UNIVERSITY OF EDUCATION, WINNEBA

THE STATUS AND QUALITY OF SENIOR HIGH SCHOOL INTEGRATED SCIENCE TEACHING AND LEARNING IN SELECTED SENIOR HIGH SCHOOLS

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DECLARATION

STUDENT'S DECLARATION

I, Gideon Asamoah, 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 that it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE: ……

DATE: …….

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of 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: Dr. James A. Azure

SIGNATURE: ……

DATE: …….

DEDICATION

This work is dedicated to my sister Linda Agyeiwaa Asamoah and the entire Asamoah family and also my wife Naomi Louisa Asamoah Kwarteng.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

Figure **Page**

ABSTRACT

The study investigated the status and quality of Integrated Science teaching and learning in selected Senior High Schools in the Central Region of Ghana. The research involved 6 schools within the Region. A total of 300 students were selected in addition to 80 Integrated Science teachers. The study was a descriptive survey. The target population for the study is made up of form three students in selected Senior High Schools and teachers who taught integrated science in the SHS of the Central Region. A self -constructed questionnaire for both the Integrated Science teachers and the students, and a Laboratory checklist were the main instruments for the data collection. A duration of 12 weeks was used for the collection of data from both students and teachers; and questionnaires administered and the data finally analyzed using SPSS version 20.0. The study revealed that 48.8% of the teacher sample had a Bachelor degree in science education and 21 teachers (26.3%) had no education component in their Bachelor degrees. Also 20 teachers which is 11.3% had further pursued post graduate programmes in education and were certified, some other 11 teachers representing 13.7% have had a post graduate certificate but not in science education. Instructional materials were inadequate for the teaching and learning of science. Teachers within the Region attested to the need to use practical oriented methods to teach science. Majority (63.70%) of the students said they were able to remember facts. It was also noted that 120 of the students, that is 40.00%, said they understood scientific ideas but only 24.20% could apply the scientific concept taught in integrated science lessons to real life situations. In view of this, the researcher suggested the use of practical-oriented methods in the teaching and learning of science and the discontinuation of literary approaches to science teaching and learning. It was further recommended that in-service training programmes should be regularly organized for science teachers. Efforts should also be made by the relevant authorities in education to ensure that adequate materials and laboratories exist at SHS level in the research area

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter comprises the background to study which talks about the expectations in the learning of integrated science and its implications on students, it also entails the statement of the problem, which is about the status and quality of senior high school integrated science teaching and learning. Next in line is the purpose of the study which is about the main reason why the study was conducted. It is followed by the objectives and the research questions guiding the study. The significance of the study tells the usefulness of the study. It also entails limitations and delimitations of the study as well as the organization of the study.

1.1 Background to the Study

When we develop a plan of teaching following a centralized theme across the boundaries of disciplines it indirectly symbolizes the unitary nature of knowledge. The power of this unified knowledge when unleashed has the potential to solve any educational problem.

Science is taught through concepts (Kaur, 2013). Concepts are simply the mental representations of knowledge with a set of attributes that generalize or distinguish them. integrated Science as a discipline is having two-fold functionary aspects, firstly, to facilitate the concept attainment process by bridging connecting links and secondly, associating a utilitarian value to the knowledge of the concepts such that it is easily accommodated and assimilated as a valid piece of knowledge.

Integrated science solicits the perspectives of the four science disciplines, agriculture, biology, chemistry and physics and integrates them during all phases of the approach to solve scientific and resource management problems. It is required of all senior high school students in Ghana to have diverse ideas to examine the linkages among single – discipline perspectives, to develop new methods, concepts and approaches during teaching and learning process, also teaching science through inquiry to young ones improves their knowledge in the field. When teachers develop a greater sense of efficacy to jointly solve problems of practice, they also develop a sense of collective responsibility that reduces attributions of low students‟ achievement to student-related factors such as family poverty, lack of ability, or low motivation and improve achievement. (Lee & Loeb, 2000).

Quality integrated science teaching enhances student‟s achievements, strengthens public confidence in schools and helps students attain conceptual understanding of nature. Quality teaching is characterized by teacher‟s adequate knowledge of subject matter; encouraging inquiry and hands-on approach to learning for students; and recognizing individual students as learners as the teacher builds on learners‟ strengths rather than trying to pinpoint students‟ weaknesses.

The quality of integrated science teaching and learning is questionable because of the poor performance of a great number of senior high school students in integrated science.

Ghana‟s performance in all the sciences which includes integrated science remained one of the lowest in Africa and in the world (Anamuah-Mensah, Mereku &Ampiah, 2009).

It is also expected that scientific experiences in school will help cultivate in students the interest and love for science that will urge some of them to seek further studies in science as preparation for careers in the sciences. For a successful study of science at the basic level, the curriculum requires that students should have good observational skills, mathematical skills and communication skills (CRDD, 2007). The continued existence of human depends on the mastery of the knowledge and attitudes of science and technology (Anderson, 2006).

According to Harlen and Holroyd (1995) weak teacher knowledge and low confidence in the teaching of integrated science have been reported to result in teachers who focused on process skills in science and avoided concept development.

Pell and Jarvis (2001) found that students like practical activities over non-practical activities in integrated science lessons.

Teachers mostly use the lecture format to teach students integrated science. One of the pitfalls to the lecture format is that it does not engage students in their learning. This teaching technique encourages rote memorization of facts and note-taking instead of students pointing out the usefulness of the knowledge they are obtaining and how applicable this knowledge is to their lives.

