriptive chemistry, memorisation being an important skill to achieve examination success. The sub-microscopic interpretation and symbolic representation were left until later (see Figure 1). The figure below indicates how chemistry was taught in the past.

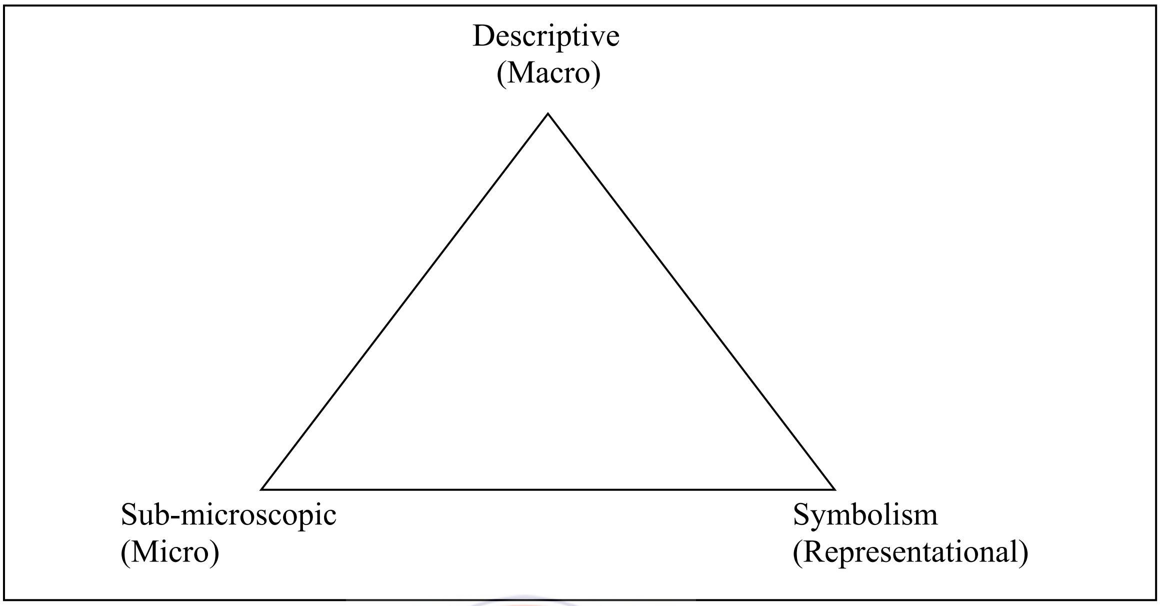

Figure 1: The Chemistry Triangle

Today, the descriptive is taught alongside both the 'micro' and the 'representational'. Chemical knowledge is learned at three levels: "sub-microscopic", "macroscopic" and "symbolic", and the links between these levels should be explicitly taught (Treagust et al., 2003). Importantly, the interactions and distinctions between them are characteristics of chemistry learning and they are necessary for achievement in comprehending chemical concepts. Therefore, if students face difficulties at one of the levels, it may influence the other. Thus, determining and overcoming these difficulties should be the primary goal of all chemistry teachers.

In order to determine whether students' understanding of chemistry would increase if the particulate nature of matter (sub-microscopic level) was emphasised, Gabel (1993) conducted a study involving students in an introductory chemistry course. When he introduced extra instruction to the experimental group that required students to link the particulate nature of matter to other level (macroscopic and symbolic levels), he found that the experimental group performed higher in all levels than the control group. It seems that this kind of additional instruction was effective in helping students make connections between the three levels on which chemistry can be taught and understood.

Reid (2000) suggested that the chemistry syllabus to be taught should not be defined by the logic of the subject but by the needs of the learner and that the order and method of presentation must reflect the psychology of the learner. These two fundamental principles would offer a constructive basis for dialogue in re-structuring the way chemistry is offered at school and higher education. In simple terms, define the material to be taught by the needs of the learner, and define the order of presentation by the psychology of learning.

2.3.2 Overload of students' working memory space

The working memory space is of limited capacity (Baddeley, 1999). This limited shared space is a link between, what has to be held in conscious memory, and the processing activities required to handle it, transform it, manipulate it, and get it ready for storage in long-term memory. When students are faced with learning situations where there is too much to handle in the limited working space, they have difficulty selecting the important information from the other less important information. Faced with new and often conceptually complex material, the chemistry student needs to develop skills to organise the ideas so that the working space is not overloaded. If the student is unable to organise the structures available to him or her when receiving new and more complex information, the student frequently resorts to rote learning which does not guarantee understanding. To resolve this problem, it is argued that teachers have to look more closely at what is known about human learning and also look at the nature of the discipline of chemistry and its intellectual structure in an effort to harmonise them.

The ability to develop strategies to cope with information overload depends heavily on the conceptual framework already established in the long-term memory. Working space cannot be expanding but it can be used more efficiently. However, this depends upon some recognisable conceptual framework that enables students to draw on the old, or systematise new material.

2.3.3 Language and communication in science (chemistry) teaching

Language is a contributor to information overload. Language problems include unfamiliar or misleading vocabulary, familiar vocabulary which changes its meaning as it moves into chemistry, use of high-sounding language, and use of double or triple negatives. In 2001, Johnstone and Selepeng carried out an investigation to establish the effect of language on working memory space using the second language. They observed that where the learner was operating in a second language, the usable working memory space dropped by about one unit. It was suggested that this unit was being "used" to handle the language transfer.

Words, which are understandable in normal English usage, changed their meaning (sometimes quite subtly) when transferred into, or out of, a science situation. For example, the word "volatile" is assumed by students to mean "unstable", "explosive" or "flammable". Its scientific meaning of "easily vapourised" was unknown. The reason for the confusion is that "volatile", applied to a person, does imply instability or excitability and this meaning is naturally carried over into the science context with consequent confusion.

Language influences the thinking processes necessary to tackle any task. The whole area of language, including the use of representational symbolisms, needs careful thought. Language helps or hinders interactions with long-term memory but it can offer more opportunities for the learner to verbalise and discuss ideas as they are being presented. This would give opportunities for misunderstandings and confusions to become more apparent, allowing the learner to adjust thinking and clarify ideas.

2.3.4 Concept formation

Chemistry learning requires much intellectual thought and discernment because the content is replete with many abstract concepts. Concepts such as dissolution, particulate nature of matter, and chemical bonding are fundamental to learning chemistry. Unless these fundamentals are understood, topics including reaction rate, acids and bases, electrochemistry, chemical equilibrium, and solution chemistry become difficult to learn.

Conceptions are pieces of intellectual ideas/facts that either reinforces each other or act as barrier for further learning. To overcome obstacles or barrier in learning, student conception researchers such as Nicoll (2001) and Ebenezer (1991) have been focusing on identifying and assessing students' "misconceptions". Such researchers hold the view that students' difficulties in learning science concepts may be due to the teachers lack of knowledge regarding students' prior understanding of concepts. Students' conceptions are constrained both by the perceiver (learner) and the perceived (chemical phenomena) (Ebenezer, 1991). Thus, learning involves knowledge that needs to be restructured, adapted, rejected and even discarded (Duschl & Osborne, 2002).

It is worth recognising that misconceptions will occur as learners do not come to chemistry class with empty minds. The process of learning chemistry will involve the modification or alteration of previously held ideas and this is a natural process. It is individual in nature and there is no way by which the teacher has the time or capacity to approach each learner on an individual basis. However, in practice, if concepts are developed with care, building on the language and thought forms already present while allowing concepts to be approached from several directions, the learner will be enabled to develop ideas more meaningfully. In addition, learners need the opportunity to "play with ideas", to share ideas, to verbalise concepts so that, in a natural, step-wise fashion, concepts steadily move forward on a secure base. This will allow inadequate conceptions to be modified in an acceptable way. Nonetheless, misconceptions will always occur, even among those highly experienced in chemistry.

2.3.5 Motivation

There is no doubt that motivation to learn is an important factor controlling the success of learning and teachers face problems when their students do not all have the motivation to seek to understand. However, the difficulty of a topic, as perceived by students, will be a major factor in their ability and willingness to learn it. Students' motivation to learn is important but does not necessarily determine whether they employ a deep or a surface approach. Aspects of students' motivation to learn can be classified as either intrinsic or extrinsic.

2.4 The Role of Chemistry Education in National Development

Throughout the world, education is considered to be an important tool for attaining national goals. Education provides learners with skills for survival and for the continuity of the society.

Science and chemistry education in particular is a veritable instrument for national development. According to Okon-Enoh (2008), science is a way of seeking information (process) and also an accumulated knowledge resulting from research (products). Okoro (2013) sees science as a systematic investigation of nature with a view to understudy and harnes them to serve human needs.

Chemistry is a popular subject among S.H.S students in Ghana due to its nature. It addresses the needs of majority through its relevance and functionality in content, practice and application. What many nations like Ghana need now is a functional chemistry education that will assist in national development. Chemistry education has been identified to be one of the major bedrocks for the transformation of our national economy. Chemistry education can be seen as the acquisition of knowledge or ideas relevant to chemistry. It is concerned with the impartment of knowledge on properties, component, transformations and interactions of matter (Emendu, 2014).

Chemistry education is therefore the systematic process of acquiring the fundamental knowledge about the universe. With these indispensable knowledge richly acquired, man can shape and reshape his world for his benefit. Hence, the development of the nation is usually measured by the degree and extent of growth brought to it through the enterprise of science education and a gate way to it is through chemistry education. Chemistry education is the vehicle through which chemical knowledge and skills reach the people who are in need of capacities and potentials for development. In addition, chemical education addresses the social objective of substance development as education is now of the primary means for empowerment, cultural preservation, social mobility and equity (Emmanuel, 2013). Chemistry education plays important roles in enhancing the quality of teaching and research as well as ensuring that students are equipped with good knowledge to produce intensive goods and services to meet human needs for food, health care products and other materials aimed at improving the quality of life (Emendu, 2014). Every single material thing in the universe is a chemical and the ability to understand and manipulate these chemicals is responsible for everything from modern foods and drugs to plastics and computers.

Conclusively, the ideas of chemistry are not getting the attention they desire in either formal or informal education. It is argued that an improvement in this position requires further intensive development of the nature and quality of chemical education to chemical industries is intensive and extensive research.

2.5 Teachers' Role in Achieving Curriculum Objectives in Chemistry

The study of chemistry as a science subject in senior secondary schools entails the exposure of learners to both theoretical and practical aspects of learning experiences. Njoku (2003) opined that chemistry is practical-oriented and the interest of learners in the subject must be sustained all the time.

The continuous record of low students' performance in chemistry has attracted a lot of assertions. Nwosu (2003) had pointed out that the teacher is an important determinant of the quality of learning by the learner. Eze and Njoku (2011) opined that teachers are the pivot of the education system and therefore they are at the centre of any reform effort in the system. According to Ikeobi (2012), it is the teacher who orgainses the interactions between the subject (learner) and the object (learning materials). It is the teacher who ensures that equipment and materials are properly used by the learner to achieve the expected results/ objectives. All these points to the fact that the teacher is a very significant factor when learners failed to exhibit the expected mastery in science subject like chemistry.

Research has shown that a mention of science lessons to students leads them to think about laboratories for practical lessons. Some do so with delight others with absolute horror (Gastel, 1991). The range of reactions may result in part from the differences in learning styles and many also reflect the wide variability in quality of teaching. Jonhstone (1997) identifies three basic components of modern chemistry, the macro-chemistry of the molecular, atomic and kinetic and the representations-chemistry of symbols, equations, stoichiometry and mathematics as represented in Figure 2. The figure represents the three basic components of modern chemistry identified by Johnstone (1997).

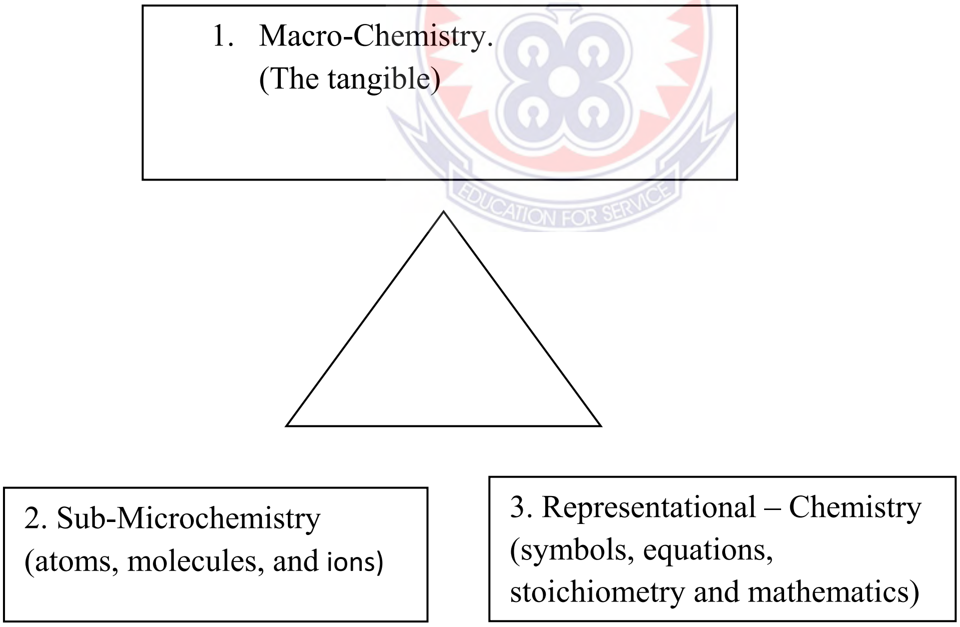

Figure. 2: Components of Chemistry Knowledge

Source: Adopted from Wilson, 1999.

According to Jonstone (1997), a teacher operates inside the triangle represented in Figure 2. For him, this may pose problems for students if careful planning and preparation prior to teaching is not done. This is because chemistry lessons frequently introduce abstract concepts alongside complicated laboratory procedures to students. Teachers therefore need to be aware of the potential difficulties students have with some chemical concepts for them to carry out their role effectively (Wilson, 1999).

Although recent developments in science education advocate for inquiry-based approach where the students find out things for themselves through their own effort, most students know that the teacher knows the answer even if she/he does not. As a result, they typically look to the teacher to tell them if what they saw was supposed to ‘’happen”, and to confirm that their data are right (Wellington, 1981).

Following the above arguments, teachers undoubtedly have roles to play in realising the curriculum objectives. They need to plan carefully, integrate the lessons with other instructional strategies and motivate students for effective teaching and learning. Unfortunately, as Woolnough and Allsop put it:

> *Most science teachers have themselves been brought up on a diet of content dominated cookbook-type practical work and many have got in the habit of propagating it themselves (Woolnough & Allsop, 1985 p 80).*

Tobin and Gallagher (1987) found that science teachers rarely, if ever, exhibited behaviour that encouraged students to think about the nature of scientific inquiry and the meaning and purposes for their particular investigation during chemistry lessons.

Metacognition involves elaboration and application of one’s learning, which can result in enhanced understanding. Thus it is vital to provide opportunities that encourage students to suggest hypothesis, design investigations – “minds-on as well as hands-on’’ and ask questions. According to Cucccio-Schirripa and Steiner (2000), questioning is one of the thinking skills which is structurally embeded in the thinking operation of critical thinking, creative thinking and problem solving. Therefore, other than providing students with frequent opportunities for feedback reflection and modification of their ideas (Barron, Schwartz, Vye, Moore, Petrosino & Zech, 1998), there is need for teachers to create effective learning environment in which students are given opportunities to ask relevant and scientifically sound questions in an attempt to develop scientific literacy among them (Penick & Bonnestetter, 1996)

Research has also suggested that while laboratory investigations offer important opportunities to connect science concepts and theories discussed in the classroom and in textbooks with observation of phenomena and systems, laboratory inquiry alone is not sufficient to enable students to construct the complex conceptual understanding of the contemporary scientific community. "If students' understanding is to be changed towards those accepted by science, then interventions and negotiations with an authority, usually a teacher, are essential" (Driver, 1995). Teachers should thus emphasise the scientific aim of a laboratory task and make students aware of its purpose if worthwhile learning is to be achieved. All these led to Osborne and Freyberg (1985) describing the teacher as a motivator, diagnostician, guide, innovator, experimenter and researcher.

2.6 The Role of Curriculum Materials (Textbooks) in Achieving Curriculum Objectives in Chemistry

For better or for worse, the textbook is the single most predominant curriculum material in schools. Textbooks play an important role even in selecting the methods to be used to teach students.

Textbooks play a prominent role in the teaching and learning process and they are the primary agents of conveying knowledge to learners. Besides, one of the basic functions of textbooks is to make the existence of knowledge available and apparent to the learner in a selected, easy and organised way. Hutchinson and Torres (1994) argue that the textbook has a very important positive part to play in teaching and learning. Textbooks can serve as a tool to motivate and stimulate learning. In a learning environment in which learners are motivated and positive about their learning environment, the speed of chemistry learning can be greatly enhanced. Secondly, textbooks can serve as a reference point for teachers managing their teaching progress and also help to provide a focus for teaching (Tomlinson, 2008). One of the motivations in using textbooks in teaching and learning is that textbooks can serve as a good monitor for measuring progress of teaching and learning. Textbooks can have a similar function of a map, showing the teaching progress (McGrath, 2002) and can provide for direction and ideas in how lessons can be delivered (Tomlinson, 2008). They are effective tools in terms of allowing for carefully planned and systematic presentation of the syllabus of the S.H.S chemistry course. Thirdly, textbooks are particularly useful in providing support and security for new inexperienced teachers or teachers, who have relatively low confidence to deliver chemistry lessons effectively. A good textbook can be an extremely valuable device especially in situations where interesting and motivating authentic materials are difficult to compile in an organised manner (McDough & Shaw, 1993).

Students can also benefit from using textbooks in many different ways. Similar to the case of teachers, textbooks can act as a reference point to their learning process and keep track of their development. Students can use textbooks as a tool for revision of previously taught items, and at the same time, familiarise themselves with the new items that will be taught soon. Textbooks are also one of the more economic and convenient forms of access to carefully structured and packaged learning materials

(Ur, 1996). According to Cunningsworth (1995), textbooks provide additional benefits to students as they are an efficient collection of materials for self-accessed learning and for knowledge consolidation. Textbooks can potentially save learners from teachers' incompetency and deficiencies (Litz, 2005).

In spite of the many advantages that textbooks might have as essential tools for teaching and learning in general and chemistry in particular, a number of researchers have highlighted the disadvantages regarding the use of textbooks. One of the advantages as suggested by Hutchinson and Torres (1994) was that textbooks can provide a basic framework on how a lesson can be derived. In reality, many teachers would, therefore, develop reliance on textbook and become uncreative in teaching (McGrath, 2002). Although textbooks can function as a framework for the teaching and learning process for both students and teachers, no one textbook can effectively address individual learning styles, differences of learners and the requirements of every classroom setting (Tomlinson, 2003). At its worst, the teachers may become totally reliant on the textbook (Ur, 1996), and not spend time preparing their lessons (Tomlinson, 2008). This will lead ultimately to an adverse situation where the teacher "teaches the book", rather than teaching the actual chemistry concept. The structure of the textbook may even lead learners to believing that the activities and task of the textbooks are always superior to their own ideas (McGrath, 2002). Also, learners may dislike the topics covered by the textbook and this may lead to association with boredom in chemistry lessons. No matter how pedagogically sound the textbook is, learners will quickly lose interest if they find the materials dull and not interesting (Cunningsworth, 1995).