Activity based learning method encourages students to discuss scientific topics, develop questions about the material learnt. The belief that effort will lead to increased competence constitutes a growth mindset, which has been found to foster greater academic, emotional and social domains (Dweck, 2000, 2017).

From the range of evidence in the science education literature, it is very clear that science education is faced with numerous problems that need to be addressed in our country, so that this generation of students can live effectively in our modern age of science and technology.

The quality of integrated science teaching and learning could be affected such as inadequate instructional materials, inappropriate instructional strategies used by teachers, poor teacher preparation before lessons and poor attitude and interest of students towards the subject. Intelligence, cognitive styles and personality are individual characteristic that play important role in teaching and learning of integrated science. This is considered because the introduction of free senior high has led to overwhelming increase in enrollment, as a result so many students with diverse intellectual challenges. Other variables such as motivational orientation, self-esteem and learning approaches are important factors that affect teaching and learning.

Also, the contextual factors that are limiting the implemented science curriculum and act as barriers to students‟ learning for developing scientific literacy are presented.

The Chief Examiner explained that the abysmal performance in integrated science could either be that the candidates did not have the right caliber of physics teachers, or if they had the right teachers at post, very little time might have been allotted to practical lessons. (WAEC, 2018, p. 273). The Chief Examiner also lamented that the responses of candidates for some of the subjects showed that they were not adequately prepared for the examination. This feature was reported for Chemistry, Biology, Physics and Integrated Science. (WAEC, 2018, p. 263).

It is, however, believed that if appropriate steps are not taken to address these lingering barriers to reform, the citizens will not be able to develop scientific literacy useful for coping in the modern scientific and technological world. Efforts at developing scientifically literate citizens is the introduction of integrated science in our junior and senior high schools. Improving the quality of science teaching and learning in schools is a laudable reform that should preoccupy the mind of the policy makers and all the key stakeholders in science education.

1.2 Statement of the Problem

The current situation of integrated science teaching and learning in Ghana is a concern to all stake holders, including government and the society at large. Many students found integrated science to be difficult, boring and not interesting to them. To solve these lingering problems, one needs to investigate what goes on in the teaching and learning of integrated science in senior high schools of Ghana and develop a realistic picture of what is currently happening in the teaching and learning of integrated science in senior high schools in Ghana and also to identify the factors that are limiting the quality of science education.

Presently in Ghana, integrated science is perceived to be a difficult subject due to its broad nature (Abanyie, 2014). This perhaps may be responsible for the poor performance of some Senior High Schools (SHS) students in the subject at the West Africa Senior Secondary Certificate Examination (WASSCE). In the research area, records from the selected schools from 2018-2020 indicated that the WASSCE integrated science results for the three years were poor. The selected schools presented 3230 candidates for the WASSCE in 2018. Out of this number, 1680

(52.01%) candidates had grade A1-C6, and 1550 (47.99%) had grade D7 and below. In 2019, 3616 candidates were presented and out of that, 1233 (34.09%) candidates had A1-C6 and 23831615 (65.91%) candidates had grade D7 and below. In 2020, a total of 3598 candidates were presented and out of this number, 1212 (33.69%) had grade A1-C6 and 2386 (66.31%) had grade D7 and below. The breakdown of the results for the three years showed that the performance of the students in integrated science was below expectation. The causes of this problem might be multidimensional. Other researchers including, Parku (2012) and Adongo (2011) have carried out similar researches in other regions but nothing of that sort has been done in the study area. For this reason, the researcher undertook this study to determine the possible contributory factors to the problem of the low academic performance of the SHS pupils in integrated science in those selected schools in central region.

1.3 Purpose of the Study

The purpose of this study was to investigate the status and quality of Senior High school integrated science teaching and learning in selected schools in the Central Region, Ghana with the intention of comparing an expected picture of science teaching and learning with actual practices.

1.4 Research Objectives

The objectives of the study addressed are:

1. Find out the level of qualification and experience of integrated science teachers in Senior High Schools.
2. Examine the instructional methods used for teaching integrated science.
3. Find out the attitude of students toward the learning of integrated science.

4. Examine the availability of resources in science laboratory and whether teachers use them in teaching.

1.5 Research Questions

More specifically, the study addressed the following research questions:

1. What are the levels of qualifications and experience of the integrated science teachers in the selected Senior High Schools?
2. What are the instructional methods used for teaching integrated science in the selected schools?
3. What are the attitudes of students toward the learning of integrated science?
4. What resources are available for the teaching and learning of integrated science in the selected senior High Schools?

1.6 Significance of the Study

In an effort to make the learning of integrated science more attractive to students, this study will make the following important contributions to knowledge and education. This study was conducted to find out the importance of Senior High School integrated science teachers‟ qualifications and area of specialisations. The studies explore the importance of available instructional materials in the SHS for the teaching and learning of integrated science.

The study looked at the instructional approaches‟ teachers used during integrated science lessons at the Senior High Senior Finally it found out the problems the integrated science teachers and student encountered during the teaching and learning of science in the Senior High School.

This study also provides integrated science educators, integrated science curriculum planners and government with detailed information about the Attitudes of students towards integrated science teaching and learning. This in turn can help in planning and formulating further policies for integrated science education in Ghana. It can also inform educators about how to improve the teaching approaches.

Again, it is hoped that this study will engage key stakeholders in science education in revealing the actual and ideal picture and gaining their support for recommendation for closing the gaps of senior high schools integrated science education in the country. This in essence will inform them about the features of quality integrated science education and gain their support for improving the recommendations of the study.

1.7 Delimitations to the Study Report

Delimitations of a case study are the choices made by the Researcher which should be mentioned. They describe the boundaries that the Researcher has set for the study.

The study focused only on selected SHS students and their science teachers in the in the selected schools in Central Region. The study only sought to identify problems that hindered effective teaching and learning of integrated science in the selected schools. The teachers‟ and students‟ knowledge of the subject matter was not determined.

This research finding is focusing on only the teaching and learning of integrated sciences. The following were the delimitations of the study.

Also, the sample of the population were willing to participate in the study and responded to the interventions honestly and participated without biasing the study results. This caused the study to be valid.

1.8 Limitations to the Study

According to Dusick (2014) limitations of a case study are those elements the Researcher has no control over that place restrictions on the conclusion of the study and its application. The following are the limitations of the study.

The purposeful sampling technique employed limits the generalisability of the findings in this study to the three the central Region of Ghana. Also, a limitation of the study was the lack of classroom observations that may have provided further insights into current classroom practice. This was due to the government restrictions of human traffic and other government institutions as a result of the covid 19 pandemic. Furthermore another limitation of this study is the similarity in responses given by the teachers about the status and quality integrated science teaching and learning based on individual perceptions, and this may not honestly reveal the true picture of the situation at stake.To begin with, the power to detect significance differences or relationships as they existed in the population sample were limited due to the analysis of the research questions and findings as well as test and informal observation. Because the subject used in the study are humans, there is a possibility of change of behaviours towards the researcher during the collection of data. Though the result of the findings can be generalized, it is still limited in application.

1.9 Definition of Terms

Equipment: They refer to tools used to teach practical lessons in the laboratory.

Apparatus: They are used to measure, observe and gather data for experiment, as well as to safely perform reactions and to heat things.

Chemicals: These are consumables that are used to perform various routine tests and experiments in the laboratory.

Improvised materials: They are science materials designed by the teacher for teaching.

Glassware: They are objects made from glass for the purpose of science teaching and learning.

Quality: The performance of student in terms academics, discipline, etc per their expectations

Status: The state or prevailing conditions of the SHS integrated science education in the selected schools in central region.

1.10 Abbreviations

BECE: Basic Education Certificate Examination.

CRDD: Curriculum Research and Development Division.

GES: Ghana Education Service

SHS: Senior High School.

TLMs: Teaching and Learning Materials.

WASSCE: West Africa Senior Secondary Certificate Examination

1.11 Organization of the Study

This project work is presented in six chapters. The first chapter deals with the background to the study, statement of the problem, purpose of the study, objectives of the study, research questions, significance of the study, limitations of the study, delimitations of the study, rationale for the study and organization of the study.

The review of e existing relevant literature on the problem at stake forms chapter two with chapter three dealing with the methodology. The methodology comprises the design of the study, populations, sample size and sampling technique, instruments and the data collection procedure as well as the method of data analysis.

Chapter four (4) has to do with the presentation of the data collected. The fifth chapter deals with analysis of the data (results) and the discussion of the findings. Lastly, the summary of the main findings, conclusions and recommendations as well as suggestions for further research constituted the sixth chapter.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter discusses relevant literature related to this study. The literature is discussed under headings which include the purpose and goals for senior high school integrated science education, quality teaching of integrated science, preparation of senior high school integrated science teachers in Ghana, Theoretical model, importance of teaching and learning material and the students‟ attitudes have also been discussed in this chapter.

2.1 Conceptual Framework

The poor performance of students in integrated science cannot be blamed solely on the students as far as academic work is concerned. Fig 1 represents the conceptual framework for the study. The listed factors were believed to affect the overall performance of students in integrated science in senior high schools in the research area. Each of these factors is important in teaching and learning of integrated science. For instance, teachers‟ academic qualification and specialization inform the quality of education given to students and hence their performance. Students have peculiar challenges which could be personal, emotional and sometimes even social problems which affect teaching and learning and subsequently their performance. Even after the teacher and student challenges, the right TLMs should be used to enhance both teaching and understanding of lessons. The choice of TLMs used can either affect performances of pupils positively or negatively. Human beings are dynamic and need the rightful approach to remain focused. Hence in science lessons, another factor that affects academic performance is the instructional approach. If the approach is not

suitable, especially to the pupils, then they lose focus right away and it is difficult to bring such pupils back on track. This will adversely affect the overall output (final exam). To achieved effective teaching and learning of integrated science by pupils all these factors must be adhered to and should balance. For this reason, the variables listed in the conceptual framework shown in the Figure1, were measured to determine the extent to which each of them affected science teaching and learning in the research area.