2.7 Students' Attitude towards the Study of Chemistry

Since the teaching-learning process also concerns itself with the promotion of desirable behaviour, education must draw some of its principles from psychology. This entails having a good grasp of all theories that influence the teaching and learning process. Attitudes associated with science appear to affect students' participation in science subjects and impacts in science (Linn, 1992). Further research on psychological effects has found that students' self-concept of ability to perform in science positively correlates with achievement. It has been observed that many students fear chemistry. Such fear is characterised by mass disenchantment among the students towards the subject. According to Keeves and Morgenstern (1992), students' anxiety towards the learning of chemistry makes them lose interest in the sciences. On the other hand, Deboer (1987) points out that students' achievement is influenced by favourable attitudes towards oneself (positive self-concept) as well as the subject. A student with positive self-concept of ability in a subject has a higher probability of developing favourable attitudes towards that subject, and as a result spends more time and energy in the subject thus gaining mastery of the subject resulting in success. Deboer (1987) further argues that as a result of this success, the student is reinforced further to continue performing well in the subject by possibly developing stronger favourable attitudes towards the subject. Mwamwenda (1995) argues that a person's self-concept is a guide to their personality in terms of his or her own feelings, attitude, psychological health and the way he or she is likely to interact with others in and outside his or her environment. Mwamwenda (1995) further points out that a pupil with a positive self-concept stands a better chance of performing than a pupil with negative self-concept of ability. Thus, it can be argued that enhancement of positive self-concept of ability of a science student will possibly enhance the students' performance by fostering development of favourable attitudes toward chemistry. However, care should be taken when interpreting results of a relationship between achievement and attitudes. This is because low achievement does not necessarily mean the students have unfavourable attitudes, towards science or any other subject for that matter.

However, a critique by Kiragu (1988) on a similar study conducted by Kathuri and Pals (1993) asserts that the significant relationship between students' attitudes towards a subject and academic achievement is a function of their personal attitudes rather than external factors which may influence them. Furthermore, there are also stronger predictor variables outside the school, which influence students' attitude towards a subject. These include parental influence and beliefs from one's culture.

Students' attitudes regarding the difficulty of chemistry lessons relate to concepts and symbols than their understanding. The application of chemistry concepts and symbols depends on the ability of the students to transfer from macroscopic level to symbolic level and vice versa (Dori & Hameiri, 2003). Chemistry teachers can transfer rapidly from one level to another, but students cannot do the same. In addition to the difficulties that students have in understanding and applying chemical concepts, such as atoms, molecules, mass, volume and mole, they also have difficulties in solving chemical problems requiring mathematical skills.

Students' attitudes regarding the interest of Chemistry course are also neutral. The content of chemistry curriculum, the chemistry lessons time, the methods of teaching chemistry and lack of laboratory experiments might be some of the reasons that form such attitudes. This is supported by Freedman (1997) who says that a positive attitude towards science is related to the laboratory programme. Chemistry in most schools is taught theoretically without hands-on activities and this lack of practice decreases students' interest for chemistry lessons.

Most people in the science education community tend to agree to a greater or smaller extent that negative attitudes in chemistry cause a crucial problem. Further research in attitude should contribute to the explanation of the persisting problem of alienation from chemistry by young people. If carefully focused and designed, attitude research could go a step further and provide bases on which correct decisions will be taken about aspects for classroom practice. This might get more learners choosing to study chemistry, feeling that the subject really offers them something useful and interesting. Such positive attitudes, cognitive skills and knowledge will help the future citizens to make judgments and decisions on issues related to Chemistry.

Chepkorir (2013) holds the view that students' negative attitudes, lack of interest and lack of confidence contribute to low performance in chemistry. He further states that wide coverage of syllabus, low awareness of career opportunities in Chemistry, lack of exposure to well-equipped laboratory as well as poor teaching methods cause students' negative attitudes towards learning Chemistry.

Students' beliefs and attitudes have the potential to either facilitate or inhibit learning. Burstein (1992) in a comparative study of factors influencing mathematics achievement found out that there is a direct link between students' attitudes towards mathematics and student outcomes. Studies carried out have also shown that the teachers' method of teaching mathematics and his personality greatly accounted for the students' positive attitude towards mathematics and that, without interest and personal effort in learning mathematics by the students, they can hardly perform well in the subject (Olatunde, 2009). Students' attitude toward the learning of chemistry is a factor that has long attracted the attention of researchers. Ojo (1989) and Adesokan (2002) asserted that in spite of realisation of the recognition given to chemistry among the science subjects, it is evident that students still show negative attitude towards the subject thereby leading to poor performance and low enrolment. According to Bassey, Umoren and Udida (2008), students' academic performance in chemistry is a function of their attitude. Papanastasiou (2001) reported that those who have positive attitude towards science tend to perform better in the subject.

2.8 Influence of Gender on the Learning of Chemistry

In a study, Eze (2008) asserted gender had significant effects on students' achievement in chemistry, and showed that male students achieved higher than their female counterparts did. Owoyemi (2007) asserted that student's achievement in chemistry course has nothing to do with whether the student is male or female. Adigwe (1992) found that male students performed better in both achievement and acquisition of problem solving skills in chemistry than their female counterparts. Ahiakwo (1998) showed that girls performed better than boys in chemistry, and that the difference between their mean achievement score was significant. Trigwell (1990) found that male students were superior over female students in problem-solving and achievement in chemistry. Erinosho (1994) cited in Adesoji and Babatunde (2008) showed that the difference between the mean achievement scores of female and male students was not statistically significant in chemistry. Agbir (2004) found that gender was not a significant factor in the overall mean achievement rating of students in practical skills on acid-base titration. Ifeakor (2005) showed a significant gender-related difference in students' cognitive achieving in favour of female students over their female counterparts. Ssempala (2005) investigated gender differences in the performance of practical skills on quantitative analysis, among senior secondary school girls and boys in selected co-educational schools. The author showed that there were no statistically significant differences between girls and boys in their ability to manipulate the apparatus/equipment, take observation, report/record results correctly and compute/interpret/analyse results during chemistry practical: girls performed slightly better than boys. However, the boys performed slightly higher than the girls in the following skills: recording/reporting results correctly, and computing/interpreting/analysing results.

Eze (2008) studied the effect of two questioning techniques on students' achievement, retention and interest in chemistry and found that gender had significant effects on students' achievement, male students achieved higher than their female counterparts did. Okorie and Ezeh (2016) found out that female students' overall mean achievement was higher than that of the male students even though statistically, gender was shown not to be a significant factor in students' achievement in chemical bonding.

2.9 Factors Influencing Effective Teaching and Learning of Chemistry

There are a number of factors that influence the effective teaching of chemistry. These factors contribute immensely to the performance of the students. The factors which affect students' performance in chemistry include physical classroom and laboratory, instructional arrangement and school management (Johnson, 2011). The physical classroom and laboratory represents the presence of good ventilation, availability of good chalkboard, preparatory room, enough chairs and tables, charts and clean environment.

The other factors include the presence of instructional materials in the laboratory such as apparatus and chemicals (Owoeye & Yara, 2011). The dissemination of information to students through bulletin boards, posters and charts, if well organised and made accessible to students will enhance assimilation and performance in their academics. Finally, the school management or organisation is another vital factor that may be considered before anticipating a good result. The school management's responsibility now includes positioning of the school laboratory, school library, provision of essential services like water supply, light, food vendors, counselling services and first aid services (Owoeye & Yara, 2011).

2.9.1 Inadequate functional laboratories for the teaching and learning of chemistry at the SHS level

A lot of concern has been shown about the inadequacy of science laboratory in Ghana. Laboratory has been given a central and distinct role in science education, and science educationists have suggested that rich benefits in learning accumulate from using laboratory activities. According to Aina (2012), the science laboratory is a setting in which students can work supportively in small groups to investigate scientific occurrences.

To achieve the desired objective of effective teaching of chemistry in secondary schools, operational chemistry laboratory equipment have to be provided but it is dish-eating to note that most of our schools do not have functional laboratories. Sam (2009) observed that infrastructure is often stressed as a result of the insufficient or incomplete laboratory equipment in most of our schools. Laboratory is an integral part of chemistry teaching as it is used when (Owoeye & Yara, 2011):

- It is needed as a means of obtaining and learning scientific information
- Stimulates learners' interests as they are made to personally engage in useful scientific activities and experimentation

- It is needed as means of verifying scientific principle, law or a theory that is already known to students
- It can be easily engaged with textbooks and other learning activities
- Knowledge obtained through laboratory work promotes long term memory.

Practical work allows students to have experiences that are consistent with the goals of science literacy and have been used in natural science to teach students or many age spans in different cultural and classroom contexts (Hofstein & Mamlok-Naaman, 2007). Thus, laboratory experience shoulders distinctive importance for assisting students/learners to think through chemical concepts and enlighten them as well.

Onaofo (1993) had observed that equipment, materials and chemicals are not stocked specifically for the teaching of chemistry and the outcome of such a situation is that most chemistry teachers handle the subject negligently and superficially. The student activities are completely neglected and practical classes are held not according to schedule but according to how convenient it is for the teachers. Adefunke (2008) and Owoeye and Yara (2011) observed that an important ingredient for the effective science teaching is laboratory equipment.

2.9.2 In-service training for chemistry teachers

This is a programme or training which enriches the skills of the full time worker needed to carry out their normal duties with a view of becoming more efficient on the job. In-service training is a programme intended to provide updating, improvement, conversion and support to teaching professionals along their careers, the training actions can be drawn by schools, according to the needs of their teachers or simply, result from the individual initiative of the teacher (Pereira, Ferreira, Afonso, & Barreiro, 2013). A teacher can be referred to as a catalyst that brings about changes in the behaviour of the students/learners. He/she plays a central role in the actualisation of educational goals and the survival of the educational system (Okecha, 2008). Therefore, a continuous teacher training is the keystone of improvement and transformation in schools, for personal growth and professional development. In-service training can be in the form of on-the-job training, workshops, post qualification courses, formal or informal, structured or unstructured (Mohammed, 2006)

In-service training (on-the-job education) creates conducive environment for further learning which exposes the workers to new development and ideas in their area of study. It could also be refreshing courses which make the professional not to lose grips with their skills, attitude or knowledge. In some cases, the reward for such training usually leads to a new rank or the acquisition of better and higher status, hence absence of this training affects the teachers in effectiveness, improvement and stressed that teachers require professional knowledge and professional teaching skills, as well as a broad base of general knowledge in order to carry out instructional processes effectively. He further suggests that teachers should be both academically and professionally trained. Higher academic and professional training improve teacher effectiveness on the job. It is a source of enthusiasm for the understanding of the contemporary scientific community. If students understanding is to be changed towards those of accepted science, then intervention and negotiation with an authority, usually a teacher, is "essential" (Driver, 1995). Teachers should thus emphasise the scientific aim of a laboratory task and make students aware of its purpose if worthwhile learning is to be achieved. All these led to Osborne and Freberg (1985) describing the teacher as a motivator, diagnostician, guide, innovator, experimenter and researcher.

As to whether secondary school chemistry teachers in the Western Region of Ghana were helping the SHS chemistry students to overcome their learning difficulties or not, became the key focus in this study.

2.9.3 Proficiency in mathematics as a factor in students' perception of chemistry topic difficult

Mathematics is an essential skill that students of science (chemistry) need to master. Many topics in the science subjects (biology, chemistry and physics) are inter-related. There are overlaps or areas of intersection in the content areas. Atomic structure is taught in physical chemistry as well as modern physics. Fermentation is a topic taught both in biology and chemistry. Many equipment used in science laboratories cannot be understood without sound knowledge of mathematics. Setidisho (1 996) asserted that mathematics is a fundamental science which is necessary for understanding of most other fields. Mathematics as a subject serves as a binding force among the various branches of science-physical, biological and social (Adetoye & Aiyedun, 2003). Mathematics is the language of science and central intellectual discipline of the technological societies (Odeyemi, 1995). A student needs basic knowledge of mathematics like change of subject to understand density which appears under major topics like ecology in biology, diffusion in chemistry and flotation in physics.

A research conducted by Eshiwani (1984) indicates that students show no significant sex difference in performance in mathematical ability up to adolescence (13-14yrs). Afterwards, males outperform females on nearly all tasks related to mathematical ability. This is attributed to differences in cultural pressures (Fennema & Sherman, 1978), whose one of its manifestations is mathematics anxiety, which leads to females' avoidance of mathematics. Hence, they avoid courses that entail the use of mathematics for example chemistry and physics. Mathematical ability is highly related to science achievement (Kotte 1992). Mathematics is therefore a factor in the learning of science (chemistry) as most topics entail the use of mathematics. They include the mole concept, electrochemistry, reaction rates and radioactivity, just to name a few.

2.9.4 Resources and performance in chemistry

The types of schools are important for successful learning of science. The secondary school system in Ghana has grades of schools. A major characteristic of the schools in the Grade "A" or "B" category is their enormous resources. These facilities diminish drastically as we go down the type of school hierarchy in Ghana. Associated with low physical resources is teacher quality.

In the new science curricula, which stress the process of science and emphasise the development of higher cognitive skills, the laboratory plays a central role, not just as a place for demonstration and appreciation of the spirit and method of science, but promotes problem solving, analytical thinking and generalisation ability and provides students with some understanding of the nature of science. Given that chemistry is essentially practical subject, any learner who misses out on the practical due to lack of resources is disadvantaged. In fact, in Ghana there is a regulation that any candidate who does not pass in the practical examination in the WASSCE, cannot pass with a credit in the chemistry examination conducted by the WAEC (CRDD, 2010).

2.9.5 Teacher characteristics and performance in chemistry

As teachers play an important role in teaching science no one will doubt their influence on their students' acquisition of knowledge. Just how teachers and the way they teach chemistry affects the generation, constitution or reduction of gender differences in chemistry achievement has to be considered. Knowledgeable teachers are less likely to pass on misconceptions, are more confident in imparting information, use less time for preparation, and are able to present a wider range of examples and analogies which may help students to learn and understand a certain topic easily. Only in some cases does teaching experience produce higher science achievements. Differences have been shown between male and female teachers with respect to their classroom behavior as well as their expectations of achievement of students (Kelly, 1978). One would probably see this as an effect of the science teacher being male or female, thereby following his or her own gender typical role in teaching. For Kelly (1978), there is no empirical evidence that female science teachers produce better results with girls. In fact more secondary school science teachers were found to be males (Keeves & Kotte, 1981).

2.9.6 Motivational orientations of male and female students

Sex differences in science performance vary with age levels. The greatest difference is at adolescent age level which has been explained in part that pre-adolescent boys' attempts to enhance their manliness by achieving more in science. It is worth of note that this pattern in sex differences in achievement with respect to age level is paralleled by the motivational orientation of boys and girls.

Sex differences in attitudes, aspirations and other motivational orientations towards science are large in some subject areas than others. Females have positive attitudinal orientation towards biological sciences while males are towards the physical sciences (Keeves and Katte 1991, Kotte, 1992). Girls have positive orientation towards biology because it requires less mathematics and spatial ability. Biology also deals with life processes, which are related to maternal role; thus, biological knowledge is often perceived by females as inevitable in the fulfilment of their motherhood duties. Biology also revolves around the verbal propensities of girls and thus serves as a vehicle for girls increasing interest. Males' positive orientation towards physical science has been attributed to the "out of school learning". Many activities in the physical sciences can be learnt outside the classroom, and boys have more opportunities to develop positive attitudes in these areas (Kelly, 1981). Cognitive superiority in males according to Maccoby and Jacklin (1974) was frequently proposed as an explanation for boys' more positive orientation towards the physical sciences. It is primarily the acquisition of proficiency in a subject that leads to positive attitudes in that subject. Therefore, boys will hold a more positive attitude towards physical science. Low performance of girls in the physical sciences may be due to their poor attitudes towards these subjects. Many girls, consider science occupations too demanding to combine with family responsibilities.

Conversely, socio-economic status is considered as an important factor which affect students' attitudes. Girls' orientation towards science is more positive in relation to boys in disadvantaged communities whereas boys' orientation towards science is more positive in upper middle class communities (Kotte, 1992).

Poverty restricts a range of experiences that by the cognitive ground work for later interest and achievement in science. The findings that girls have more positive attitudes than boys in disadvantaged communities, has implications that girls have more experiences than boys do in these communities. The sex difference could be a function of changes in learning climate that occur in schools. Girls function less well in discovery situations.

Among countries of the world, the greatest male superiority in motivational orientation tended to occur in developed countries, with Japan leading the list. Also, motivational orientation is a function of age and the gap is widest at adolescence and narrows down as the age increases. Contrary to expectation, motivational orientation towards science could be on the increase.

2.10 Effective Approach as to the Teaching of Chemistry

Teachers in most cases are blamed by educational authorities for the poor performance of students in chemistry at the SHS level. Educational authorities claim poor teaching methods among other factors are the causes of the appalling students' achievement in chemistry at the SHS level.

To ensure that students increase their performance levels and pass rate, the application of teaching strategies can actually promote active learning and raise the confidence level of learners. This is exemplified by the Fink (1999) model of active learning shown in Figure 3 below.