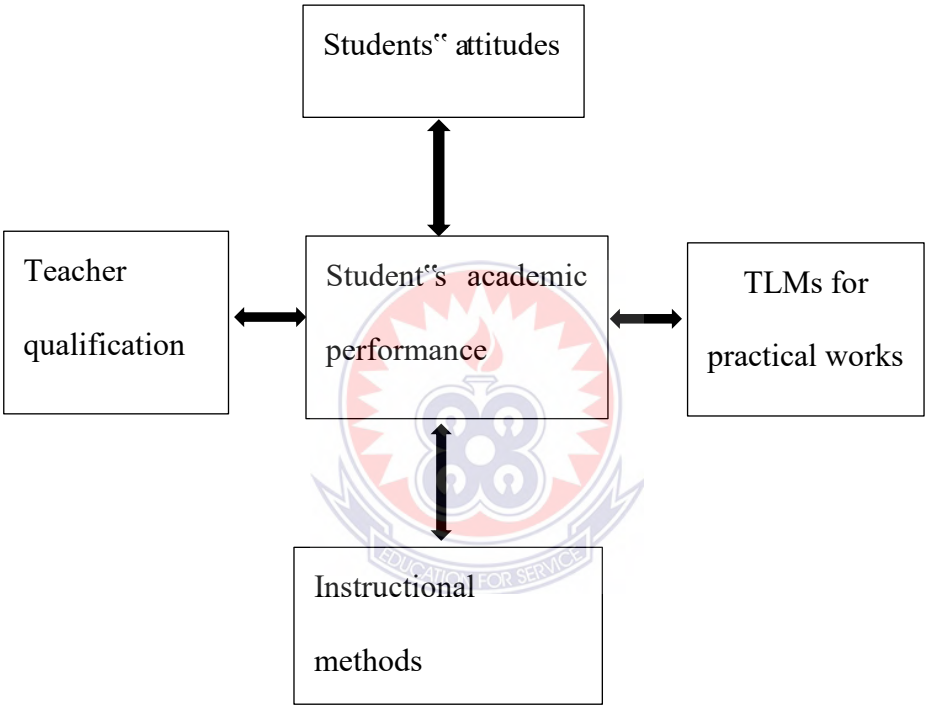

Figure 1: Diagrammatic form of the conceptual framework

2.2 Purpose and Goals for Senior High School Integrated Science Education

This section presents the purpose and goals of science education and highlights the importance of scientific literacy. The section further examines the relationship between science and technology and the roles they play in the social and economic development of a nation.

Ghana is located in West African sub-region and with a growing population of about 31 million people comprising of about 46 different ethnic groups within the sixteen Regions. As at the beginning of the 2017/2018 academic year, Ghana had begun a free senior high school which will see the Ghanaian student be in school until at least the completion of Senior High School. The level of poverty, environmental pollution and degradation in Ghana has been ascribed to the level of ignorance and illiteracy among the citizenry. The level of environmental awareness among school leavers remains low (Balogun, 1987) and the current level of scientific illiteracy coupled with poor student achievement in science is of concern to governments, educational authorities and individuals (Akpan, 1996). The underlying problems have been traced to many factors including poor teacher preparation resulting in poor teaching skills among science teachers, and inability to determine a realistic and a well-articulated purpose and goals for senior high school integrated science education (Okebukola, 1997).

According to Bell, Blair, Crawford and Lederman (2003) an adequate understanding of the nature of science and scientific inquiry is the main instructional purpose of science education. The study of science as a „way of knowing," and a „way of doing" can help students reach deeper understandings of the world". Shamos (1995) claimed, the knowledge of science was important in making crucial decisions on everyday issues and problems, and in the production of informed citizens who are capable of taking personal actions to find solutions to any identified issues and problems.

Scientific knowledge update is needed to understand the great scientific and technological changes. But this must be done properly, stimulating the interest; the

mass media often do not help since they may insist on aspects which are doubtful or incorrect or not scientific.

The teaching syllabus for senior high school integrated science (2010) is aimed at providing excellent opportunities for the development of positive attitudes and values in our youth. These include:

1. Curiosity to explore their environment and question what they find
2. Keenness to identify and answer questions through scientific investigations
3. Creativity in suggesting new and relevant ways to solve problems
4. Open-mindedness to accept all knowledge as tentative and to change their view if the evidence is convincing
5. Perseverance and patience in pursuing a problem until a satisfying solution is found
6. Concern for living things and awareness of their responsibility toward maintaining the quality of the environment
7. Honesty, truthfulness and accuracy in recording and reporting scientific information
8. Love, respect and appreciation for nature and desire to conserve natural balance.

The syllabus is also designed to help the student to:

1. solve basic problems within his/her immediate environment through analysis and experimentation
2. keep a proper balance of the diversity of the living and non-living things based on their interconnectedness and repeated patterns of change.
3. adopt sustainable habits for managing the natural environment for humankind and society
4. use appliances and gadgets effectively with clear understanding of their basic principles and underlying operations
5. explore, conserve and optimize the use of energy as an important resource for the living world
6. adopt a scientific way of life based on pragmatic observation and investigation of phenomena.
7. search for solutions to the problems of life recognizing the interaction of science, technology and other disc.

Thus, a scientifically literate student develops higher order cognitive thinking to identify and evaluate ill-defined problems, to make informed decisions, and also to provide a variety of solutions to any particular problem (Craven & Penick, 2001).

Therefore, understanding the nature of science and scientific inquiry to foster learners‟ ability to develop scientific literacy is a purpose and goals for science education.

2.3 Research into Quality Teaching and Learning of integrated Science

This section examines the characteristics of quality teaching and learning of science in schools with emphasis on teachers‟ content knowledge and the knowledge of teaching

pedagogy. This follows with a section on constructivist approaches to teaching and learning.

The section further looks into the role of science teachers in quality teaching and learning. This continues with a section on the inquiry approach to science teaching and learning. The next section reviews assessment practices and the purposes of assessment in teaching and learning of science. A further section highlights the classroom implications of quality teaching and its impact on students‟ achievement in science. The final section examines the factors that inhibit quality of science teaching and learning in schools.

Quality has been described in different ways, although, often in an intuitive manner (Reeves, 2002). Literatures describe quality as achieving or reaching for the highest standard and the maintenance of academic standards (Cooper, 2002). Based on these descriptions of the term „quality‟ any definitions of quality depend upon which values that are given priority (Reeves, 2002). Quality therefore is an elusive concept that takes on different meanings in different settings; however, it is fundamental for effective teaching and learning and for meeting educational goals.

For the purpose of this study, quality would be defined as a process whereby teaching and learning are continuously improved and maintained with a view to bringing about desirable educational goals in the school system.

Currently, achieving quality teaching and learning in science for developing scientifically literate citizens is a worldwide problem (Darling-Hammond, 1997; Goodrum et al., 2001; Osborne & Millar, 1998). Quality teaching in integrated

science is crucial for developing scientifically literate citizens and improving economic productivity for sustainable development.

Much research in recent years has indicated that science classrooms can be created in ways that enhance the quality teaching. Teachers can have profound effects on adolescents‟ cognition and motivation as they attend to daily, routine issues. The specific decisions that science teachers make on a daily basis can affect a number of important educational outcomes.

The types of instructional practices that teachers use affect how students learn in important ways. Teachers make choices everyday regarding (a that they will use in class and for homework assignments; (b) the types of rewards that students can earn; (c) assessment procedures; (d) grouping arrangements) the types of tasks (e.g., heterogeneous vs. homogeneous); (e) how much autonomy will be afforded to students; and (f) whether or not they will hold high expectations for all students (Anderman & Anderman, 2009). The decisions that teachers make about each of these instructional practices are related in important ways to how well students learn science, to students‟ motivation toward science (including their desire to study science in the future), and their beliefs about their own abilities in science.

The types of assessment practices that science teachers employ are also related to the types of skills that adolescents use in classrooms. Research indicates that teachers make choices about whether or not they will pursue interpersonal relationships with their students (Davis, Ashley, & Couch, 2003). Specifically, when teachers are committed to having positive interpersonal relationships with their students, academic achievement is enhanced (Delpit, 1995, Reeve, in press).

According CRDD (2007), for effective teaching and learning of integrated science syllabus, it is recommended that schools should have science equipment and materials. As much as possible, the social relevance of all integrated science concepts taught must be made clear, example, their application to agriculture and industry. Teaching of the subject can only be most effectively achieved when teachers create learning situations and provide guided opportunities for pupils to acquire as much knowledge and understanding of science as possible through their own activities (Bawre 2015).

There are times when the teacher must show, demonstrate, and explain. But the major part of a pupil's learning experience should consist of opportunities to explore various mathematical situations in their environment to enable them make their own observations and discoveries and record them. Teachers should help pupils to learn to compare, classify, analyze, look for patterns, spot relationships and come to their own conclusions/deductions. Teachers should discourage rote learning and drill-oriented and rather emphasize participatory teaching and learning in their lessons.

A suggestion that will help pupils acquire the capacity for analytical thinking and the capacity for applying their knowledge to problems and issues is to begin each lesson with a practical problem. The selection of a problem for a lesson must be made such that studets can use knowledge gained in the previous lesson and other types of information not specifically taught in class.

In the review of science education in Nigeria, Okebukola (1997) identified the following five factors as inhibiting science education according to Okebukola (1997) include:

1. Student-related factors; such as poor attitude to work, apprehension that science is naturally difficult to learn, difficulty associated with learning science symbols and difficulty in learning the language of science.
2. Teacher-related factors; such as poor preparation of integrated science teachers, lack of motivation of many science teachers, inadequate knowledge of subject matter by teachers, and lack of skills/competence required for teaching.
3. School-related factors; such as overcrowded classrooms, overloaded examination syllabus, lack/inadequate laboratory and workshops, poorly equipped library and lack of vital instructional materials such as textbooks, teacher‟s guide and audio-visuals.
4. Home-related factors; such as imposition of science subjects by parents on children despite poor attitude to science especially at the secondary level, non-monitoring at home of students‟ progress in science and lack of provision in many homes for the educational needs of students in science; and
5. Curriculum-related factors; such as overloaded syllabus and insufficient time allotted to teaching of integrated science in schools (p. 3-4).

Dzama and Osborne (1999) further see a gap between indigenous African cultural beliefs and the worldview that Western education seeks to develop among African students as a crucial factor of underachievement in science education among the African students.

Literature in science education in developed countries of Australia and the United States of Teacher quality is the most important factor inhibiting science learning in schools that needs to be addressed (Darling-Hammond; 1997; Darling-Hammond &

Ball, 1997; Goodrum et al., 2001). In the United States, Darling-Hammond (1997) in *„Doing what matters most: Investing in quality teaching'* reveals that without a sustained commitment to teachers‟ learning and school redesign, achieving quality achievement will remain unfulfilled. Darling-Hammond asserts: …the nation lacks systems to attract and retain the kinds of teachers needed for high demand fields and locations. Rather than creating policies to address shortages, standards are too often waived or lowered to admit people without qualifications to teach. …. Many beginning teachers receive little or no mentoring; and teacher evaluation and reward systems are disconnected from nation‟s educational goals. Professional development investments are fairly paltry, and most districts offerings, limited to "hit and run" workshops… And teachers have little time to learn from one another. They rarely have opportunities to plan or collaborate with other teachers, to observe and study teaching, or to talk together about how to improve curriculum and meet the needs of students. In short, many…teachers enter the profession with inadequate preparation (p. 2).

A similar study in Australia by Goodrum et al. (2001), claim that large class size, limited resources, inadequate time for preparation, reflection and teachers collaborating with colleagues limit the quality of teaching science in secondary schools. It is worth noting that quality teaching and learning of science in schools cannot be achieved in a vacuum but requires adequate resources, improved teacher preparation, limited class sizes, ongoing professional development for science teachers and the recognition of the importance of science education in society among others. Improving the quality of teaching and students‟ achievement in science depends on the quality of initial teacher education, mentoring and induction

programmes provided for beginning teachers, opportunities for ongoing professional development provided for teachers, teaching resources in school and community support among other factors.