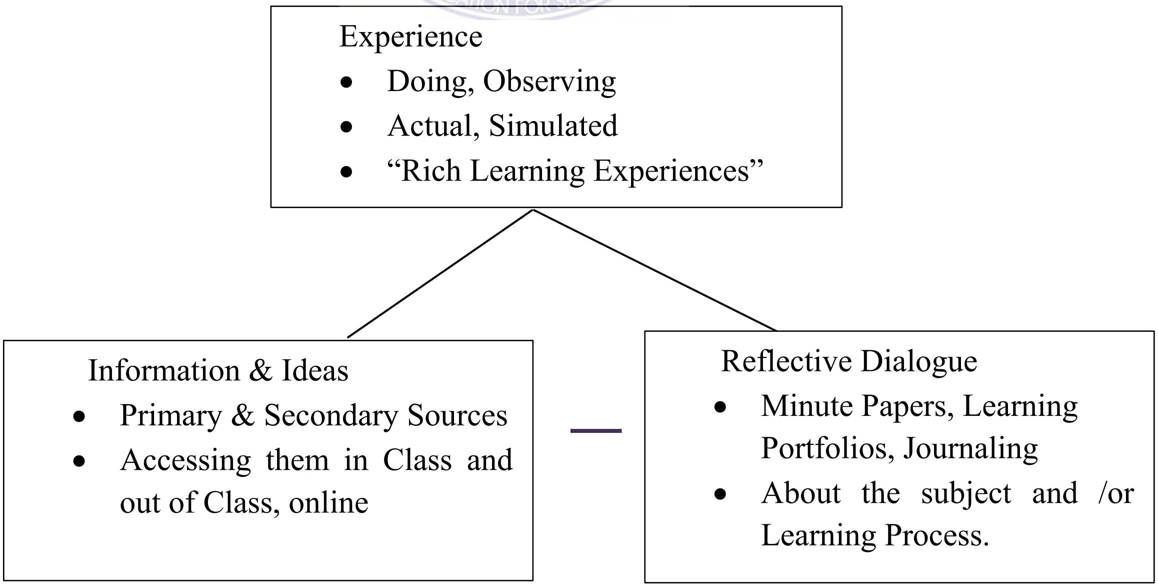

Figure 3: Fink model of active learning

Explanation of the components:

Usually, the most traditional teaching consists of little more than having students read a text, listen to a lecture, and a very limited or limiting form of dialogue with others. Fink (1999) recommended some steps for implementing the active learning model shown in Figure 3, which include:

> *(1) Expansion of the kinds of learning experience the educator creates by creating small groups of students and ensuring that they make a decision or answer a given question at a given time, determining ways to engage students in meaningful dialogues about the topic or subject being considered, helping students to directly or vicariously observe what they are learning and making sure that students learn actually what they need to learn.*
>
> *(2) Applying the "power of interaction" by ensuring the use of more of the four components of the model of active learning in the process of teaching to add variety and enhance students' interest. A proper connection of the components in an interactive manner brings about an increased education impact both to the teacher and students, thereby granting them the advantage of "power of interaction" (Fink, 1999). For instance, a teacher might use a mixed approach in his/her class by discussing a topic with the learners, assigning the learners to some groups of few membership, giving them individual and group task and setting them into action among themselves with him/her moderating the whole exercise. By so doing, the learners and the teacher share from active interaction which eventually promotes active learning.*
>
> *(3) Providing dialectic between experience and dialogue by creatively setting up dialectic of learning activities in which students share new experiences and engage in a deep and meaningful dialogue. This provides the opportunity for the students to experience significant and meaningful learning that helps them to improve their overall performances especially in chemistry.*

It is becoming an open knowledge that the level and type of motivation shown to the learners significantly affects their quality and height of performance in whatever programme they are involved. Barbara (1999) observed that educators can encourage learners to become self-motivated independent learners by helping learners to find personal meaning and value in the materials provided, assigning tasks that are not too easy nor too difficult. This makes the learners feel that they are valued members of a learning community and creating open and positive atmosphere that can foster learners participatory and effective learning. Such will amount to good everyday teaching practices which eventually enable the learners overcome learner apathy. It further implies that an enthusiastic educator with a genuine interest of students and what they learn, invariably promotes students' performances in the subject. The saying that "expectations affect performance" is not a mockery. When learners believe that they can learn something, they show readiness for it irrespective of its level of complexity. A chemistry educator is expected to observe the importance of variety in reawakening of learners' involvements in the learning task and their motivations to learn instead of the usual routine talk and chalk method that brings boredom and disgusting feelings in the learners and hence less effective learning taking place. This can be done by incorporating a variety of teaching activities and methods in the subject, such as role playing, discussion and demonstrations, thereby bringing the understanding of the subject matter closer to the learners.

Effective teaching of chemistry like other sciences demands consistency with the nature of scientific inquiry. Project 2061 (2010) observed that sound teaching usually starts with questions and phenomena that are interesting and familiar to learners as they try to find answers to such questions. The approach involves active engagement of learners and use of team approach to ensure formation of groups in the classroom. It is usual to see scientists and engineers work mostly in groups instead of isolated investigators. Learners in their groups come to common understandings and can always inform each other about procedures and meanings of the task at hand. By so doing, there is team responsibility, feedback and communication which become more realistic than the experiences of the usual individualistic textbook-homeworkrecitation approach. A purposeful and effective teaching of chemistry and science in general should reflect scientific values which culminate in curiosity, creativity, spirit of healthy questioning, promotion of aesthetic values and avoidance of dogmatism among the learners (AAAS (American Association for the Advancement of Science), 1989).

2.11 Students' Interest in Science (Chemistry) Education

Mallam (2002) provided a definition of interest as referring to a differential likelihood of investing energy in one set of stimuli rather than others. This definition is applicable to situations in the classroom where the interests of students in academic areas are reflected in actions such as time and effort spent studying a particular subject, willingness to engage in additional activities involving the subject area besides that given by the teacher, and voluntarily selecting the subject for further study. Mallam (2002) indicated a positive relationship between student interest and learning. Ziegert (2002) pointed to various research results (Gardner, 1975, Schibeci, 1994) which indicated the importance of cultivating students' learning interests about science.

Despite this evidence of the importance of student interest in science, especially as it relates to their academic achievement, studies worldwide have revealed that interests in or attitude towards science declines during students' secondary school years (Zieget, 2002). What is unclear is the specific reasons for this decline. Researchers have identified a number of factors that may have an impact on students' interest in specific subjects. For example, Strutchens, Harris and Martin (2001) identified a significant decline in interest in physics and chemistry as students progress through secondary school. They also note that this decline is especially pronounced for girls.

Analysis of results from a Relevance for Science Education Project (RSEP) undertaken in countries throughout Europe from 2003-2008 revealed that the number of students regarding science subjects, in particular physics and chemistry, as difficult has increased (Strutchens, Harris & Martin, 2001). There has also been a persistent decline in post-compulsory high school science enrolment worldwide over the last two decades (Zieget, 2002).

2.12 The Nature of the S.H.S Chemistry Curriculum (Syllabus)

A syllabus according to Burstein (as cited in Ennin, 2015), is a statement of the contents of a subject which students are supposed to study. It is also a statement of the order in which students are supposed to study those contents. The definition of Burston leaves out a lot of elements found in the syllabus by way of recognising only the content. The definition therefore represents a parochial view of the syllabus. A more comprehensive definition of syllabus is given by Farrant (2005) which recognised the syllabus as an outline specifying the rationale, aims and objectives, content, learning activities and evaluation tools of a particular subject, packaged in the school curriculum.

According to CRDD (2010), chemistry is a subject which is concerned with the study of matter and its changes. As such, it is about us humans and everything around us.

2.12.1 The general aims of the S.H.S chemistry syllabus

The S.H.S chemistry syllabus is intended to create awareness of the interrelationship between chemistry and the other disciplines or careers. It is also intended to provide knowledge, understanding and appreciation of the scientific methods, their potentials and limitations and develop the ability to relate chemistry in school to the chemistry in modern and traditional industries or real world situation. The syllabus is aimed at helping students use facts, patterns, concepts and principles to solve personal, social and environmental problems as well as train students to use their theoretical ideas to design experiments to solve practical chemistry problems as well as train students to use their theoretical ideas to design experiments to solve practical chemistry problems.

Additionally, the syllabus is aimed at developing in students the ability to communicate ideas, plans, procedures, results and conclusions of investigations orally, in writing and/or in electronic presentation, using appropriate language and a variety of formats. Finally, the syllabus is intended to encourage investigative approach to the teaching and learning of chemistry and make chemistry lesson, problem solving in nature (CRDD, 2010).

2.12.2 Scope of the chemistry syllabus content

The syllabus builds upon the Integrated Science learnt at the Junior High School level, and is designed to offer at the Senior High School Level, the chemistry required to promote an upstanding of the chemical processes taking place all around us. The syllabus is also designed to provide enough chemistry to students who:

(i) Will end their study of chemistry at the S.H.S level

(ii) Require knowledge of chemistry in their vocational studies

(iii) Wish to continue their studies at tertiary institutions

2.12.3 Pre-Requisite skills for the S.H.S chemistry course

The outline of the syllabus requires that students before being introduced to the course should have acquired a number of skills which will enable them to understand the concepts and principles in the subject (course). Some of the key skills students are required to acquire include:

-proficiency in English Language and a high level of achievement in JHS Integrated Science

-Mathematical knowledge in the areas of arithmetic and algebra, indices, reciprocals, decimals, approximations, significant figures, use of scientific calculators, basic calculus, graph drawing and their interpretations.

2.12.4. Duration of the course/period allocation

The S.H.S Chemistry course is designed for three (3) years. A total of six (6) periods per week is allocated to the teaching of the subject with each period lasting for forty (40) minutes. The teaching period for the SHS Chemistry course is presented in Tale 1 below.

Table 1: Period Allocation for the Teaching of the SHS Chemistry

Year	Practical	Theory	Total
1	2	4	6
2	2	4	6
3	2	4	6

Source: SHS Chemistry Teaching Syllabus, 2010

2.12.5 Organisation of the syllabus

The syllabus has been structured to cover the three years of S.H.S programme. Each year's work consists of a number of sections with each section comprising a number of units. The syllabus covers the three-year S.H.S education. Year one of the syllabus has five main sections, year two has six sections and year three has two sections. The five sections of the first year syllabus embrace themes such as Introduction to Chemistry, Atomic Structure, Chemical Bonding, Conservation of Matter and

Stoichiometry and States of Matter. Those of year two are Energy and Energy Changes, Inorganic Chemistry, Chemical Kinetics and Equilibrium, Acids and Bases, Redox Reactions and Electrochemistry and Chemistry of Carbon Compounds. The two sections in the year three syllabus are Chemistry, Industry and Environment and Basic Biochemistry. The structure of the syllabus is shown in Table 2.

Table 2: The Structure of the SHS Chemistry Syllabus

S.H.S 1 **SECTION 1**	**S.H.S 2** **SECTION 1**	**S.H.S 3** **SECTION 1**
INTRODUCTION TO CHEMISTRY	ENERGY AND ENERGY CHANGES	CHEMISTRY, INDUSTRY AND ENVIRONMENT
Unit 1: Chemistry as a discipline	Unit 1: Energy Changes in Physical and Chemical Processes	Unit 1: Chemical Industry
Unit 2: Measurement of Physical Quantities	Unit 2: Energy Cycle and Bond Enthalpies	Unit 2: Extraction of Metals
Unit 3: Basic Safety Laboratory Practices		Unit 3: Extraction of Crude Oil and Petroleum Processing
		Unit 4: Environmental pollution
		Unit 5: Biotechnology
		Unit 6: Cement and its uses
SECTION 2	SECTION 2	SECTION 2
ATOMIC STRUCTURE	INORGANIC CHEMISTRY	BASIC BIOCHEMISTRY
Unit 1: Particulate Nature of Matter	Unit 1: Periodic Chemistry	Unit 1: Fats and oils
Unit 2: Structure of the Atom	Unit 2: Transition Chemistry	Unit 2: Proteins
Unit 3: Periodicity		Unit 3: Carbohydrates
		Unit 4: Synthetic polymers
SECTION 3	SECTION 3	SECTION 3
CHEMICAL BONDS	CHEMICAL KINETICS AND EQUILIBRIUM	
Unit 1: Interatomic Bonding	Unit 1: Rates of Reactions	

Table 2 continued

Unit 2: Intermolecular Bonding Unit 3: Hybridisation & Shapes of Molecules	Unit 2: Chemical Equilibrium	
SECTION 4	SECTION 4	SECTION 4
CONSERVATION OF MATTER AND STOICHIOMETRY	ACIDS AND BASES	
Unit 1: Carbon-12 scale	Unit 1: the Concept of Acids and Bases	
Unit 2: Solutions	Unit 2: Properties of Acids, Bases and Acid-Base Indicators	
Unit 3: Stoichiometry and chemical Equations	Unit 3: Classification of Acids and Bases	
Unit 4: Nuclear Chemistry	Unit 4: Concept of pH and pOH Unit 5: Buffer Solutions	
	Unit 6: Solubility of Substances Unit 7: Salt and Chemicals from Salt.	
SECTION 5	SECTION 5	SECTION 5
STATES OF MATTER	REDOX REACTIONS AND ELECTROCHEMISTRY	
Unit 1: Solids and Liquids	Unit 1: Oxidation-reduction processes and Oxidizing-reducing agents	
Unit 2: Gases and their Properties	Unit 2: Balancing redox reaction equations	
	Unit 3: Redox Titration	
	Unit 4: Electrochemical Cells	
	Unit 5: Electrolytic Cells	
	Unit 6: Corrosion of Metals	
SECTION 6	SECTION 6	SECTION 6
	Unit 1: Bonding in Carbon	
	Unit 2: Classification of Carbon Compounds Unit 3: Identification of elements in Organic Compounds Unit 4: Separation and purification of Organic	

Table 2 continued

	Compounds
	Unit 5: Alkanes
	Unit 6: Alkenes
	Unit 7: Alkynes
	Unit 8: Benzene
	Unit 9: Alkanols
	Unit 10: Alkanoic Acids
	Unit 11: Alkanoic Acids derivative (Alkylalkanoates (esters)

Source: SHS Chemistry Teaching Syllabus, 2010

2.12.6 Suggestions for teaching the subject

The general objectives for the syllabus have been listed at the beginning of each section. The general objectives specify the skills and behaviours students should acquire as a result of learning the units of a section. Teachers are expected to read the objectives carefully before they start teaching the section. After teaching all the units of a section, teachers are supposed to go back and read the general objectives adequately to find out if such objectives were achieved in the course of their teaching. The syllabus has been planned on the basis of Sections and Units. Each year's work is divided into sections. A section consists of a fairly homogeneous body of knowledge within the subject. Within each section are units. A unit consists of a more related and homogenous body of knowledge and skills. The syllabus is structured in five columns: Unit, Specific Objectives, Content, Teaching and Learning Activities and Evaluation.

2.13 Textbook Development and Distribution Policy for Pre-Tertiary Education in Ghana

The Textbook Development and Distribution Policy of the Ministry of Education seeks to ensure the development, selection and provision of good quality textbooks, teachers' guides and supplementary reading books that will promote effective teaching and learning in schools. It is an objective of the MoE that textbook usage in the classroom by teachers and pupils should be improved and upgraded to encourage more active pupil/students involvement in the learning process and to discourage rote learning and excessive memorisation. Specifically, the policy aims at:

- The timely development and production of textbooks and other instructional materials, including large prints and books in Braille for the visually impaired.
- Cost effective and sustainable procurement of textbooks and other instructional materials.
- The sustainable achievement of target 1:1 textbook pupil/student ratios.
- The upgrading of local capacity in book development, publishing, distribution and printing and in the book industry in general.
- Active private sector involvement in the implementation of a sustainable book development production and distribution system.
- The development of school and classroom libraries is considered essential for the development of reading fluency, student research capacity and active student learning.

The MoE Textbook Policy places a high priority on investment in the growth and development of libraries at all educational levels (MoE Textbook Policy, 2001)

In Ghana, the production and distribution of prescribed textbooks to pre-tertiary institutions is the responsibility of the CRDD of the G.E.S. This body is mandated to produce and distribute textbooks, teachers' guides and associated learning materials (e.g. work books), plus supplementary reading materials for Pre-Tertiary institution that is Pre-school, Primary, J.H.S, S.H.S and Technical/Vocational Institutes (TVI) including Special and Integrated Schools. Furthermore, the MoE Policy on textbooks for pre-tertiary level of education in Ghana specifies that at the S.H.S level, textbooks, teachers' guides, DVD/CVD/Cassettes, Posters/Charts are required for the core subjects for the S.H.S/Secondary-Technical Schools which include English Language, Mathematics, Integrated Science, Social Studies and I.C.T. The CRDD is mandated to also produce and distribute textbooks for the elective subjects for the S.H.S/ Secondary-Technical schools. The programmes for the S.H.S/Secondary-Technical Schools include, General Science, Business, Home Economics and Technical Programmes.

The elective subjects for the General Science Programme are Elective Mathematics, Biology, Physics and Chemistry. Even before this policy came into being, the Ghana Association of Science Teachers (GAST), since the introduction of the S.H.S programme, has been producing textbooks for Integrated Science, Chemistry, Biology and Physics for G.E.S and they are approved for use by both teachers and students. So, the official textbook for the S.H.S chemistry course is the GAST Chemistry. In addition to this, there are other G.E.S approved textbooks written by teachers of the subject which are used by both teachers and students.

2.14 Empirical Framework

Various empirical studies on perceptions of difficult chemistry topics /concepts in secondary and tertiary institutions have been done at both national and international levels.

Childs and Shecham, (2009) conducted investigations to determine the topics in chemistry in Ireland that pupils/students found difficult to learn. The students completed a five point Likert-type questionnaire listing the topics covered in the different chemistry course, which asked them whether they found each topic difficult or easy. Results from the study indicated that a number of topics ranked high in terms of perceived difficulty in both the Leaving Certificate chemistry pupils and University chemistry students' lists. These topics were Volumetric Analysis Calculations, Redox Reactions and Concentration of Solutions. Other findings indicated that the mathematical ability of the pupils/students had an effect on the topics they chose as difficult or very difficult. Childs and Shecham (2009) concluded by saying that the persistence of these topics being seen as difficult throughout the pupils'/students' experiences of chemistry indicates that problems associated with these topics have never truly been addressed.

Gengden, Gongen and Lohdip (2011) assessed the areas of difficulty in the Senior Secondary School II chemistry syllabus of the Nigeria Science Curriculum. It came out after their assessment that students perceived topics such as types of chemical reactions, redox reactions, balancing redox reactions, electrode potential and electrochemical cells, laws of electrolysis, chemical equilibrium, reversible reactions, solubility, and IUPAC nomenclature of organic compounds to be difficult. Students assigned reasons such as lack of practical work, the cognitive demand of the course content, language and vocabulary of chemistry with the attendant confusion of IUPAC names as some of the factors responsible for the difficulty in learning chemistry.

Similarly, Agogo and Orda (2014) researched into students' perceived difficult concepts in Senior Secondary School Chemistry in Oju Local Goverment Area of Benue State, Nigeria. They found out that concepts such as mass volume relationship, hydrogen and the reactivity series, ionic theory, hydrocarbons, alkanols, alkanoic acids and alkanoates were perceived as difficult to study. In the opinion of the students, the abstract nature of the chemistry concepts was what made them difficult to study. They also assigned other reasons such as poor knowledge in mathematics, not non-availability of textbooks, old and out dated textbooks (when available) and the lack of instructional materials for practical activities

Jimoh (2005) investigated the perceptions of difficult topics in the chemistry curriculum by students in Nigerian Secondary Schools. His study involved five hundred and sixty (560) SSS III chemistry students randomly selected from 28 senior secondary schools in seven states. A 20-item questionnaire was administered to the respondents. Findings showed that chemistry students perceived 13 topics (65%) to be difficult to comprehend. The study also revealed that students' gender and school location had no influence on their perception of difficult topics in chemistry curriculum, while school (nature) influenced perception of chemistry topics.

Kihwele (2014) did a study into students' perception of science subjects and their attitudes in Tanzanian Secondary Schools. He found out that most students from ward (boarding) secondary schools drop science subjects. Some students believe they have low ability to manage science subjects. According to the research, students are not interested in science because they believe science is difficult and requires high understanding ability. It also involves a lot of calculations and uses difficult language yet the students were not doing well in English and Mathematics subjects. They admitted that science subjects were difficult, but they could not drop biology and mathematics because they were compulsory.

Davis (2010) investigated senior secondary school students' and teachers' most difficult organic chemistry topics in some selected senior secondary schools in the Central Region of Ghana. His studies compared the rank order of students' most difficult topics in organic chemistry to those of their teachers. The survey method was used, where questionnaires were administered to 300 chemistry students and 35 teachers. The sample was drawn from 10 senior secondary schools that had already treated organic chemistry in the Central Region. The results showed that the SSS chemistry students' and teachers' most difficult organic chemistry topic was aromatic hydrocarbons. The spearman's rank correlation was found to be 0.58 which indicated that, there is not much difference in the ranks of organic chemistry topics students found difficult to learn and what their teachers found difficult to teach. Similarly, Anamuah-Mensah (1995), Draphor (1994) and Ampiah (2001) have all done studies into students' perceived topic difficulty into the senior secondary school chemistry curriculum in Ghana.