2.4 The Importance of Teachers' Qualifications and Areas of Specialisation

Teachers‟ professional development refers to the opportunities offered to practicing teachers to develop new knowledge, skills, approaches and dispositions to improve their effectiveness in their classrooms. In other words, it is advancement/enhancement of teachers‟ knowledge of the students, the subject matter, teaching practices, and education-related legislation. It includes formal and informal means of helping teachers not only to learn new skills but also develop new insight into pedagogy and their own practice, and explore new or advanced understanding of content and resources. Professional development is defined as ―the process of improving staff skills and competencies needed to produce outstanding educational results for students (Hassel, 1999). As Guskey (2000, p. 4) states, one constant finding in the research literature is that notable improvements in education almost never take place in the absence of professional development. Professional development is key to meeting today‟s educational demands.

The issue of professionalism in teaching has been on course for quite some decades ago. Scholars argued the necessity of skilled teachers for effective learning. Fajonyomi (2007) emphasized that the success or failure of any educational programme rests majorly on the adequate availability of qualified (professional), competent and dedicated teachers. Seweje and Jegede (2005) noted that the ability of

a teacher to teach is not derived only from the academic background but also on the outstanding pedagogical skill acquired. Ngada (2008), while remarking on teachers‟ quality, observed that over 80% of respondents in a survey research were of the view that teachers are carriers of weaknesses. These weaknesses include, among others, inadequate exposure to teaching practice, poor classroom management and control, shallow subject-matter knowledge and lack of professionalism.

The education of pre-service and in-service science teachers is meant to help the individual teacher grow and develop as a person, provide him or her with the skills and professional abilities to motivate children to learn, assist them in acquiring the right types of understandings, concepts, values and attitudes to manage classroom instruction and be productive members of the society in which they are born, grow and live (Lawal, 2003).

Yusuf (2002) view is that the main objectives of teacher education are to develop awareness, knowledge, attitudes, and skills, evaluate ability and encourage full participation in the teaching and learning process. Professional competence is reflected in the performance of the

professional, and observing the professional‟s performance assesses the level of competence. Wenglinsky (2000) found a positive correlation between professional development activities aimed at the needs of special education students, and students‟ higher-order skills and laboratory skills in science. More recently, Harris and Sass (2007) identified what they call the ―lagged effect of professional development, that is, the larger effect of teachers‟ professional development on student outcomes not becoming apparent until three years after the teachers had completed their courses.

The interpretation of the positive effect of participation in teacher professional development activities is not clear cut, as this variable is confounded with other teacher attributes, that is, teachers who participate in these activities are also likely to be more motivated and, usually, more specialized in the subjects they teach.

Professional development is an intensive, ongoing, and systemic process that aims to enhance teaching, learning, and school environments (Elmore, 2002). Effective professional development programs are sustained over a period of time and provide clear and consistent linkage to the subject matter and the core ways in which students learn (Zemelman, Daniels, & Hyde, 2005).

In fact, research has repeatedly shown that the most important variable in student achievement is the quality of the teacher in the classroom (Block, 2000; Darling-Hammond, 2000; Haycock, Jerald, & Huang, 2001). Undoubtedly, the ultimate goal of professional development is to increase student achievement (Mundry, 2005; Porter, Garet, Desione, & Birman, 2003; Quick, Holtzman, & Chaney, 2009), and instructionally-focused professional development supports teachers toward that goal.

Research shows that the more time teachers spend engaged in professional development, the more likely their teaching practice is to improve (National Staff Development Council, 2009; Porte, Garet, Desimone 2003; Quick, Holtzman & Chaney, 2009).

Effective professional development is coherent because it is connected to clear goals such as a school improvement plan or state learning standards (King & Newmann, 2004). When teachers‟ varying professional development, experiences are related to each other as well as to school goals or state learning standards, they are able to see

the ―big picture‖. This causes teachers to perceive their learning experiences as more valuable (Quick, Holtzman & Chaney, 2009), which makes them more likely to change their teaching practice to positively affect student outcomes (Porter, Garet, Desimone 2003).

Accodding to Ramatlapana (2009), the mandate of in-service training is to improve the quality of teaching by supporting teachers through training programmes that enable them to take ownership of their professional development. It is the process by which, alone and with others, teachers review, renew and extend their commitment as change agents to the moral purposes of teaching; and by which they acquire and develop critically the knowledge, skills and emotional intelligence essential to good professional thinking, planning and practice with children, young people and colleagues throughout each phase of their teaching lives.

If Junior High School children are to have satisfactory science experiences, then teachers have to be preparing to provide for them. Good undergraduate methods course in the colleges will not equip the teachers enough. Too many teachers are already out there teaching. These teachers must be reached through in-service training. The question is not should there be in-service training, but what kind of in-service training will really affect the teacher and what she does with the child in the classroom?

Good teachers have distinguishable impacts on students‟ success. The major manpower saddled with the responsibility of impacting the concepts considered fundamental to science and technology is the teacher.

The issue of professionalism in teaching has been on course for quite some decades ago. Scholars argued the necessity of skilled teachers for effective learning. Ngada in Fajonyomi (2007) emphasized that the success or failure of any educational programme rests mainly on the adequate availability of qualified (professional), competent and dedicated teachers. Agyeman (1993) reported that a teacher who did not have both the academic and the professional teaching qualification would undoubtedly have a negative influence on the teaching and learning of his/her subject. Similarly, educational qualification is said to be an important aspect of how a teacher perceives areas of difficulty in teaching (Uche &Umoren, 1998). According to Subahan, Lilia, Khalijah and Ruhizan (2001), teachers of various educational backgrounds teaching science subjects are common in most schools. As a result, teachers with various subject major backgrounds were often required to teach science subjects for which they were not trained. Though these teachers might have used various kinds of coping strategies in their teaching, they are in dire need for in-service training courses in order to teach science meaningfully and effectively whilst filling the gaps of content knowledge and pedagogical content knowledge in the subject that they are required to teach.

Some people with various levels of education, including those with no professional qualification have been employed as teachers. Probably some of the science teachers currently on the field are not professionally qualified (Parku, 2012). Probably these findings apply to the teachers in this study. For this reason, an attempt will be made to determine whether the teachers in the present study have the requisite qualification in science and whether they had undergone any in-service training.

Adu, Akinloye and Adu (2015) noted that the success of educational system depends mainly on the quality of teachers employed and their training is quite inevitable because of the explosion brought about by technological innovation which make the whole world a global village. Teachers interpret the aims, goals and plans of education and ensure that the students are educated in the direction of the aims and goals. He gave an advice that adequate number of teachers should be employed, so as to cope with the constant increase in school enrolment at different levels, and in addition are sufficiently trained and selected for their duties.

In this study teachers‟ area of specialisation is used to encompass the teachers‟ qualifications (certificate, diploma or degrees obtained by the teachers), their subject majors and years of teaching experience. Teachers‟ qualifications also measure the educational attainment (education level) of the teachers. That is the highest qualification obtained by the teachers in any subject.

It was categorized according to the highest qualification the teachers obtained, namely Certificate, Diploma, Bachelors, Masters or Doctoral degrees. A number of studies have examined the ways in which teachers‟ highest qualifications are related to students‟ achievement. Many of the studies found that teachers‟ qualifications corresponded positively with students‟ achievement. For instance, Betts, Zau, and Rice (2003) found that teachers‟ highest degree correlated positively with students,, achievement. Rice (2003) found that when teachers have an advanced degree in their teaching subjects, it will have a positive impact on the students‟ achievement. Inexperienced teachers were typically less effective than more senior teachers. In the research area, there is no empirical evidence of the overall quality of the integrated

science teachers and its effect on the students‟ performance. This knowledge gap is intended to be filled by this study.

2.5 Preparation of Senior High School Integrated Science Teachers in Ghana

Teacher education is regarded as a tertiary education in Ghana and it is the responsibility of Governments. Currently in Ghana, the Faculties and Institutes of Education in the universities, such as the University of Education, Winneba, the University of Cape Coast among others are tasked to prepare science teachers for our Senior High School.

High school leavers who wish to be integrated science or other science related subject may have a four-year specialization. Teachers who have had an initial diploma in education (the enables the said teacher to teacher at the basic level) are allowed to acquire a four-year degree in science education with specializations in integrated science, chemistry, biology or physics. At the graduate level, preservice teachers (without teaching qualifications usually those with honours degrees in science) are gradually introduced to the teaching profession and courses in education leading to the award of a Post Graduate Diploma in Education (PGDE). Another path for science teacher preparation in Ghana is through part-time or sandwich programmes organised by the Colleges of Education and the universities for providing on the job training to teachers with lower qualifications so that they can upgrade their qualifications and also for adults who are seeking a change of career into teaching. These programmes are suitable for adults who could not afford attending the full time programme as a result of financial commitments and other reasons. These programmes usually last for

a longer period of four-years for degrees. Classes are held in the evenings, weekend and during school vacations. It is important to indicate that graduates from these programmes and the full-time courses is gradually reducing the shortages of science teachers in Ghana schools.

Preservice courses include specific science content, courses in education and supervised teaching practice (Internship). The university lecturers, school principals and the cooperating teachers are responsible for supervising practical teaching experience in local schools for a period of one semester (on campus teaching practice) in the universities and one semester out programme in the Senior High Schools. Preservice teachers engage in observing, planning instruction, whole class teaching and tutoring, supervising student examinations, keeping school records and taking part in other school activities like staff meetings and extracurricular activities.

The government through the Ministry of Education, the various Universities and Ghana Education Service is charged with the responsibilities of ensuring the orderly development of preparatory process to maintain standards.

2.6 Teaching Methods in Teaching Integrated Science

There are different teaching methods employed in science education in the second cycle institutions, and these teaching methods affects the performance of the students in these institutions. Among the causes of this poor performance is the teachers‟ method of teaching (Wanbugu, Changeiywo and Ndritu, 2013). Based on this, it is important to review the different type of teaching methods in science education, their disadvantages and the need for a shift of paradigm. Miles (2015) asserted that it is expected of a teacher to implement a range of instructional strategies that will bring

academic success to all the science students. For any method to be able to bring good result in the present age, it should be a method that promote maximum social interaction. Social interaction between students and between teacher and student plays a crucial role in learning (Nguyen, Williams, and Nguyen, 2012). These authors further stressed the need for the students to be provided with a supportive, open and interactive environment as this could help them discover knowledge. The teaching methods commonly used in science education classes are lecture and demonstration method. These methods shall be briefly discussed.

Research in science teaching asserts that teachers‟ subject matter knowledge, attitude to adopt new teaching methods, and using their teaching skills in classroom practices are central components of their practices (Mavhunga & Rollnick, 2013). According to Ajaja (2007), most of the science teachers do not put their skills into classroom practices, which they have acquired during the teaching certification.