Finally, Ennin (2015) carried out an investigation into topic difficulty in Integrated Science perceived by selected senor high school students and teachers in Ghana. Her study involved 300 Integrated Science students and 15 Integrated Science teachers from two public senior high schools in Gomoa East district in the central region of Ghana. Her research revealed that science topic difficulties existed among students and teachers of Integrated Science. Again, there was significant difference between male and female science students' perceived science topic difficulties. Both students and teachers gave reasons such as the subject being full of mathematics and diagrams, unavailability of prescribed textbooks, poor teaching methods by teachers among others. She concluded by saying that the topics that both teachers and students perceived to be difficult are the very ones that WAEC's Chief Examiner's Report (2010-2011) indicated as posing difficulties to S.H.S science students. She recommended a number of strategies to be adopted by teachers to help themselves and their students in making the perceived difficult topics in the S.H.S Integrated Science syllabus, less difficult. From the on-going discussion, it is clear that topic difficulty in chemistry exists. However, not much work has been done in the area of investigating how teachers of the subject and the prescribed textual materials (curriculum materials) help in addressing the difficulty the students face. This is the primary objective of this research work.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter spelt out the methodology or the procedures that were followed in conducting this study. The following sub headings are discussed in this chapter:

- Design of the Study
- Location of the Study
- Research Approach
- Sample Size
- Sampling Technique/Procedure
- Research Instruments
- Validity of Instruments
- Reliability of Instruments
- Trial-testing of the Instruments
- Data Collection Procedure
- Data Analysis Procedure

3.1 Design of the Study

A research design can be described as a detailed plan outlining how a study is conducted. It is a detailed "blueprint" or framework for the process of collecting, discussing, analyzing and interpreting data/information as well as related literature in order to enhance the drawing of inferences and arriving at final conclusions based on the relationships between and among the variables of interest in the study (Creswell, 2003).

The researcher employed the descriptive survey design for this study. Descriptive survey involves collecting data in order to test hypotheses or answer questions concerning the current status of the subject of interest. It therefore determines and reports events as they occur naturally (Gay & Airasian, 2003). This design allows researchers to describe situations as they are and to generalize from a sample to a population. The descriptive survey design was employed for this research piece because the researcher tested hypotheses. Again, some of the variables the researcher worked with were quantitative in nature and the nature of the topic also required a large sample size in order to obtain the needed data.

Descriptive survey design has many merits. For instance, the design provides a more accurate and meaningful picture of events and seeks to explain people's perception and behaviour on the basis of data gathered at a particular time (Fraenkel &Wallen, 1993). This allows for in-depth follow up questions and items that are unclear to be explained. The main advantage of descriptive survey design is that it has the potential to provide a lot of information from quite a large sample of respondents (Fraenkel & Wallen, 1993).

In spite of the aforementioned advantages, the descriptive survey design is beset with some disadvantages. According to Fraenkel and Wallen (1993) and Cohen, Manion and Morrison (2004), in descriptive survey, there is the difficulty of ensuring that the questions the respondents answer are clear and not misleading. The reason is that survey results can vary greatly due to the exact wording of questions. As a result, it may produce unreliable results. There is also the difficulty of obtaining adequate number of questionnaire completed and returned for meaningful analysis to be made in some cases. Notwithstanding these disadvantages, the descriptive survey design was found to be most appropriate and applicable for the study.

3.2 Location of the Study

The study was carried out in the Western Region of the Republic of Ghana. Western Region is one of the ten administrative regions of the republic of Ghana. It is situated in the south-western part of Ghana. It shares common borders with La Cote d'Ivoire on the West, the Central Region in the East, parts of Ashanti Region in the North and the Gulf of Guinea (Atlantic Ocean) in the South. It covers an area of 23,921 square kilometers representing about 10% of the total land surface of Ghana (Population and Housing Census, 2010). Sekondi-Takoradi is its regional capital.

The Western Region was selected for this study because that it came out from the chief examiners' reports that the region was among the regions that consistently recorded low performance in chemistry in the WASSCE. Again, checks made at the Regional Education Office indicated that some of the senior high schools in the region did not have adequate teachers to handle the subject. Based on these two reasons, the region was chosen for the study.

3.3 Research Approach

Broadly speaking, there are three approaches or methods to conducting educational research: qualitative method, quantitative method and the mixed method (Creswell, 2003; Tashakkori & Teddlie, 2003). However, this study employed the quantitative approach in achieving the set objectives.

Quantitative research method as explained by Creswell (2003) is a formal, objective, systematic process in which numerical data are used to obtain information about the world, and it is used to describe variables, examine relationships among variables and determine cause-and-effect interactions between variables (p. 23). It is thus, a formal, objective, and systematic process for obtaining quantitative data about the world which is presented in numerical form, and analysed by using statistics in order to describe and test relationships. Simply put, quantitative research method is concerned with numbers, statistics and the relationships between events and numbers.

The researcher employed the quantitative approach in this study because the variables used in conducting the research were quantitative in nature. Also, the research questions posed demanded the use of quantitative approach.

3.4 Target Population

Population has been defined as the universe of units from which the sample is to be "selected" (Bryman, 2008). Similarly, according to Bebbie (1990) the population of a study is an abstract idea of a large group of many cases from which a researcher draws a sample and to which results from a sample are generalized (p. 224). According to Agyedu, Donkor and Obeng (2011), research population is the complete set of individuals (subjects), objects or events with common observable features for which a researcher is interested in studying. It is also regarded as the larger group from which individuals are selected to participate in a study.

The target population for this study was all S.H.S elective chemistry students and teachers in Ghana. However, the accessible population comprised S.H.S 3 chemistry students from the public senior high schools in five administrative districts in the Western Region of Ghana. The five districts selected for the study were Sekondi-Takoradi, Wassa Amenfi West, Sefwi Wiowso, Bibiani-Anhwiaso-Bekwai and

Juaboso. Chemistry teachers in the selected schools were also part of the accessible population for the study. One reason for selecting S.H.S 3 students was that they had completed the senior high school forms one (1) and two (2) syllabus of the chemistry course and were familiar with the course content.

3.5 Sample Size

It will be very expensive and time consuming for a researcher to study all individuals in a large population. As a result, there will be the need for the researcher to select a certain number of individuals who will be representative of the population for the study. Sample refers to the segment of the population that is selected for investigation and sample frame as the listing of all units in the population from which the sample will be selected (Bryman, 2008). The selected number of the respondents will therefore form the sample for the study.

As of the time of conducting this research, there were forty seven (47) public senior high schools in the Western Region. Out of this number, thirty three (33) offered both General Science and General Agricultural Science programmes and therefore had students who offered elective chemistry (Programmes and courses for public and private senior high school, technical and vocational institutes, Ghana Education Service, 2015). The five selected districts had twenty one (21) public senior high schools. There were thirteen (13) schools in the Sekondi-Takoradi Metropolis, the Bibiani-Anhwiaso-Bekwai district had three schools, there was only one school in the Juaboso district while the Wassa Amenfi West and Sefwi Wiowso districts had two schools each. Each of these schools offered General Science or General Agricultural Science programme. The researcher selected eight (8) out of the twenty one (21) schools in the five selected districts representing 38% of the schools in the five districts. This according to van Dalen (1979) was acceptable since the sample size was more 10% of the number of schools targeted. The selection was done in accordance with the Ghana Education Service classification of public senior high schools.

3.6 Sampling Technique/Procedure

Purposive sampling technique was used to select the schools that were used for the study. Makhado (2002) agreed with the use of purposive sampling techniques by stressing the fact that it is important to select research subjects who will provide the needed information as this will help the researcher to address the purpose of the research. McMillan and Schumacher (2001) also recommended purposeful sampling because the samples that were chosen here were likely to be knowledgeable and informative about the phenomenon the researcher investigated.

The Ghana Education Service (G.E.S) has grouped all public senior high schools into three (3); Class "A", Class "B" and Class "C", according to the available school facilities and the general performance of students in the final West African Senior School Certificate Examination (WASSCE). The Class "A" schools are the well-endowed, the Class "B" schools are considered as average and the Class "C" schools are the less endowed. Out of the twenty one (21) public senior high schools in the selected districts as of the time of this research, there were three (3) Class "A" schools, seven (7) were average schools and eleven (11) were less endowed. To ensure high degree of representativeness, purposive sampling technique was used to select the eight (8) schools for the collection of data. Two (2) schools were selected from the Class "A" schools, three (3) each were also selected from the average and the less endowed schools.

In each of the eight (8) selected schools, all the students in the General Science classes responded to the questionnaire. The researcher did not get full classes for some of the schools because some of students were not in classes. This was due to the fact that students were writing their mock examination and had left the class after writing the day's papers. In all, two hundred and eighty (280) students responded to the questionnaire.

Sixteen (16) teachers were also purposively selected with two (2) coming from each of the eight (8) schools. The teachers selected were those who assisted the researcher in organizing the students for the exercise and also in administering the questionnaire to the students.

3.7 Research Instruments

Two main instruments were used. These were questionnaires and document analysis. The questionnaire was of two types. One was for students and another for teachers. These questionnaires were titled "Questionnaire for Chemistry Students" (QCS) and Questionnaire for Chemistry Teachers (QCT). The structure of the instruments was adapted from previous studies in the areas of perceptions (Ampiah, 2001; Wood, 1994) and teachers and students' reasons for content difficulties in S.H.S chemistry syllabus and modified them to suit the present study.

The students' perception of topic difficulty was based on the G.E.S elective chemistry syllabus. The students' instrument had five items. Items 1 and 2 contained background information on age and gender. Items 3, 4 and 5 solicited free responses on difficult topics in chemistry, reasons for the difficulty and how the textbooks they often use as well as other textual materials help them in learning chemistry.

The Teachers Questionnaire (QCT) had three (3) sections. Section one (1) of the questionnaire solicited demographic information including teaching experience and qualifications of chemistry teachers. Section three (2) of the instrument was devoted to gather information on teachers' views on how the textbooks available for use address topic difficulty in chemistry. The last section dwelt on how teachers themselves help students in overcoming topic difficulty. Document analysis was also used in gathering data to support the data gathered from the questionnaire in answering the research questions. Documents that were analysed included the S.H.S chemistry syllabus (G.E.S), WAEC chief examiner's report (chemistry) and available textual materials in use by teachers and students

3.8 Validity of the Main Instruments

The main instruments used for this research work was validated by the researcher's supervisors.

3.9 Reliability of the Instruments

Trial- testing of instrument reduces ambiguity of items and therefore enhances their reliability (Meriwether, 2001). To ensure high reliability of the instruments for this research work, both instruments were pilot-tested in two selected senior high schools in Ashanti Region. Crobach's Alpha Coefficient was used to calculate the reliability of the pilot study. The results from the pilot test helped the researcher to identify areas of difficulty in the questionnaire and also modify some aspects of the instruments before administering them to the accessible population. The reliability of the questionnaire (both students and teachers) was estimated using Crobach's Alpha Coefficient. The reliability for the students' questionnaire was found to be 0.95 and that of the teachers was 0.84 which according to Bryman (2008) indicates that the instruments were reliable and could be used for data collection.

3.10 Trial-Testing of the Instruments

The students' and teachers' questionnaires were pilot-tested in two senior high schools in Ashanti Region. The schools were Konongo-Odumasi and Collins Senior High Schools. Forty students and four teachers were used for the pre-testing of the instruments. The two aforementioned schools were used for the pre-testing of the instruments because according to the Ghana Education Service's grouping of senior high schools, Konongo-Odumasi SHS is a well-endowed school and the Collins SHS is a less endowed one. Therefore, the two schools had characteristics that were similar to the schools that were used for the main research.

3.11 Data Collection Procedure

There were four stages in the collection of data for the study. In the first stage, a letter of introduction was secured from the Head of Science Education Department of the University of Education, Winneba to be sent to the headmasters of the selected schools for permission to undertake the study in their schools. The heads of chemistry department in the selected schools were also informed accordingly.

During the second stage, the researcher visited the selected schools. After going through the introductory formalities, he administered the questionnaire to the students (respondents) and collected them back on the same day after the respondents had completed them. The third stage was the analysis of the primary data collected from the schools for this research work using the SPSS. The final stage was the analysis of the necessary secondary data for this research work. The secondary data analysed included the chemistry syllabus (G.E.S), WASSCE Chemistry Chief Examiner's Reports and the available textbooks used by teachers and students.

3.12 Data Analysis Procedure

The data collected were analysed using the research questions as a guide. The data collected was organised and coded with numbers assigned to each distinctive variable such as age, gender among others for students and also gender, age range, academic qualification, among others in respect of the teachers.

Students' perceived difficulties with chemistry topics at the SHS level were analysed by the use of the percentages, means and standard deviations. The items in section "B" of the questionnaire for the students were assigned values on a five-point Likert scale (1-very difficult, 2-difficult, 3-moderately difficult, 4-slightly difficult and 5-not difficult). Since the scale was a 5-point Likert-type scale format, three (3), the mid-value was chosen as an average value to which mean scores below it were considered perceived difficult topics to be learnt by students. Mean scores above the average mean score of three (3) were considered as topics perceived not difficult to learn by students. The mean and standard deviation scores for each of the twenty topics selected were estimated. Hence, students' perceived difficulties with the topics were determined when a response had a mean of 3.

Similarly, the reasons for students' difficulty with the selected topics was also analysed using a 5-point Likert scale format (1-strongly agree, 2-agree, 3-undecided, 4-disagree and 5-strongly disagree). Three (3) was chosen as the mid-value to which mean scores below it meant that respondents agreed with the researcher that they perceived certain topics in the SHS syllabus difficult to learn due to the reasons provided. On the other hand, mean values above three (3) were considered as not reasons why students perceived certain topics in the SHS syllabus as difficult. This same format was followed to analyse the data collected using section "D" and "E" of the students' questionnaire which solicited views on how the available textual materials treat topics in the SHS chemistry syllabus and how chemistry teachers help students in addressing students' perceived topic difficulty. This same pattern was followed in analyzing the teachers' questionnaire and the results were used to answer the research questions set.

For the null hypothesis, the difference between male and female chemistry topic difficulties in the chemistry syllabus was determined by comparing their mean scores. An independent t-test for the two independent samples (male chemistry students and female chemistry students) was performed to determine if there was a significant difference in the difficulties encountered by these two groups.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

The purpose of this study was to investigate topic difficulty perceived by S.H.S chemistry students and how the available textual materials and teachers address the difficulty in eight public senior high schools in Western Region. In this chapter, findings from the study are presented and discussed in relation to the five research questions stated for the study. Students' and teachers' views on aspects of chemistry teaching and how the available textual materials address the difficulties students face in learning chemistry are presented in this chapter. A test of differences between male and female students' perceived difficulties with the selected topics is presented. Discussions on the research questions were based on the quantitative data collected and the analysis of documents (textual materials) used for the teaching and learning of chemistry at the S.H.S level. The discussions focused on the demographic information on the respondents (students and teachers) and findings related to the research questions.

The research questions formulated to guide the study were:

1. What chemistry topics do senior high school students perceive as difficult?
2. What are the causes of the topic-difficulties perceived by the senior high school students in chemistry?
3. To what extent do the available textual materials help in addressing students' perceived topic-difficulties in chemistry?
4. How do chemistry teachers help in addressing students' perceived topic difficulty in the SHS chemistry syllabus

5. Do differences exist in the chemistry topic-difficulties perceived by male and female SHS students?

4.1 Demographic Data on the Respondents

4.1.1 Demographic data on the teachers

In all, there were sixteen (16) teacher-respondents. Interestingly, all the sixteen teacher-respondents were males. This pre-supposes there are more male chemistry teachers teaching chemistry at the S.H.S level. This information is presented in Table 3.

Table 3: Sex of Respondents (Teachers)

Sex	Frequency	Percentage (%)
Male	16	100
Female	0	0
Total	**16**	**100**

Source: Field work, 2016

All the sixteen teacher-respondents were males.

The respondents were asked to indicate their age group as shown in Table 4.

Table 4: Age of the Teacher-Respondents

Age Range	Frequency	Percentage (%)
22-30 years	2	2.5
31-39 years	8	50.0
40-48 years	4	5.0
49-57 years	2	2.5
Above 57 years	0	0.0
Total	**16**	**100**

Source: Field work, 2016

Out of the 16 respondents, 12.5% (2) were between 22-30 years, 50% (8) of them were between 31-39 years, 25%, (4) were between 40-48 years and 12.5% (2) were also between 49-57 years. None of the respondents was above 57 years. This age distribution indicates that a substantial proportion of the teachers is young (31-39) years and that could lead to efficient output. This leads to the assumption that shortage of the respondents are not likely to occur in terms of the retirement of teachers in the eight schools selected. Also, the respondents between the ages of 40 and 57 were more experienced to understand how the available textual materials they used for their teaching helped in addressing topic difficulty in the S.H.S chemistry syllabus. The respondents' academic qualifications are shown in Table 5. It is seen from Table 5 that majority of the teacher-respondents had first degree as their basic academic qualification.

Table 5: Educational Levels of the Teacher Respondents

Qualification	Frequency	Percentage (%)
Bachelor's degree	10	62.5
Master's degree	6	37.5
Ph. D	0	0.00
Total	**16**	**100**

Source: Field work, 2016

From Table 5, 62.5% (10) of the respondents had Bachelor's degree and the remaining 37.5 % (6) of the respondents also had Master's degree. None of the respondents had attained a doctor of philosophy degree (PhD). As a result of the respondents' qualifications, they were able to understand and respond appropriately to the questionnaire.

The respondents (teachers) were asked to indicate the number of years they had been teaching the subject and the result is indicated in Table 6.

Table 6: Working (Teaching) Experience of the Respondents

Years of Experience	Frequency	Percentage (%)
1-5	4	25.0
6-10	4	25.0
11-15	7	43.8
16 & above	1	6.2
Total	**16**	**100.00**

Source: Field work, 2016

In Table 6, 25% (4) of the respondents have taught from a period of one to five years, 25% (4) of them indicated a period of six to ten years, 43.8% (7) also indicated eleven to fifteen years of teaching experience while 1 representing 6.2% had taught for at least sixteen years. It can be deduced from the result that the respondents have adequate work experience and knowledge about the subject they teach and thus are able to provide reliable and adequate information. Bandura (1997) concluded that teachers with a longer experience display a higher sense of confidence and self-efficacy in dealing with the learning problems of the learners. Since half of the respondents have working experience of eleven years and above, they were in a better position to share their observation and experience with regards to how their style of teaching and how the available textual materials help in addressing topic difficulty SHS students face in learning chemistry. Vanco (2003) asserted that teachers' years of teaching play a significant role in the teaching and learning process.

The result in Table 7 indicates the area of specialization of the teachers at the university.

Table 7: Areas of Specialisation of the Teachers

Area of Specialisation	Frequency	Percentage (%)
Chemistry	13	81.2
Biology	0	0
Physics	0	0
Others	3	18.8
Total	**16**	**100.00**

Source: Field work, 2016

From Table 7, 13 (81.2%) of the respondents specialized in chemistry at the university. None of them specialized in either Biology or Physics. Three (18.8%) had their degrees in other subject areas in science apart from chemistry, biology or physics. These other subject areas could be integrated science or engineering related courses at the university. These teachers have been asked to teach chemistry due to inadequate supply of qualified teachers to teach the subject at the SHS level. It is a policy of the Ghana Education Service (GES) that teachers at the SHS level should teach in their respective subject areas. Since majority of the teachers specialized in chemistry, they could give the needed information for this research work.

In order to know the professional status of the teacher respondents, they were asked to indicate whether they were professional teachers or not. The result is summarized in Table 8.

Table 8: Professional Status of the Teachers

Professional Status	Frequency	Percentage (%)
Professional	12	75.00
Non-Professional	4	25.00
Total	**16**	**100.00**

Source: Field work, 2016.

The above table indicates that 12 (75%) of the respondents were professional teachers while the remaining 4 (25%) were non-professional teachers. This means that these teachers did not have professional teaching qualification apart from academic qualification. Again, the Ghana Education Service requires all teachers to have professional teaching qualification. Since majority of the respondents were professional teachers, they could provide the needed information.

4.1.2 Demographic data on the students

A total of 280 students from the eight (8) selected schools participated in the study. Tables 9 and 10 show the distribution of number of respondents by their sex and age respectively.

Table 9: Sex of the Students

Sex	Frequency	Percentage (%)
Male	178	63.6
Female	102	36.4
Total	**280**	**100.0**

Source: Field work, 2016

It is seen from the above table that majority of the respondents, with a frequency of 178 representing 63.6%, were males while the remaining 102 representing 36.4% were females. This therefore pre-supposes that male students were more than the females in the study.

Table 10: Age of the Students

Age	Frequency	Percentage (%)
17-19	247	88.2
20 and above	33	11.8
Total	**280**	**100.00**

Source: Field work, 2016

It is observed from Table 10 that 247 of the respondents, representing 88.2%, were between the ages of 17 and 19 while 33 (11.8%) of the respondents were aged 20 and above. Their age distribution confirms that of the Ghana Education Service in that according to the G.E.S, a student entering the SHS should be at least 15 years. Since the respondents were in S.H.S 3, it was assumed that they were all above sixteen years and the result has proven that. It was therefore not surprising that almost all the respondents were between the ages of 17 and 19.

4.2 Presentation of the Results by Research Questions

Research Question 1

What chemistry topics do senior high school students perceive as difficult?

Research question one sought to find out chemistry topics students find difficult to learn in the senior high school chemistry curriculum. The responses of the respondents are shown in Table 11.

Table 11: Topics Perceived to be Difficult to Learn by S.H.S Chemistry Students

Topic	VD	D	MD	SD	ND	Mean	Std
1. Separation of Mixtures	17.1	7.9	18.9	18.6	37.5	3.51	2.19
2. Particulate Nature of Matter (Atoms, Molecules, Compounds, Ions)	5.0	5.7	12.1	14.3	62.9	4.24	1.38
3. Writing and Naming Formulae of Inorganic Compounds	20.7	23.2	16.8	20.0	19.3	2.94	1.43
4. Writing and Balancing of Chemical Equations	16.4	15.4	17.9	22.5	27.9	3.30	1.43
5. Periodicity (Periodic Properties of the 1st 20 elements)	11.8	12.1	13.6	29.6	32.9	3.59	1.36
6. Interatomic and Intermole-molecular Bonding (lonic, Covalent Metallic and vander Waals forces)	21.4	21.1	19.6	21.4	16.4	2.90	1.77
7. Hybridisation and Shapes of Molecules	11.8	13.9	21.1	26.4	26.8	3.4	1.33
8. The Mole Concept (Carbon-12, Scale, Avogadro Constant, L, Molar Quantities, Preparation of Standard Solutions)	14.6	13.2	14.6	24.6	32.9	3.48	1.43
9. Chemistry of Transition Elements	15.0	21.1	21.8	25.7	16.4	3.0	1.31
10. Kinetic Theory of Matter/ The Gas Laws	12.1	12.5	17.9	25.4	32.1	3.52	1.37
11. Nuclear Chemistry	16.1	16.1	16.1	25.7	26.0	3.29	1.42
12. Enthalpy changes and Bond Energy Calculation	20.4	22.1	17.9	22.9	16.8	2.93	1.39
13. Rate of Chemical Reaction	18.6	25.4	15.7	21.1	19.3	2.97	1.40
14. Chemical Equilibrium	22.1	18.6	17.5	27.9	13.9	2.92	1.38
15. Concept of pH and pOH of Solutions	22.1	22.5	18.9	18.2	18.2	2.88	1.41
16. Acid-Base Titration Experiments	19.6	15.0	21.8	21.4	22.1	3.11	1.42
17. Solubility of Substances	13.2	27.9	22.9	22.9	13.2	2.95	1.25
18. Nomenclature of organic compounds	28.2	22.9	21.4	23.9	3.6	2.51	1.22
19. Redox Reactions (Determining oxidizing/reducing agents, balancing redox reactions, oxidation-reduction titrations)	30.0	25.7	21.4	17.1	5.7	2.42	1.23
20. Electrochemical cells/ electrochemistry (Electrolysis, electric cells construction and electrode potential)	27.1	27.1	23.9	15.4	6.4	2.46	1.23

VD-Very Difficult, D- Difficult, MD- Moderately Difficult, SD-Slightly Difficult, ND-Not Difficult and std-Standard Deviation

Source: Field work, 2016

The result in Table 11 gives the responses of the 280 students who responded to the questionnaire. This aspect of the questionnaire solicited the views of the respondents as to whether they find it difficult or easy in learning each of the twenty (20) carefully selected topics. The average mean score was taken to be 3.0. Therefore, all topics with average mean score below 3 were taken as being very difficult or difficult to learn. On the other hand, all topics with average mean score above 3 were considered as topics in the SHS chemistry curriculum that students perceived as not difficult to learn or very easy to understand. Table 12 indicates the order in which students perceived the twenty (20) select topics starting from the most difficult topic to the least one.

Table 12: Order of Topic Difficulty in the SHS Syllabus Perceived by the Respondents

Topic	Mean Score	Stand. Deviation	Remarks
Redox Reactions	2.4286	1.2394	Difficult to learn
Electrochemistry	2.4679	1.2206	Difficult to learn
Nomenclature of Organic Compounds	2.5179	1.2297	Difficult to learn
Concept of pH and pOH of Solution	2.8786	1.4197	Difficult to learn
Interatomic and Intermolecular Bonding	2.9036	1.3917	Difficult to learn
Chemical Equilibrium	2.9286	1.3816	Difficult to learn
Enthalpy Changes and Bond Energy	2.9357	1.3923	Difficult to learn
Chemical formula of inorganic compounds	2.9393	1.4332	Difficult to learn
Rate of chemical Reaction	2.9714	1.4088	Difficult to learn
Chemistry of Transition Elements	3.0750	1.4378	Not difficult to learn
Acid-Base Titration	3.1143	1.4247	Not difficult to learn
Nuclear Chemistry	3.2964	1.4223	Not difficult to learn
Writing & Balancing of Chemical equations	3.3000	1.4378	Not difficult to learn
Hybridisation & shapes of molecules	3.4250	1.3312	Not difficult to learn
The Mole concept	3.4786	1.4341	Not difficult to learn
Separation of Mixtures	3.5143	1.4809	Not difficult to learn
Kinetic theory of Gases/Gas Laws	3.5286	1.3701	Not difficult to learn
Periodic Properties of 1st 20 Elements	3.6435	1.3678	Not difficult to learn
Particulate Nature of Matter	4.2429	2.1724	Not difficult to learn

Source Field work, 2016

Referring to Table 11, majority of the respondents indicated that "Separation of Mixtures" is not difficult to learn. This is evident from the mean value of 3.54. Only seventy (70) representing 25% of the respondents said that this topic is either very difficult or difficult to learn. Students therefore, did not have any problem learning this topic. One other topic that students did not have problem with in learning is "Particulate nature of matter" (Atoms, Molecules, Compounds, Ions). This topic had the highest mean score value of 4. 24 and 250 out of the 280 respondents representing 89.3% said they found it very easy to learn.

However, respondents indicated their difficulty in learning the concept, "Writing and Naming Formulae of Inorganic Compounds". This topic had a mean value of 2.94. One hundred and twenty-three (123) representing 43.9% of the respondents admitted that this concept is either "very difficult" or "difficult" to learn. This is one of the fundamental topics in chemistry. So, if students have difficulty in learning, then it will have effect on their ability to learn other related topics. Contrary to this, respondents did not have much difficulty in learning the concept "Writing and Balancing of chemical Equations". This topic relates to the former and one would expect students to give similar response. From the result, 191 (69.2%) of the respondents found this topic easy to learn. Again, respondents indicated that "Periodicity (Periodic Properties of the 1st 20 Elements)" is not a difficult concept to learn. This topic had a mean score of 3.59. Only 66 (23.9%) of the respondents admitted that they had difficulty in learning it.

One of the fundamental concepts in chemistry is "Interatomic and Intermolecular Bonding (lonic, covalent, metallic, Hydrogen Bonding and van der Waals forces)". Students' response indicated that this topic poses difficulty to them. The topic had a mean score of 2.90 and 119 (42.5%) of the respondents said they found it either very difficult or difficult to learn. "Hybridisation and Shapes of Molecules" as a concept in chemistry was not difficult topic to learn according to the respondents. The mean score for this topic was 3.43. Two hundred and eight (75.3%) indicated that this topic was easy to learn. Another topic that showed a similar pattern is the "Mole concept". Its mean was 3.07 meaning that majority of the responded agreed that this concept was not difficult to learn. Similarly, the respondents indicated that "Kinetic Theory of Matter/The Gas Laws" was not difficult to learn. This is because only 69 (24.6%) of the respondents indicated that this topic was either very difficult or difficult to learn. The remaining 211 (76.4%) of the respondents indicated that the topic was not difficult to learn. A mean score of 3.53 also confirmed this. Again, "Nuclear chemistry" was also not difficult to learn according to the respondents. Ninety (32.2%) of the respondents admitted that learning this topic posed a challenge to them. However, the remaining 190 (67.8%) indicated that this topic was not difficult to learn. The mean score was 3.29.

"Enthalpy changes and Bond Energy" is one of the topics students have to learn in the second year of the SHS chemistry curriculum. According to Table 11, 119 (42.5%) of the respondents admitted that this topic was either very difficult to learn or difficult to learn. This was also confirmed by the mean score of 2.94. Childs and Shecham (2009) conducted investigations to determine the topics in chemistry curriculum in Ireland that pupils or students found difficult to learn and it came out that "Rate of chemical reactions and "chemical equilibrium" were difficult to the pupils. The results in Table 11 confirmed their assertion. The mean score for both topics were below 3 (Rate of chemical reaction = 2.97 and chemical Equilibrium = 2.93). These mean scores indicated that both topics were difficult to learn. Gengden, Gongden and Lohdip (2011) in assessing areas of difficulty in the Senior Secondary School II chemistry syllabus in Nigeria came out that chemical reactions and reversible reactions (chemical equilibrium) posed difficult to students. Students' response on "Acid-Base Experiments" indicated that they did not have difficulty in learning since the mean score was above 3.0. This is in sharp contrast with that of Childs and Shecham (2009) in Ireland who found out that Volumetric Analysis Calculations posed difficulties to Ireland chemistry students. Again, Agogo and Orda (2014) in Nigeria found out that mass- volume relationship also posed difficult to chemistry students of Nigeria.

Students' response on "Solubility of substance" indicated that this topic posed difficulty to them. The mean score was 2.95 with 115 (41.1%) of the respondents saying that this topic was difficult to learn. This result is in agreement with that of Gengden, Gongden and Lohdip (2011) when they assessed the areas of difficulty in the Senior Secondary School II chemistry syllabus in Nigeria and found out that ''solubility" was one of the difficult topics among students.

Davis (2010) investigated senior secondary school students' and teachers' most difficult organic chemistry topics in some selected senior secondary schools in the central Region of Ghana and found out that "Nomenclature of organic compounds" and "aromatic hydrocarbons" were difficult to students. This result is in agreement with that in Table 9 which indicated that the topic "Nomenclature of organic compounds" was difficult to learn since the mean score was below 3. 143 (51.1%) which is more than half of the respondents admitted that the topic was a difficult one. Anamuah-Mensah (1995), Draphor (1994) and Ampiah (2001) had similar results in their studies on this topic. Agogo and Orda (2014) also found out that students perceived hydrocarbons, alkanols, alkanoic acids and alkanoates as difficult topic to learn in organic chemistry. Students' responses to "Redox reactions" and Electrochemistry" indicated that these two topics were difficult to learn. Both topics had mean scores below 3 which indicated that they were difficult. More than half of the respondents indicated that these two topics were difficult to learn. These results are in agreement with those of Gengden, Gongden and Lohdip (2011), as well as Childs and Shecham (2009).

Making reference to Table 12, the most difficult topic according to the students was "Redox Reactions" followed by "Electrochemistry" and "Nomenclature of organic compounds" in that order. Again, the least difficult topic according to the results in Table 12 was "particulate Nature of Matter (Atoms, Molecules, Compounds, lons). Again, the results in the table indicated that nine (9) out of the twenty (20) selected topics were perceived to be difficult to learn by SHS chemistry students. This result is very similar to Jimoh (2005) who investigated the perceptions of difficult topics in the chemistry curriculum by students in Nigeria Secondary Schools and found out that students perceived 13 (65%) out of the twenty selected topic difficult to comprehend. According to Table 12, students perceived "Electrochemistry" "Redox Reactions" "Nomenclature of organic compounds", "concept of pH and pOH of solutions", Interatomic and Intermolecular Bonding, "Chemical Equilibrium", "Enthalpy changes and Bond Energy calculation", Writing and Naming Formulae of Inorganic Compounds", "Solubility of substance", and "Rate of chemical Reactions" to be difficult to learn.

Research Question 2

What are the causes of the topic difficulty perceived by the senior high school students in chemistry?

Research question two sought the reasons why students were unable to understand some chemistry topics. Respondents were presented with a five-point likert scale to indicate the extent of their agreement or disagreement to each of the ten (10) reasons by ticking in the appropriate box. The result gathered is presented in Table 13.

Table 13: Reasons for Topic Difficulty in the SHS Chemistry Curriculum

Reason	SA	A	U	D	SD	Mean	Std.
Poor Mathematical Skills (PMS)	16.6	29.3	10.4	26.4	15.4	2.91	1.38
Abstract Nature of Topics (ANT)	28.2	35.7	17.1	11.4	7.5	2.34	1.21
Poor Teaching Methods (PTM)	17.1	22.5	12.9	23.2	24.3	3.15	1.45
Lack of Practical Activities (LPA)	33.2	27.9	7.5	13.2	18.2	2.25	1.50
Lessons are not Interesting (LI)	29.3	19.3	16.1	23.2	12.1	2.69	1.41
Misconception of Content (MC)	16.1	31.4	15.4	22.5	14.6	2.88	1.33
Low Motivation by Teachers (LM)	21.4	22.9	14.6	20.0	21.1	2.96	1.46
Unavailability of Prescribed Textbooks (UPT)	27.9	29.6	6.4	17.9	18.2	2.68	1.49
Language Used in Textbooks are Difficult To Understand (L)	21.4	33.3	9.6	18.9	15.7	2.73	1.39
Low Mental Ability (LMA)	21.1	22.5	11.1	23.2	22.1	3.02	1.48

SA – Strongly Agree, A- Agree, U- Undecided, D- Disagree, SD- Strongly Disagree, Std- Standard deviation

Source: Field work, 2016

The results in Table 13 indicate that respondents agreed with the researcher that poor mathematics skills is one of the major reasons why students perceive some topics in the SHS chemistry syllabus to be difficult. One hundred and thirty four (45.9%) of the respondents agreed that due to poor mathematical skills, some chemistry concepts were difficult to learn. This compliments Agogo and Orda (2014) who found poor knowledge in mathematics as one of the reasons why students perceived some chemistry topics difficult. Kihwele (2014) found out that students in Tanzanian Secondary Schools dropped science as they progress mainly due to poor mathematical knowledge. Ennin (2015) found out that SHS students perceived topics in Integrated Science to be difficult due to the mathematical nature of it.

Samba and Eriba (2012) as cited in Uchegbo et al. (2015) identified the abstract nature of chemistry as one of the key reasons why students perceive topics in chemistry to be difficult. Agogo and Orda (2014) pointed out that students' anxiety for chemistry learning can be attributed to students' perceived difficulty nature of chemistry and abstract nature of chemistry concepts. Students' response on this reason confirms these two findings. One hundred and seventy nine (63.9%) of the respondents confirmed that the abstract nature of chemistry concepts constitute one of the key reasons why students perceive some chemistry topics as difficult to learn.

Poor teaching method is` perceived to be one of the reasons why students find it difficult in learning some concepts in chemistry. Although majority of the respondents disagreed to this fact, sizeable number of the respondents admitted that poor teaching methods remained a major reason why students perceive some topics to be difficult. One hundred and eleven (39.6%) of the respondents agreed that poor teaching methods contributed to their inability to learn certain topics in chemistry. The fact that students agreed to approaches adopted by teachers in the teaching of chemistry concepts are effective to aid understanding of concepts agreed with Osafo-Affum (2001) who revealed that wrong approaches to teaching largely affect students' understanding of concepts taught. According to lkeobi (2012) it is the teacher who organises the interactions between the subject (learner) and the object (learning materials). It is the teacher who ensures that equipment and materials are properly used by the learner to achieve the expected results/objectives. All these point to the fact that the teacher is a very significant factor when learners fail to exhibit the expected mastery in science subjects like chemistry.

The data in Table 13 indicates that 61.1% of the respondents agreed that the lack of practical activities was one of the reasons why they found some chemistry topics difficult. Given that chemistry is essentially a practical subject, any learner who misses out on practical activities due to lack of resources is disadvantaged. In fact in Ghana there is a regulation that any candidate who does not pass in the practical examination in the WASSCE, cannot pass with a credit in the chemistry examination conducted by the WAEC.

Respondents' indication on the extent to which they agree or not with the statement "chemistry lessons are not interesting" was large. Out of the 280 respondents, 136 representing 48.6% affirmed that indeed chemistry lessons are not interesting to them and that constitutes a reason why they find some topics in the syllabus to be difficult. It is possible teachers do not make lessons interesting to the students or students' interest in the subject is low. Mallam (2002) provided a definition of interest as referring to a differential likelihood of investing energy in one set of stimuli rather than others. This definition is applicable to situations in the classroom where the interests of students in academic areas are reflected in actions such as time and effort spent studying a particular subject, willingness to engage in additional activities involving the subject area besides that given by the teacher, and voluntarily selecting the subject for further study. So, if chemistry lessons are not interesting to students, time and effort spent in studying the subject reduce and this will invariably affect their performance.

It is worth recognising that misconceptions will occur because-learners do not come to chemistry classes with empty minds. The process of learning chemistry will involve the modification or alteration of previously held ideas and this is a natural process. So, when respondents were asked to indicate whether they agreed or not with the statement "Misconception of Content" as a reason for topic difficulty in chemistry, 133 of the respondents representing 47.5% indicated that misconception of content is a challenge to learning chemistry. Forty-three (15.4%) of the respondents could not decide whether misconception of content was a reason for topic difficulty or not while the remaining 106 (37.9%) disagreed with this assertion. Misconception was therefore a barrier or an obstacle to learning chemistry.

There is no doubt that motivation to learn is an important factor controlling the success of learning and teachers face problems when their students do not have the motivation to seek to understand. So, to find out whether or not teachers' inability to motivate students to learn is a contributing factor to topic difficulty in chemistry, 124 (44.3%) of the respondents agreed that teachers' inability to motivate students to learn is a reason for topic difficulty. Forty one (14.6%) of the respondents could not decide whether teachers' inability to motivate students to learn is a reason for topic difficulty in chemistry or not. The remaining 41% of the respondents disagreed with the statements.

Textbooks play prominent roles in the teaching and learning process and they are the primary agents conveying knowledge to learners. Besides, one of the basic functions of textbooks is to make the existence of knowledge available and apparent to the learner in a selected, easy and organised way. Unavailability of prescribed textbooks to support students in their learning process is a major hindrance to learning. It is therefore not surprising to note that more than half of the respondents agreed that unavailability of prescribed textbooks is a reason for topic difficulty in chemistry. From Table 13, 161 (57.5%) of the respondents indicated that unavailability of textbooks is a reason why some topics in chemistry are difficult to learn. Only 18 of the respondents representing 6.4% could not decide whether this assertion is a reason for topic difficulty or not in chemistry. The remaining 101 (36.1%) did not agree to this statement. To them, unavailability of prescribed textbooks is not one of the reasons why topic difficulty exists. According to Cunningsworth (1995), textbooks provide additional benefits to students as they are an efficient collection of materials for self-assessed learning and for knowledge consolidation. Textbooks can potentially save learners from teacher's incompetency and deficiencies (Litz, 2005).

In writing textbooks for use by students, one of the key factors writers should be mindful of is language use. Language is a contributor to information overload. So, if language used in writing textbooks for students is unfamiliar or misleading, students may not show interest in using such books. One of the reasons for topic difficulty in chemistry is that language used in textbooks is difficult to understand. From Table 13, more than half of the respondents agreed that language used in textbooks is difficult to understand. One hundred and sixty-six (55.7%) of the respondents agreed that language used in textbooks are difficult to understand. Twenty seven representing 9.6% of the respondents could not decide whether or not language used in textbooks is difficult to understand. The remaining 34.7% of the respondents disagreed that language used in textbooks being difficult to understand is a reason for topic difficulty in chemistry. Again, respondents were asked to indicate if "Low Mental Ability" of students is a reason for topic difficulty in chemistry. In responding, 122 (43.6%) of the respondents agreed that "Low Mental Ability" is a contributing factor to topic difficulty in chemistry. Thirty one (representing 11.1%) of the respondents remained undecided. The remaining 45.3% of the respondents disagreed to this assertion. The ranking of reasons for topic difficulty in the SHS syllabus is presented in Table 14.

Table 14: Ranking of Reasons for Topic Difficulty in the SHS Syllabus

Reason	Mean	Std
Abstract Nature of Topic (ANT)	2.34	1.21
Lack of Practical Activities	2.55	1.50
Unavailability of Prescribed Textbooks (UPT)	2.68	1.49
Lessons are not Interesting (LI)	2.69	1.41
Language Used in Textbooks are Difficult to Understand (L)	2.73	1.39
Misconception of Content (MC)	2.88	1.32
Poor Mathematical Skills (PMS)	2.90	1.38
Low Motivation by Teachers (LM)	2.96	1.46
Low Mental Ability (LMA)	3.02	1.48
Poor Teaching Methods (PTM)	3.15	1.44

Source: Fieldwork, 2016

With reference to Table 14, the most prominent reason for topic difficulty in chemistry at the SHS level according to the respondents is the "Abstract Nature of Topics". ''Lack of Practical Activities" according to the table is the second most prominent reason for topic difficult in chemistry followed by the "Unavailability of prescribed Textbooks" in chemistry for use by students. The least reason for topic difficulty in chemistry is "Poor Teaching Methods" used by teachers of chemistry.

Research Question 3

To What Extent do the Available Textual Materials Help in Addressing Students' Perceived Topic Difficulty in Chemistry?

Research question three dealt with the extent to which the available textual materials in chemistry help in addressing students' perceived topic difficulty. This question was answered by both the students and teachers. There were two set of questions for both the students and teachers. The first part of the questions sought to find the books they often use for their chemistry course, the official book approved for use by the G.E.S, and whether students prefer using this official book or not. They were also asked to assign reasons (s) for not using the official textbook for the SHS chemistry. The second part of the question was a five-point likert which allowed the respondents to indicate the extent of the agreement or disagreement to reasons why they prefer using other textual materials on chemistry apart from the official textbook, the GAST. The questionnaire for teachers was also in two parts; the first part sought to find out the books (textbooks/ pamphlets) they use in their teaching. The second part was a five-point likert which allowed the respondents to indicate why they do not use the official textbook for chemistry but rather the other books. Finally, a brief evaluation of four of the books currently in use by both teachers and student was done to find out the extent to which they help students and teachers in learning the SHS chemistry. The results for both the students' and teachers' items as well as the evaluation of the four books are presented in Table 15. Students were interested in other books written by some chemistry teachers that are sold on the market. The detailed result is presented in Table 15 below.

Table 15: Chemistry Books Students Used for Their Course

Chemistry Book	Frequency	Percentage (%)
GAST	52	18.6
KOVS	90	32.1
SARPS/ KOSOKO/OTHERS	138	49.3
Total	**280**	**100.00**

Source: Field work, 2016

The result in Table 15 indicates that 52 (18.6%) of the respondents (students) use the GAST Chemistry which is the official chemistry book. Ninety (32.1%) of the respondents preferred KOVS series and the remaining 138 (49.3%) which is almost half of the respondents used SARPS/KOSOKO and any other books for their chemistry course. This result indicates that majority of the students did not prefer the GAST Chemistry which is the official book for the SHS course. Table 16 is the summary of students' views on the official textbook for the SHS chemistry course.

Table 16: The Official Textbook for the SHS Chemistry Course

Book	Frequency	Percentage (%)
GAST Chemistry	246	87.9
Other Books (KOVS, SARPS, KOSOKO etc.)	34	12.1
Total	**280**	**100.00**

Source: Field work, 2016

From Table 16, a total of 246 (87.9%) of the respondents (students) were able to indicate that the GAST Chemistry is the official textbook for the SHS chemistry course. The remaining 34 (12.1%) indicated that other books such as KOVS, SARPS and others were the official books for the SHS chemistry course. The result showed that majority of the respondents were aware that the official chemistry book for the SHS course is the GAST chemistry. Table 17 shows whether students had copies of the official chemistry textbook or not.

Table 17: Whether Students had Copies of the Official Chemistry Book or Not

Response	Frequency	Percentage (%)
Yes	32	11.4
No	248	88.6
Total	**280**	**100.00**

Source: Fieldwork, 2016

When students were asked whether they have copies of the official textbook of the SHS chemistry, 32 (11.4%) out of the 280 respondents responded "Yes" while the remaining 248 (88.6%) also responded "No". This means that majority of the students did have copies of this book. As a follow-up question to that in Table 17, the researcher wanted to find out the frequency of use of the GAST chemistry textbook by students who had copies. Table 18 is the summary of the result.

Table 18: Frequency of Use of the GAST Chemistry

Response	Frequency	Percentage (%)
Very Often	5	15.6
Often	7	21.9
Undecided	2	6.3
Less often	18	56.2
Not at all	0	0.00
Total	**32**	**100.00**

Source: Field work, 2016.

This question was answered by those who indicated in Table 17 that they had copies of the GAST chemistry book. Thirty two out of the 280 respondents answered “yes”. Five (14.7%) of 32 respondents indicated that they used the book “very often”. Seven (21.9%) said they used it “often”, 2 (6.3%) could not decide how frequent they used the book and the remaining 18 (56.3%) of the respondents said they use it “less often”. What this result means is that even respondents who had copies of the book did not use it often. It is possible that their parents bought the book for them or after buying it themselves, they did not find it useful. In Table 19, students’ reasons for using other chemistry books apart from that GAST is summarised.

Table 19: Students Reasons for Using Other Chemistry Books Apart from the GAST

Reason	SA	A	U	D	SD	Mean	Std.
The books treat topics in the SHS syllabus very well	39.6	7.1	41.8	3.9	1.5	1.98	1.14
Give examples that are direct questions from WASEC past papers	50.0	5.4	42.9	1.1	1.59	0.7	1.7
Have topics that are well explained	31.4	5.7	46.4	9.3	7.1	1.14	1.17
Have additional questions that are provided for students to try their hands on them	50	7.9	29.3	7.1	5.7	1.89	1.17
Contained solved past WAEC questions	46.4	13.6	32.9	3.6	3.6	1.85	1.02
Deal with practical lessons alone	18.6	17.1	17.9	25.4	21.1	3.13	1.41
Are cheap and very easy to purchase	19.6	14.3	22.5	20.7	22.9	3.04	1.46
Are written based on the areas in chemistry (inorganic, organic and practical which makes them very easy to understand)	26.1	12.5	36.4	12.1	12.9	2.49	1.46
Give illustration and examples that make it easy for one to understand	25.7	41.1	14.3	12.5	6.4	2.32	1.17
Are revised almost very often and are therefore very current.	25.7	32.1	33.9	7.1	7.1	2.25	0.96

SA- Strongly Agree, A- Agree, U-Undecided, D-Disagree, SD-Strongly Disagree, Std.-Standard Deviation.

Source: Fieldwork, 2016

On the reason that those books treat the topics in the SHS syllabus very well, 81.4% (228) of the respondents agreed to this fact. Twenty (7.1%) of the respondents could not decide and the remaining 32 (11.4%) disagreed with the researcher. The mean score was 1.98 which was far below the average mean score of 3.0. Textbooks are written to supplement whatever information teachers give to their students in the teaching/learning process. In doing so, writers make sure that the teaching syllabus for the subject is consulted in order to cover every topic specified in the syllabus. The individual topics must also be well explained taking into consideration the cognitive level of the users (students). Students' response suggests that other chemistry books (KOVS, SARPS, and KOSOKOO etc.) treat the topics in the SHS syllabus very well, hence their preference for them. This agreed with the view of Hutchinson and Torres

(1994) who argued that textbooks played very important and positive roles in teaching and learning.

One special feature of textbooks is that they provide examples when the main concept has been explained for students to follow. According to the result, students preferred the other chemistry books because the books gave examples that were direct questions from WAEC past papers. Almost all respondents agreed to this assertion. Two hundred and sixty (92.90%) of the respondents agreed to this fact while 15 (5.4%) could not decide and the remaining 5 (1.8%) disagreed to this fact. The fact that the examples (questions) the books provide are WAEC past questions, boosts up students' confidence. Although the GAST chemistry has a number of questions for students to solve after reading each topic, they questions are not necessarily direct past questions from WAEC. This makes students think that these questions are not probable questions that could drop during their final examination.

Chemistry is a practical-oriented subject. Practical work allows students to have experiences that are consistent with the goals of science (chemistry) literacy. Therefore it is expected that textual materials used by students to support their learning will provide enough practical experiences to enhance their learning. When the respondents were asked whether or not if the other chemistry books deal separately with practical lessons, 102(36.5%) of the respondents agreed that the other books deal with practical lessons alone, 48(17.1%) remained undecided and the remaining 120(46.4%) of the respondents did not agree that the other books deal will practical lessons alone. The mean score for this question was 3.12 which is above 3 meaning that majority of the respondents did not agree with the assertion that the other chemistry books deal with practical lessons alone.

It is assumed that respondents preferred other chemistry books due to the fact that such books are “cheap and very easy to purchase’’. Students responses indicated that 118(42.1%) of the respondents agreed that the other chemistry books are cheap and are very easy to purchase. Forty (14.3%) of the respondents could not decide on this statement and the remaining 122(43.6%) of the respondents disagreed to this assertion. The mean score was 3.04 which is above 3. This means that to the students, although they prefer using the other books, the cost and how easy it is to come by them is not one of their reasons.

A careful look at the SHS chemistry syllabus indicates that areas in chemistry such as organic, inorganic and practical activities are covered and this makes it easy for students to understand. So, one of the assumed reasons for students’ preference for the other books is that these books are written based on the areas in chemistry (organic, inorganic and practical activities). The result from this question indicates that 175(62.5%) of the respondents agreed that they preferred the other books because such books deal separately with the areas in chemistry and that makes it very easy for students to learn. Thirty five (12.5%) of the respondents could not decide on this statement and the remaining 70(25%) of the respondents disagreed to this assertion. To them, their preference for the other chemistry books is not due to the fact the books are written based on the areas in chemistry. The mean score for this question is 2.49 which is below 3. Respondents therefore agreed that one of the reasons for their preference for the other chemistry books is due to the fact that such books are written based on the areas in chemistry.

Illustrations and examples in books are key areas that make every textbook a good one. The illustrations must be clear so that even in the absence of a teacher, students could read and understand. According to Cunningsworth (1995), textbooks provide additional benefits to students as they are an efficient collection of materials for self-accessed learning and for knowledge consideration. Good textbooks can potentially save learners from a teacher's incompetency and deficiencies (Litz, 2005). Students response on the reason that the other textbooks "give illustrations and examples that make it easy for one to understand'' indicates that 187(66.8%) of the respondents agreed to this assertion. Thirty five (12.5%) of the respondents remained undecided and the remaining 53(18.9%) of the respondents also did not agree to this assertion. The mean score for this question was 2.32 which is below 3. This suggests that majority of the respondents preferred using the other chemistry textbooks due largely to the fact that such books gave "illustrations and examples that make it easy for one to understand''.

Finally, one characteristic of a good textbook is that it is revised very often and is therefore very current. So, every learner will prefer a textbook that is very current and provides information that are also current. The respondents were asked if their preference for the other chemistry books was due to the fact that such books "are revised very often and are therefore current''. The result indicates that 162(57.8%) of the respondents agreed that they prefer using the other books due to the fact that such books "are revised very often and are current''. Ninety five (33.9%) of the respondents remained neutral and the remaining 23(8.2%) of the respondents disagreed. The mean score for this question was 2.23 which is below 3. Majority of the respondents agreed that their preference for the other chemistry books is because those books "are revised very often and are therefore very current''.

4.2.1 Teachers' Questionnaire

The researcher wanted to find out from the teachers (respondents) whether they knew the official chemistry textbook or not. Table 20 indicates the result.

Table 20: The Official Chemistry Textbook

Book	Frequency	Percentage (%)
GAST Chemistry	11	68.8
Others	5	31.2
Total	**16**	**100.0**

Source: Field work, 2016

From the result in Table 20, it is observed that 11, representing 68.8% of the 16 respondents, indicated that the GAST Chemistry is the official textbook for the SHS Chemistry course. The remaining 5(31.2%) of the respondents mentioned other chemistry books (pamphlets) as the official chemistry book. This means that some of the teachers who taught the SHS chemistry were not aware that the GAST chemistry textbook was the official textbook for the SHS chemistry course. As a follow-up question, the researcher wanted to know whether teachers used other books in their teaching or not. Table 21 shows the result.

Table 21: Whether Teachers Use Other Chemistry Books in Their Teaching or Not

Response	Frequency	Percentage (%)
Yes	16	100
No	0	0
Total	**16**	**100**

Source: Field work, 2016

From the above table, all the sixteen teachers responded that they used other chemistry books in their teaching. The other books used by teachers in their teaching are shown in Table 22.

Table 22: Other Chemistry Books Used by Teachers

Book	Frequency	Percentage (%)
SARPS & OTHERS	4	25.0
KOVS & OTHERS	3	18.8
KOVS & SARPS & Others	7	43.7
KOVS & SARPS	2	25.5
Total	**16**	**100.00**

Source: Field Work, 2016

The purpose of this question was to find out other books that chemistry teachers use apart from the GAST chemistry textbook in their teaching. From the table 4(25%) of the respondents indicated that they used SARPS Series and other books in their teaching. Three (18.8%) of the respondents said they used KOVS Series and other books in their teaching, while 7(43.7%) of the respondents mentioned that they used KOVS and SARPS Series and other books for their teaching and the remaining 2(25.5%) of the 16 respondents also mentioned that they used KOVS and SARPS Series only in their teaching. Teachers had reasons for using other chemistry books in their teaching. Table 23 below indicates the teachers' reasons for preferring other books apart from the GAST chemistry textbook.

Table 23: Chemistry Teachers' Reasons for Using other Books in their Teaching Apart from the GAST Chemistry

Reason	SA	A	U	D	SD	Mean	Std.
Treat the topics in the SHS syllabus very well and also treat all the topics in both the GES and WAEC chemistry syllabi	31.2	31.2	0	25	12.5	2.56	1.50
Contain solved past WAEC questions	18.8	50	6.2	18.8	6.2	2.44	1.21
Give additional questions for both teachers and students to try their hands on	37.5	25.0	12.5	18.8	6.2	2.31	1.35
Are written in accordance with how the topics are arranged in the syllabus	12.5	37.5	12.5	31.5	6.2	2.81	1.22
Are written based on the areas in Chemistry (organic, inorganic and practical) which makes it very easy to understand.	25	31.2	0	37.5	6.2	2.68	1.40
Challenge the teacher to do further search on topics before teaching them.	25	31.2	0	31.2	12.5	2.75	1.48
Are revised almost every year and are therefore very current.	25	31.2	0	37.5	6.2	2.31	1.40

SA – Strongly Agree, A – Agree, U – Undecided, D – Disagree, SD – Strongly Disagree, and Std.-Standard Deviation

Source: Field Work, 2016

The teacher-respondents were required to indicate the extent to which they agreed or disagreed with each of the seven reasons why they preferred using other chemistry books (textbooks/pamphlets) in their teaching.

The data in Table 23 indicate that 10 (62.4%) of the 16 respondents agreed that the topics in the SHS Syllabus are treated very well and they also treat all topics in both the G.E.S and WAEC Chemistry syllabi. The remaining 6(37.5%) of the respondents did not agree with the researcher. The mean score for this question was 2.56 which is below 3. This is a strong indication that the teacher – respondents use other chemistry books due to the fact that the topics are well treated. So, teachers feel comfortable in using them.

Another reason why teachers prefer using the other books compared with the official textbook proposed by the researcher is that those books "give additional questions for both teachers and students to try their hands on". The teachers' response indicated that 10(62.5%) of the responded agreed to this reason while two (12.5%) remained undecided. The remaining 4(25%) of the responded did not agree with the researcher. The mean score for this question was 2.31 which is below the average mean score of 3 meaning that majority of the responded agreed that one of the reasons for preferring the other books is that those books give additional questions for students and teachers to try their hands on after treating a particular topic.

They also agreed to the fact that the topics in the books are arranged in accordance with the syllabus. The result obtained indicated that 8(50%) of the respondents agreed to this reason. 2(12.5%) could not decide and the remaining 6(37.4%) disagreed to this reason. The mean score was 2.81 which is below 3 meaning that majority of the respondents agreed that such books are written in accordance with how the topics are arranged in the G.E.S Syllabus.

Again, it came out during the analysis of the available textual materials for the SHS chemistry course that some of the books are written based on the areas in chemistry such as organic, inorganic or practical which makes it very easy for one to understand. When the respondents were asked whether their preference for such books was due to this fact, the result showed that 9(56.2%) of the respondents agreed that they are written based on the areas in chemistry, but the books challenged them to do further search on the topics before teaching. What they meant want that there are separate books for organic, inorganic and practical which makes it very easy to understand. The remaining 7(43.7%) of the respondents disagreed to this reason. To them, their preference for the books was not due to the fact they are written based on the areas in chemistry, but for the fact that the books were revised periodically.

When the respondents were asked whether the books challenged them or not to do further search on topics before teaching them, 9(56.2%) of them indicated that indeed the books actually challenged them to do further search on topics before teaching them while the remaining 7(43.8%) of the respondents disagreed to that reason. The mean score was 2.75 which is below the average mean of 3. This meant that majority of the respondents agreed to the fact that one of the reasons for preferring the other books was that the books challenge teachers to make further search on topics before teaching them.

The respondents agreed that the other chemistry books are revised very often and as a result, they are current. The result from the analysis showed that 9(56.2%) of the respondents agreed to the fact that the books are revised almost every year and are therefore current. None of them remained undecided while 7(43.8%) did not agree to this question. The mean score was 2.68 which is below 3.

4.2.2 Evaluation of four selected textual materials used by both teachers and students for the SHS chemistry course

In evaluating the textbooks in use by teachers and students, the naturalistic evaluation design which according to Wolf (1991) is the act of gathering information and juxtaposing it with some set of criteria to make judgment, regarding the strength and weakness, merits or worth of an educational innovation, materials, programmes or products was used. The researcher found this design useful because it involved making value judgment about the selected textbooks in use in the selected schools. The instrument that was used for data collection was the 8 – point quantitative evaluation model for science textbooks which was developed by Emerole in 2009. The 8-point model evaluates science textbooks using the following indices:

i. Topical Coverage Index (TCI)
ii. Learning Activities Index (LAI)
iii. Study Questions Index (SQI)
iv. Illustration Index (ILI)
v. Chapter Summary Index (CSI)
vi. Under – Representation Population Index (UPI)
vii. Readability And Comprehensibility Index (RCI)
viii. Teacher Perception Rating Index (TPI)

However, for the purpose of this work, the last point was not considered making the model to be seven instead of eight. The results of the analysis of the four selected textbooks used by teachers and students are presented in Table 24 in line with now 7 -point quantitative evaluation model.

Table 24: Indices of Topical Coverage Index (TCI)

Textbook	Tt	Ts	St	Ss	Index
The Ultimate Chemistry for West African Senior High Schools	51	53	184	198	0.93
Brightest and Best Elective Chemistry for West African Senior High Schools	53	53	193	198	0.98
Comprehensive Notes on Modern Chemistry for West African Senior High Schools & Colleges	49	53	179	198	0.91
GAST Chemistry for Senior High Schools	52	53	197	198	0.99

Acceptance range = 0.8 – 1.0

Source: Field work, 2016

Tt – Number of topics sufficiently covered by the textbook

Ts – Number of topics specified in the syllabus

St – Number of subtopics sufficiently covered by the textbook

Ss – Number of subtopics in the syllabus.

The results presented in Table 24 revealed that all the four selected chemistry books in use by both teachers and students were within the acceptance range of topical coverage. This implies that they covered the content of the SHS chemistry curriculum. Table 25 shows the learning activity index for the books evaluated.

Table 25: Learning Activity Index (LAI)

Textbook	A	P	Index
The Ultimate Chemistry for West African Senior High Schools	115	41	0.47
Brightest and Best Elective Chemistry for West African Senior High Schools	135	22	0.72
Comprehensive Notes on Modern Chemistry for West African High Schools	150	59	0.43
GAST Chemistry for Senior High Schools	180	50	0.56

Acceptance Range: 0.5 – 1.0

Source: Field work, 2016

A- Number of sentences requiring the learner to perform some activities

P- Number of sentences requiring the learner only to receive information with no other activity.

The results presented in Table 25 revealed the Learning Activity Indices (LAI) for the four chemistry books evaluated. Two of the four books fell outside the acceptance range meaning that these two books did not contain enough sentences requiring the learners to perform some activities. Most of the sentences in these books were those that required the learners to receive information without engaging in any other activity. The result in Table 26 is the summary of the study question index of the evaluated.

Table 26: Study Question Index (SQI)

Textbook	T	R	Index
The Ultimate Chemistry for West African Senior High Schools	101	19	0.68
Brightest and Best Elective Chemistry for West African Senior High Schools	78	28	0.47
Comprehensive Notes on Modern Chemistry for West African Senior High Schools	113	34	0.54
GAST Chemistry for Senior High Schools	102	60	0.26

Acceptance range: - 0.25 – 1.00

Source: Field work, 2016

T-Number of questions that require students to engage in real thinking

R-Number of questions that require students to merely recall knowledge.

From the Table, all the four books had their indices within the acceptance range. This means that the books contained enough study questions that required students to do real thinking before they could provide responses to them.

Table 27 shows the chapter summary for the four textbooks selected for the evaluation.

Table 27: Chapter Summary Indices (CSI)

Textbook	Js	Jc	Ns	Nc	Index
The Ultimate Chemistry for West African Senior High Schools	No Summary	41	No Summary	75	No Index
Brightest and Best Chemistry for Senior High Schools	No Summary	34	No Summary	67	No Index
Comprehensive Notes on Chemistry for Senior High Schools	No Summary	38	No Summary	71	No Index
GAST Chemistry for Senior High Schools	No Summary	36	No Summary	74	No Index

Acceptance range: 0.60 – 1.00

Source: Field work, 2016

Js-Number of statements in the summary which represents major points covered in the chapter

Jc- Number of major points covered in the chapter

Ns-Number of statements in the summary which represent minor points covered in the chapter

Nc-Number of minor points covered in the chapter

Surprisingly, none of the four books had chapter summary. As a result, the indices could not be calculated. A careful study of the books revealed that the authors provided study questions at the end of each topic but failed to do chapter summary. Again, with the exception of GAST Chemistry, there were no learning objectives in the beginning of the chapters in the books.

Table 28 below indicates the mean scores of the illustrations index (ILI) in each of the four chemistry textbook evaluated.

Table 28: Illustration Index (ILI)

Textbook	La	Lb	Index
The Ultimate Chemistry for West African Senior High Schools	32	72	-0.38
Brightest and Best Elective Chemistry for West African Senior High Schools	47	81	-0.27
Comprehensive Notes on Modern Chemistry for West African Senior High Schools	53	85	-0.23
GAST Chemistry for Senior High Schools	67	91	-0.15

Acceptance range: - 0.5 – 0.00

Source: Field work, 2016

La- number of illustrations requiring the learner to perform some activities

Lb- number of illustrations requiring the learner only to view

The results presented in Table 28 reveals that the four books evaluated were within the acceptance range of illustration index (ILI) of - 0.05 to 0.00. This implies that all the textbooks evaluated contained enough illustrations. In Table 29, the readability and comprehensibility index of the four books evaluated is summarized.

Table 29: Readability and Comprehensibility Index (RCI)

Textbook	Mean Readability Score	Decision
The Ultimate Chemistry for West African Senior High Schools	56.6%	fairly difficult to read
Brightest and Best Elective Chemistry for West African Senior High Schools	55.1%	fairly difficult to read
Comprehensive Notes on Chemistry for West African Senior High Schools	31.7%	very difficult to read
GAST Chemistry for Senior High Schools	52.8%	fairly difficult to read

Acceptance range: 40% and above

Source: Field work, 2016

The researcher employed the Automatic Readability Checker to obtain the mean readability score in percentages for the four books. From Table 29, the

Comprehensive note on Chemistry for West African Senior High Schools had a score below the acceptance range meaning that the book is difficult to read and understand. The readability level was above the students for whom the book is intended. The remaining three books did not score higher percentages, their mean scores fell within the acceptance range. Table 30 shows the under-represented population index for each of the four books evaluated.

Table 30: Under-Represented Populations Index (UPI)

Textbook	G	B	Index	Decision
The Ultimate Chemistry for West African Senior High Schools	232	50	0.65	Accepted
Brightest and Best Elective Chemistry for West African Senior High School	223	41	0.74	Accepted
Comprehensive Notes on Modern Chemistry for West African Senior High Schools	232	35	0.74	Accepted
GAST Chemistry for Senior High Schools	275	44	0.72	Accepted

Acceptance range: -1.00 to +1.00

Source: Field work, 2016

G-Number of illustrations, examples, gender and ethnic connoted statements that are neutral

B- Number of illustrations, examples, gender and ethnic connoted statements that are biased

The results presented in Table 30 reveals that all the four books evaluated are within the acceptance range of under - represented population's index.

Research Question 4

How do Chemistry Teachers Help in Addressing Students' Perceived Topic Difficulty in the SHS Chemistry Syllabus?

Research question four sought to find out how the teaching strategies adopted by chemistry teachers help in addressing students' perceived topic difficulty in chemistry. Two set of questions were answered by both teachers and students. In doing so, the respondents were presented with a five-point likert scale to express their views on this research question. The students' questionnaire was meant to confirm the views expressed by the teachers on the teaching strategies they adopt in helping students to overcome their learning difficulties. The result gathered is presented below.

4.2.3 Teachers' views on aspects of chemistry teaching at SHS level

The views of the teacher-respondents on how their instructional approaches help their students in learning difficult topics in chemistry are shown in Table 31.

Table 31: How Teachers Instructional Approaches Help Students in Overcoming their Learning Difficulties

Teaching Strategy	Mean score	Standard deviation
I often use the lecture/traditional method in my teaching	3.13	1.55
I seldom use computer assisted instructions in teaching more difficult topics because……		
- They are very difficult to prepare	2.94	1.43
- They are not available in my School	2.68	1.77
- The laboratory environment is not conducive enough to enhance its usage	2.81	1.68
I do not take into consideration the cognitive level of development of my students when teaching	3.43	1.57
In most cases, I help students in overcoming mathematical difficulty on a particular topic before moving on to a new one	2.25	1.57
I give more relevant exercises on the more difficult topics after teaching and mark them promptly.	2.18	1.51
My style of assessing reflects the aims of the Course (subject)	2.13	1.50
Practical works are conducted when my students are about to write the final examination	3.62	1.45
Both intrinsic and extrinsic forms of motivation are used in arousing and sustaining the interest of my students during teaching.	2.37	1.62

Source: Field work, 2016

The results from Table 31 shows that as regards the use of lecture/traditional method in their teaching, majority of the teachers disagreed with the researcher (Mean=3.13, SD = 1.55) meaning that in their teaching, they did not employ the traditional or lecture method. This is in sharp contrast with Osafo-Affum (2001) who observed that many integrated science teachers "lecture" instead of "teaching". Another teaching strategy that the respondents had a contrary view with respect to that of the researcher is on the statement "I do not take into consideration the cognitive level of development of my students when teaching". The mean score for this question strongly suggested that the teachers held contrary views to this teaching strategy.

They considered the cognitive level of development of their students in their interaction with them. To achieve the desired objective of effective teaching of chemistry in secondary schools, practical activities cannot be overlooked. Practical activities are so essential that they have been incorporated into the curriculum. So, to find out whether teachers conducted practical work as expected or not, their response to the statement "Practical works are conducted when my students are about to write their final examination" indicated that they regularly conducted practical activities. The mean score for this question was 3.62. This result is in sharp contrast with Onaofo (1993) who observed that equipment, materials and chemicals were not stocked specifically for the teaching of chemistry and that the outcome of such a situation was that most chemistry teachers handled the subject negligently and superficially. Students' activities were completely neglected and practical classes were held not according to schedule but according to how convenient it was for the teachers. Adefunke (2008) and Owoeye and Yara (2011) observed that important ingredients for effective science teaching are appropriate items, laboratory equipment and materials.

Apart from these three teaching strategies about which the respondents held contrary views, they held similar views the researcher on the remaining teaching strategies. This was because the mean score of these teaching strategies were below 3 indicating that the respondents either "strongly agreed" or "agreed" to the statements they were presented with. To them, they adopted the best teaching strategies in teaching and therefore did not agree that their teaching strategies contributed to the students' inability to learn some difficult topics in chemistry.

It is evident from the Table 31 that teachers seldomly use computer assisted instructions as a teaching strategy. They indicated that employing computer assisted instructions in teaching was very difficult. One difficulty they face is the preparation of the instructions. They also asserted that the computer assisted instructions are not available in their schools. Even if they are available, the laboratory environment is not conducive enough to enhance their usage. It is expected that in this technological era, teachers will make use of computer assisted instructions in teaching in order to arouse and sustain the interest of learners. However, the responses given by the teachers as to whether or not they employ computer assisted instructions is negative. This result sharply defeats the roles of ICT as indicated by Amajuoyi (2012). According to him, incorporating ICT in science education promotes students' intellectual qualities through higher order thinking, problem solving, improved communication skills and deep understanding of the learning tools and concepts to be taught. Campbell and Denby (2005) also indicated that the use of ICT in science education can make learning active, constructive, contextual, co-operative, self-regulatory, reflective and cumulative.

Mathematics is an essential skill that students of science (chemistry) need to master. It is the language of science and central intellectual discipline of the technological societies (Odeyemi, 1995). Teachers agreed with the researcher that they helped students in overcoming their mathematical difficulty on a particular topic before moving on to a new one. The mean score on this teaching strategy according to Table 31 indicated that majority of the teachers responded positively. The response of the teachers is a clear indication that they guide their learners who have difficulty in applying certain mathematical skill in teaching some concepts in chemistry. This is one way through which teachers could help their students in overcoming learning difficulty in chemistry.

Assessing students' learning is one of the fundamental roles chemistry teachers play in the teaching-learning process. In going through the S.H.S chemistry syllabus, assessment procedure has been clearly specified. Assessment in teaching is done to find out if students have learning difficulty on a particular topic and the strategy a teacher could adopt in helping his or her students in overcoming such difficulties. It is also done to find out whether the teachers' teaching strategy is appropriate or not. The researcher wanted to find out whether teachers follow the laid down procedure in assessing their students during and after teaching. Again, the mean score for this teaching strategy according to Table 31 suggests that majority of the teachers' style of assessment reflects the aims of the S.H.S chemistry course. Once majority of the teachers followed the laid down procedure in assessing students after learning, it is a clear indication that teachers' style of assessment is acceptable.

One of the strategies in assessing students after teaching is to give them relevant exercises on the more difficult topics after teaching, mark them promptly and discuss the results with the students. The researcher wanted to find out if teachers adopt the appropriate way of giving exercises to their students and marking them promptly. The mean score for this teaching strategy according to the Table 31 indicates that majority of the teachers adopted appropriate ways of setting, marking and discussing exercises with their students. If all teachers could adopt this teaching strategy well, it will enhance students' learning.

It is becoming an open knowledge that the level and type of motivation shown to learners significantly affects their quality and height of performance in whatever programme they are involved. Barbara (1999) observed that educators can encourage learners to become self-motivated independent learners by helping learners to find personal meaning and value in the material provided, assigning tasks that are not too easy or too difficult. This will make the learners feel they are valued members of a learning community and creating open and positive atmosphere that can foster learners participatory and effective learning. In view of this, the researcher wanted to find out whether or not teachers use both intrinsic and extrinsic forms of motivation in arousing and sustaining the interest of the students during teaching. The data in Table 31 indicates that majority of the teachers adopt this teaching strategy. This suggests that students are well motivated during teaching which enhances their learning. If teachers are able to sustain this teaching strategy, it will help them in learning most of the difficult topics in the S.H.S Chemistry syllabus.

4.2.4 Students views

The students' questionnaire was meant to solicit their views on the teaching strategies used by their teachers during teaching and how the strategies help them in learning the perceived difficult topics. The students were given eight (8) statements on the strategies their teachers used in teaching and were asked to indicate the extent to which they agreed or disagreed with the statements. The results were used to confirm the views expressed by the teachers. It could be deduced from the table that, the students held contrary views with regards to those of their teachers on some of the teaching strategies adopted by their teachers. Details of their responses are presented in Table 32.

Table 32: How Teachers Help in Addressing Students' Perceived Topic Difficulty

Teaching Strategy	SA	A	U	D	SD	Mean	Std.
Teacher does not provide the most current information on topics he/she teaches	16.4	17.1	14.3	19.6	32.5	3.3429	1.49
The teacher allows us to work in groups	20.6	23.2	15.4	20.4	20.4	2.9643	1.44
The teacher always dictates notes to us	26.8	25.0	14.6	15.4	18.2	2.9643	1.43
The teacher gives enough exercises after teaching	20.7	21.9	14.3	17.9	25.2	3.1457	1.48
The teacher uses simple language in explaining concepts to us.	29.6	21.4	15.0	16.8	17.1	2.7036	1.47
The teacher intimidates and shouts on students when teaching	18.9	16.4	15.7	20.4	28.6	3.2321	1.49
Practical activities are organised only when students are about to write WASSCE	24.3	18.6	14.3	19.3	23.6	2.9964	1.51
The teacher does not use ICT in his teaching to make it very interesting	22.5	22.4	16.4	21.1	18.6	2.9214	1.43

SA –Strongly Agree, A – Agree, U – Undecided, D – Disagree, SD – Strongly Disagree,

Mean – Mean score and Std – Standard deviation.

Source: Field work, 2016.

The data in Table 32 show that the respondents agreed with the researcher that their teachers did not incorporate information and communication technology (ICT) in their teaching. This contradicts the views expressed by the teachers on this same teaching strategy (Refer to Table 31).

The students were of the view that their teachers did not give enough exercises to support their learning. Again, this is in sharp contrast with the views expressed by their teachers. The teachers were of the view that they gave enough exercises to their students after teaching.

The students asserted that their teachers organised practical activities when they were about to write their final examinations. However, the teachers mean score on this same teaching strategy in Table 31 indicated that they organised practical activities regularly.

It could also be inferred from Table 32 that the students agreed with the researcher that teachers always dictated notes to them without explaining in details. This is a bad teacher strategy and does not enhance proper learning. This could also concepts not well explained to students.

However, majority of the students were of the view that their teachers allowed them to work in groups which promotes social learning.

More importantly, the students agreed with the researcher that their teachers use simple language in explaining concepts to them. According to the students, their teachers did not intimidate and also shout on them during teaching.

Research Question 5

Do differences exist in the chemistry topic difficulty perceived by male and female students?

Research question five sought to know how difficulty with chemistry topics was influenced by gender. To determine whether there was statistically significant difference in perceptions of male and female chemistry students, a two-tailed independent sample t-test was computed. The results in Table 33 indicate that female chemistry students' difficulties with topics in the chemistry syllabus was significantly higher (M=3.75, SD=4.32) than their male counterparts (M=3.13, SD=0.63). The results further show that ($p<.001$, $t=-1.87$, df =278) male students perceived more chemistry topics to be difficult compared to male students. The size of this difference was found to be r=0.062 which is insignificant.

Table 33: Result of two-tailed independent samples t-test

SEX	N	Mean	SD	T	df	Sig.
Male	178	3.13	0.664	-1.87	278	0. 062
Female	102	3.75	4.32			
Total	**280**					

Table 33 shows the mean scores and standard deviations for boys' and girls' perceived difficulty in chemistry at the SHS level. The results show that the mean score for girls is greater than the boys. To find out whether this difference is statistically significant, an independent t-test was conducted. The t-test showed that there was not a statistically significant difference between the mean perceived difficulty of boys and girls in chemistry (t= -1.87, df=278). The result suggests that boys' and girls' perception of difficult topics in chemistry was the same. The null hypothesis cannot be rejected in favour of the alternate hypothesis, which stated that there was a statistically significant difference between the perceived topics difficulty of boys and girls in SHS chemistry. This finding complements those of other researchers into topic difficulty perceived by students in chemistry. Agbir (2004) found out that gender was not a significant factor in the overall mean achievement rating of students' practical skills on acid-base titration. Owoyemi (2007) asserted that students' achievement in chemistry course has nothing to do with whether the student is a male or female. Erinosho (1994) cited in Adesoji and Babatunde (2008) showed that the difference between the mean achievement scores of female and male students was not statistically significant in chemistry. Again, the finding from this current study supports Ssempala (2005) who investigated gender difference in the performance of practical skills on quantitative analysis, an aspect of chemistry among senior secondary school girls and boys in selected co-educational schools. The author showed that there was no statistically significant difference between girls and boys in their ability to manipulate the apparatus/equipment, take observation, report/record results correctly and compute/ interpret/analyse results during chemistry practical activities.

However, other researchers have different views. For example, Eze (2008) asserted that gender had significant effects on students' achievement in chemistry, and showed that male students achieved higher than their female counterparts did. On his part Adigive (1992) showed that male students performed better in both achievement and acquisition of problem-solving skills than female students in chemistry. Ahiakwo (1998) showed that girls performed better than boys in chemistry, and that the difference between their mean achievement score was statistically significant. Trigwell (1990) found that male students were superior over female students in problem-solving and achievement in chemistry. Ifeakor (2005) identified a significant gender-related difference in students' cognitive achievement in favour of male students to their female counterparts. Okorie and Ezeh (2016) found that female students' overall mean achievement was higher than that of the male students even though statistically, gender was shown not to be a significant factor in students' achievement in chemical bonding.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Overview

In this concluding chapter, the overview of the research problem and methodology, and the key findings of the study are presented as well as the recommendations and suggestions for further research are pointed out.

5.1 Summary of the Study

The problem that prompted this study was senior high school students' low performance in chemistry in WAEC'S organised examinations in Ghana. Some contributing factors had been suggested for students' poor performance in chemistry lessons such as insufficient practical lessons, poor mathematical skills exhibited by the students, abstract nature of the subject and poor teaching methods adopted by chemistry teachers (Agogo & Orda, 2014). One other factor that could contribute to the low performance of chemistry students which has not been given much attention in chemistry education in Ghana is how the available textbooks and teachers help in addressing students' topic difficulties. The WAEC Chief Examiner's Report (2012-2014) indicated that some senior high school chemistry topics posed difficulties to students and that contributed to their poor performance in their final WASSCE.

Evidence from chemistry education literature indicated that SHS chemistry students perceived some topics in chemistry to be difficult (Childs & Shecham, 2009, Gengden, Gongden & Lohdip, 2011, Jimoh, 2005). These researchers raised questions about topics that secondary school chemistry students perceived to be difficult and suggested measures that could be implemented in addressing the difficulties.

This study was therefore carried out to find topics in the SHS chemistry curriculum that students perceived to be difficult, their reasons for the topic difficulties and specifically how the available textual materials and their teachers addressed the difficulties.

To accomplish this, the quantitative research approach was adopted and more specifically the descriptive survey design was used. The schools selected for the research work were based on the Ghana Education Service classes of schools, that is Class 'A', 'B' and 'C'. Eight (8) schools were selected from five Districts in Western Region for this research work. A total of two hundred and eighty (280) students and sixteen (16) teachers from the selected school also took part in the study. Both students and teachers responded to the questionnaire and SPSS was used to analyze the data.

5.2 Summary of the Major Findings

1. It was established that students perceived nine (9) out of the twenty (20) carefully selected topics in the SHS curriculum to be difficult. According to the respondents, the most difficult topic in the SHS chemistry curriculum was 'Redox Reactions'. This was followed by 'Electrochemistry' and 'Nomenclature of Organic Compounds'. Other topics students perceived to be difficult were 'Concept of pH and pOH of solution', 'Interatomic and Intermolecular Bonding', 'Chemical Equilibrium', 'Enthalpy changes and Bond Energy Calculation', 'Writing and Naming Formulae of Inorganic Compounds', 'Solubility of Substances' and 'Rate of Chemical Reactions'. This is an indication that topic difficulty exists among SHS chemistry students in the schools selected.

2. Respondents agreed with the researcher that the abstract nature of topics, lack of practical activities, unavailability of prescribed textbooks, uninteresting lessons, the use of difficult and complex languages in the textbooks, misconceptions of content, poor mathematical skills and low motivation by teachers were the major causes of topic difficulty among them. Other causes were low mental ability of students and poor teaching methods adopted by chemistry teachers. To them, the abstract nature of topics in chemistry was the main cause of topic difficulty in chemistry.
3. The study also found out that 81.4% of the respondents preferred using chemistry textbooks to the official one (GAST). The remaining 18.6% of the respondents who preferred the GAST to the other chemistry textbooks seldom used it. The respondents (teachers and students) indicated that the other chemistry books treated the topics in the SHS chemistry syllabus very well, gave examples that were direct questions from WAEC past papers, contained additional questions for students to try their hands on after treating a particular topic, were cheap and easy to purchase, gave illustrations and examples that make it easy one to understand, they are revised very often and are therefore very current. Respondents preferred the KOVS, SARPS, Brightest and Best chemistry textbooks instead of the GAST chemistry.
4. The study found no significance difference ($p<0.001$, $t = -1.87$, $r=0.062$, $df = 278$) between male ($M = 3.13$, $SD=0.664$) and female ($M= 3.75$, $SD= 4.32$) chemistry students with respect to their difficulties with the selected topics in the syllabus.
5. The study revealed that chemistry teachers instructional strategies contributed to students perceived topic difficulty in chemistry. It came out that the

teaching strategies adopted by the teachers in the selected schools did not help the students in learning difficult topics in chemistry. Teachers seldom conduct practical lessons for students, give enough exercises to students after teaching, do not explain difficult concepts or topics, do not use ICT in their teaching etc.

6. Some of the available textual materials in use by both teachers and students did not meet the requirements of good textbooks. The language level of some of the books was above the students. Some of the books did not provide topic summary and learning objectives. Again, some of the books did not contain enough learning activities and illustrations that would help students to easily understand concept /topics.

5.3 Conclusion

Emerging trends, according to the findings of this study, indicated that, topic difficulties among SHS chemistry students existed. Out of the twenty carefully selected topics in the SHS chemistry syllabus, students perceived nine (9), representing 45% of them to be difficult. Among the topics students perceived to be difficult were 'Redox Reactions', 'Electrochemistry', 'Nomenclature of Organic Compounds', 'Concept of pH and pOH of solution', 'Interatomic and Intermolecular Bonding', 'Chemical Equilibrium', 'Enthalpy changes and Bond Energy Calculation', 'Writing and Naming Formulae of Inorganic Compounds', 'Solubility of Substances' and 'Rate of Chemical Reactions'. It is therefore not surprising that the WAEC Chief Examiner's reports indicate that some questions are poorly answered by students which invariably lead to low performance. Once topic difficulty level is high among students, it will affect their attempt to study chemistry at the higher level.

The abstract nature of concepts, inadequate practical activities, unavailability of prescribed textbooks, lessons not interesting and poor mathematical skills were rated high as some of the causes of topic difficulty among SHS chemistry students. Chemistry is full of abstract concepts. Good mathematical skills is a pre-requisite for the study of the subject. Thus, if students' skills are not sharp, they will definitely run away from some of the topics in chemistry that involve calculations.

There was no significant difference between male and female science students' perceived difficulty of the selected topics in chemistry. This suggested that gender had no influence in the teaching and learning of chemistry at the SHS level in the selected schools.

Teachers teaching strategies had influence on students' ability to learn some of the difficult topics in chemistry. Therefore, if teachers teaching strategies are bad, topic difficulty will not be addressed and that will contribute to low performance at the final WASSCE.

Textbooks can potentially save learners from teachers' incompetency and deficiencies (Litz, 2005). A good textbook can be an extremely valuable device especially in situations where interesting and motivating and authentic materials are difficult to compile in an organized manner (McDough & Shaw, 1993). Some of the textbooks evaluated did not meet the standards of quality textbooks. Students greatly rely on them in pursuing their course to the extent that they carry them to class and refer to them when teachers are teaching. Once the available textual materials on the SHS chemistry do not meet the required standard and students also rely on them, they may not meet their learning needs hence their inability to understand some concepts or topics leading to topic difficulty.

5.4 Recommendations

Based on the findings of the study, the following recommendations were made:

1. From the work, there is evidence to show that topic difficulty existed in the SHS chemistry syllabus. The Ghana Education Service therefore has to take concrete steps to organise in-service training and workshops for the teachers on the effective and innovative ways of teaching the subject.
2. To make the teaching of the chemistry in the senior high school effective, teachers need to be encouraged to organise more practical lessons where students shall be exposed to hands-on activities on regular bases.
3. It is evident from the work that there is no significant difference in the topics perceived to be difficult between the male and female students. Teachers therefore should avoid prejudices based on the gender of students since both male and female students have unlimited potentials to excel in the subject.
4. Teachers' teaching strategy influences greatly students learning abilities. There is therefore the need for teachers to use varied teaching materials, integrate the use of ICT in their teaching and employ varied ways of motivating students to learn difficult concepts in the subject.

5.5 Suggestions for Further Research

Based on the findings of the study, the following suggestions were made for further research:

1. It is suggested that this study be replicated in other districts and regions in the country to provide empirical data on the level of difficulty of some topics perceived by SHS chemistry students.

2. It is suggested that a study be conducted to establish the effect of perceived chemistry topic difficulty on students' performance at the WASSCE.
3. A study should be carried out to establish the relationship between SHS chemistry teachers' academic and professional qualifications and their influence on students' performance in chemistry at the WASSCE.
4. A study be devoted to the assessment of available textual materials in chemistry and how they address students' chemistry learning difficulties.
5. A study on SHS chemistry students' preferred instructional approaches should be conducted.

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APPENDICES

APPENDIX A

QUESTIONNAIRE FOR STUDENTS

This questionnaire is meant to investigate perceived topic difficulty by students in the S.H.S chemistry curriculum and how the prescribed textbooks and teachers address them.

Kindly provide truthful responses to each item. You are to indicate the extent to which you agree or disagree with each of the items. There is no wrong or correct answer. Please in each case tick () in the appropriate box.

Your effort will be a useful contribution to knowledge. Again, this is purely an academic exercise. The information you provide will be treated with all confidentiality.

Thank you.

SECTION A

BIODATA INFORMATION

1. Name of School [ ]

2. Sex Male [ ] Female [ ]

3. Age [ ]

SECTION B

20 SELECTED TOPICS IN THE S.H.S CHEMISTRY CURRICULUM PERCEIVED TO BE DIFFICULT BY STUDENTS.

Please tick ( ) the appropriate response to show easy or difficult you find the topics selected below:

	TOPIC	Very Difficult (VD)	Difficult (D)	Moderately Difficult (MD)	Slightly Difficult (SD)	Not Difficult (ND)
1.	Separation of mixtures					
2.	Particulate Nature of Matter (Atoms, Molecules, Compounds, Ions)					
3.	Writing and Naming Formulae of Inorganic Compounds					
4.	Writing and Balancing of Chemical Equations					
5.	Periodicity (periodic Properties of the 1st 20 Elements)					
6.	Interatomic and Intermolecular Bonding (Ionic, Covalent, Metallic, Hydrogen Bonding and van der waals forces)					
7.	Hybridization and Shape of Molecules					
8.	The Mole Concept (Carbon-12 Scale, Avogadro Constant, L, Molar Quantities,					

	Preparation of Standard Solutions)					
9.	Chemistry of Transition elements					
10.	Kinetic Theory of Matter/ The Gas Laws					
11.	Nuclear Chemistry					
12.	Enthalpy Changes and Bond Energy Calculation					
13.	Rate of Chemical Reaction					
14.	Chemical Equilibrium					
15.	Concept of pH and poH of Solutions					
16.	Acid-Base Titration Experiments					
17.	Solubility of Substance					
18.	Nomenclature of organic compound					
19.	Redox Reactions (Determining oxidizing/reducing agents, balancing redox reactions, oxidation-reduction titrations)					
20.	Electrochemical cells/electrochemistry (Electrolysis, electric cell construction and electrode potential)					

SECTION C

Reasons for Difficulty in the S.H.S Chemistry Curriculum

For each the reasons for topic difficulty in the S.H.S chemistry syllabus given below please indicate the extent of your agreement or disagreement to each reason by ticking in the appropriate box.

S/N	REASON	STRONGLY AGREE (SA)	AGREE (A)	UNDECIDED (U)	DISAGREED (D)	STRONGLY DISAGREE (SD)
1.	Poor Mathematical Skills (PMS)					
2.	Abstract Nature of Topics (ANT)					
3.	Poor Teaching Methods (PTM)					
4.	Lack of Practical Activities (LPS)					
5.	Lessons are not Interesting (LI)					
6.	Misconception of Content (MC)					
7.	Low Motivation by Teachers (LM)					
8.	Unavailability of Prescribed Textbooks (UPT)					
9.	Language Used in Textbooks are Difficult to Understand (L)					
10	Low Mental Ability (LMA)					

SECTION D

HOW THE PRESCRIBED TEXTBOOKS ADDRESS THE DIFFICULT TOPICS IDENTIFIED.

1. Which books (textbooks, pamphlets) do you use for your chemistry course?

   a.……………………………………………………………………………

   b.……………………………………………………………………………

   c.……………………………………………………………………………

2. The official chemistry textbook for the S.H.S chemistry is

   ……………………………………………………………………………

3. Do you have a personal copy? Yes[ ] No [ ]

4. If No, why?

   ……………………………………………………………………………

5. If Yes, how often do you use it?

   ……………………………………………………………………………

6. I use other textbooks to support my learning chemistry.

The statements below are some of the reasons why you prefer using other textbooks/pamphlets in learning chemistry. Please indicate the extent of your agreement or disagreement to each of the reasons by ticking in the appropriate box.

S/N	TOPIC	STRONGLY AGREE (SA)	AGREE (A)	UNDECIDED (U)	DISAGREED (D)	STRONGLY DISAGREE (SD)
a.	The books treat the topic in the S.H.S syllabus very well					
b.	Give examples that are direct questions from WAEC past papers					
c.	Have topics that are well explained					
d.	Have additional questions that are provided for students to try their hands on them					
e.	Contain solved past WAEC questions					
f.	Deal with practical lessons alone					
g.	Are cheap and very easy to purchase					
h.	Are written based on the areas in chemistry (organic, and practical) which makes it very easy to understand					
i.	Give illustrations and examples that make it easy for one to understand					
j.	Are revised very often and are therefore very current.					

SECTION E

How Teachers Help in Addressing the Difficult Topics Perceived by Students

The statements below indicate the teaching strategies your teacher adopts in helping you to learn the perceived difficult topics in chemistry. Please indicate the extent of your agreement or disagreement to each of the strategies by ticking in the appropriate box.

S/N	TEACHING STRATEGY	STRONGLY AGREE (SA)	AGREE (A)	UNDECIDED (U)	DISAGREED (D)	STRONGLY DISAGREE (SD)
1.	The teacher provides the most current information on topics he/she teachers					
2.	The teacher allows us to work in groups					
3.	The teacher always dictates notes to us					
4.	The teacher gives enough exercises after teaching					
5.	The teacher uses simple language in explaining concepts to us					
6.	The teacher intimidates and shouts on students when teaching					
7.	Practical activities are organized only when students are about to write WASSCE					
8.	The teacher does not use ICT in his/her teaching to make it very interesting					

THANK YOU

APPENDIX B

QUESTIONNAIRE FOR CHEMISTRY TEACHERS

This is a research being conducted by an M.Phil. Science Education student from the University of Education, Winneba. This questionnaire is meant to investigate perceived topic difficulty by students in the S.H.S chemistry curriculum and how the prescribed textbooks and teachers address them.

Kindly provide truthful responses to each item. You are to indicate the extent to which you agree or disagree with each of the items. There is no wrong or correct answer. Please in each case tick ( ) in appropriate box or provide the appropriate information where necessary.

Your effort will be a useful contribution to knowledge. Again, this is purely an academic exercise. The information you provided will be treated with all confidentiality.

THANK YOU

SECTION A

Demographic Information

1. Name of school

2. Sex Male Female

3. Age: Tick the range of your age

22-30 31-39 40-48 49-57

58 and above

4. Please identify your highest academic qualification

Bachelor's degree Master's degree

Ph. D

Others (please specify)………………………………………………………………

5. Please identify your area of

specialization………………………………………………………………………

6. Are you a professional teacher?

Yes No

7. How long have you been teaching chemistry?

0-5years 6-10years 11-15years

16-20years 21years and above

HOW THE AVAILABLE TEXTBOOKS ADDRESS TOPIC DIFFICULTY IN CHEMISTRY

1. The official chemistry textbook for use by both teachers and students is

   ……………………………………………………

2. Do you use other approved /unapproved textbooks in your teaching?

   Yes [ ]   No [ ]

3. If yes, then please mention them

   a.……………………………………………………………………………

   ……………………………………………………

   b.……………………………………………………………………………

   ……………………………………………………

   c.……………………………………………………………………………

   ……………………………………………………

   d.……………………………………………………………………………

   …………………………………………………..

4. I use other approved /unapproved textbooks in my teaching. Please cite examples

   a. Approved

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

   b. Unapproved ones

   ……………………………………………………………………………

   ……………………………………………………………………………

   ……………………………………………………………………………

5. I prefer using other chemistry textbooks in my teaching because such books…

S/N	TOPIC	STRONGLY AGREE (SG)	AGREE (A)	UNDECIDED (U)	DISAGREE (D)	STRONGLY DISAGREE (SD)
a.	Treat the topics in the S.H.S syllabus very well and also treat all the topics in both the G.E.S and WAEC Chemistry syllabi.					
b.	Contain solved past WAEC questions					
c.	Give additional questions for both teachers and students to try their hands on					
d.	Are written in accordance with how the topics are arranged in the G.E.S syllabus.					
e.	Are written based on the areas in chemistry (organic, inorganic and practical) which makes it very easy to understand					
f.	Challenge the teacher to do further search on topics before teaching them.					
g.	Are revised almost every year and are therefore very current.					

SECTION C

TEACHERS VIEW ON ASPECTS OF CHEMISTRY TEACHING AT THE S.H.S LEVEL

1. Please tick ( ) the appropriate response to express your view on aspect of chemistry teaching at the S.H.S level in the table below

S/N	TOPIC	STRONGLY AGREE (SG)	AGREE (A)	UNDECIDED (U)	DISAGREE (D)	STRONGLY DISAGREE (SD)
a.	I often use the lecture/traditional method in my teaching					
b.	I seldom use Computer Assisted Instruction (CALS) in teaching more difficult topics because …………………… (1) They are very difficult to prepare					
	(2) they are not available in my school					
	(3)The laboratory environment is not conducive enough to enhance its usage					
c.	I do not take into consideration the cognitive level of development of my students when teaching					

d.	In most cases, I help students in overcoming mathematics difficulty on a particular topic before moving on to a new one					
e.	I give more relevant exercises on the more difficult topics after teaching and mark them promptly					
f.	My style of assessing students reflect the aims of the course(subject)					
g.	Practical works are conducted when my students are about to write their final examination					
h.	Both intrinsic and extrinsic forms of motivation are used in arousing and sustaining the interest of my students during teaching					

THANK YOU