2.6.1 The Lecture Method

It is often used to deliver a large amount of information to the students in a short period (Berry, 2008). According to Gehlen-Bauum and Weinberger (2014), lectures are designed to deliver a new information to a large group of students. This method is known to be effective in dealing with a large class. However, it could also be used for a small class. Research indicates that this method dominates most of the tertiary institutions (Deslauriers, Schelew and Wieman, 2011).

Research shows that teaching method like the lecture method commonly used does not help the students to acquire sufficient functional understanding (Bernhard 2007). Berry (2008) stated that lecture method lacks the effectiveness of an active learning

approach. Fagen and Mazur (2003) also thought that lecture method causes bad reading habit among the students. Franklin, Sayre, and Clark (2014), students taught in lecture-based classes learn less than those taught with activity based reformed methods. Lecture method is frequently a one – way process unaccompanied by discussion, questioning or immediate practice that makes it a poor teaching method (Al-Rawi, 2013). Lecture method concentrates on information rather than learners (Al-Rawi, 2013). In the lecture method the teacher tell the students what to do instead of activating them to discover for themselves (Miles, 2015).

2.6.2 The demonstration teaching method

The demonstration method as another type of pupil-centred lesson, involves the teacher doing or presenting something (a lesson) to the entire class or pupils in order to illustrate a principle to them or show pupils a procedure of accomplishing a task. The goal of this strategy is to help pupils acquire skills. In some cases, the teacher does it first and later asks pupils to try their hands on or perform another task.

It is a useful method of teaching because it improves students' understanding and retention (McKee, Williamson, and Ruebush, 2007). According to Al-Rawi, 2013), the demonstration is effective in teaching skills of using tools and laboratory experiment in science. However, the time available to perform this demonstration is very limited in a classroom setting. Therefore, a demonstration often designed to allow students to make observations rather than through hands-on laboratory (McKee, Williamson, and Ruebush, 2007).

2.6.3 Peer instruction and group work

It is a method created to help make teaching more interactive and to get students intellectually engaged with what is going on. It has been tested in many classes and found to be good for improving students‟ performance and also used to identify student difficult areas. Peer instruction has been used in different subjects in many countries. Peer Instruction is still a new method of teaching for teachers in many countries because of its unique feature.

Peer Instruction is an instructional strategy for engaging students during class through a structured questioning process that involves every student Crouch, Watkins, Fagen and Mazur, 2007). Peer instruction and group work provide a structured environment for students to voice their idea and resolve misunderstanding by talking with their peer (Gok, 2012).

Peer instruction is a cooperative learning technique that promotes critical thinking, problem solving, and decision-making skills (Rao and DiCarlo, 2000). Research shows talking to peers forced them to organize their thoughts and reminded them of the concepts they had difficulty recalling on their own (Gok, 2012). Peer Instruction is an interactive approach that was designed to improve the learning process (Rosenberg, Lorenzo and Mazur, 2006). This method has the advantage of engaging the student and making the lecture more interesting to the student. It also has the tremendous importance of giving the lecturers significant feedback about where the class is and what it knows.

Group work is more effective at developing students‟ conceptual understanding than traditional teacher delivery instruction. According to Crouch, Watkins, Fagen and Mazur

(2007), peer instruction and group work increase student mastery of both conceptual reasoning and quantitative problem solving. Peer instruction increase conceptual learning and traditional problem-solving skills (Lasry, Mazur and Watkins, 2008). According to (Gok, 2012). Peer instruction encourages students to take responsibility for their learning and emphasize understanding. It also increases student conceptual learning and performance on quantitative problem-solving questions.

Peer Instruction involve students during class through activities that require each student to apply the core concepts being presented, and then to explain those concepts to their fellow students. Unlike the common practice of asking informal questions during a traditional lecture, which typically engages only a few highly motivated students.

The goal is to transform the teaching environment so that it actively engages students and focuses their attention on underlying concepts. Instead of teaching from the textbook, teaching consist of short presentations on the main points. Each followed by short conceptual questions called *ConcepTest* on the subject being discussed.

2.6.4 The activity –based method

The Integrated science teaching syllabus suggests that science should be students-centered and activity oriented. The teacher should therefore act as a facilitator. Activity methods of teaching according to Petty (2001) are methods of teaching in which the teacher involves the learners in a series of tasks.

According to Lombardi (2007), Students say they are motivated by solving real-world problems. They often express a preference for doing rather than listening. In this method, the pupil discovers concepts and facts either unaided or with minimum

teacher interference. The teacher is less active, a facilitator, co-learner and a guide. The activity method takes full advantage of the learner‟s natural tendency to explore the familiar environment. The advantage of this method is that pupils learn to use their hands and minds. Again, pupils learn to organize, observe and become more curious to manipulate and carefully handle equipment during activity-based method.

Erinosho (2008) identified other suitable methods that can be used for the activities in teaching science at the basic school to include: discussion Method, demonstration Method, questioning and Answer Method, concept Maps, field Trip, cooperative Learning and simulation method. It is clear that most often the way science is taught is misleading. Teachers lay emphasis on rote learning and acquisition of knowledge rather than developing a total child which will help the child realize the relevance of what he/she learns to his/her environment. If our children are to change their attitude towards the study of science, then, teachers also need to change their way of teaching the subject to make it fun especially for young children. There are several methods of teaching science, for example the inquiry method, observation method, discussion laboratory method, discovery and activity methods.

2.6.5 The Discussion Method

Discussion as a teaching strategy is one of the best ways of helping pupils to understand and learn ideas. The method involves pupils- pupils or teacher- pupils interactive dialogue, where they talk together or share ideas about a topic(s) in order to find supporting evidence to a claim or solution to a problem. Discussion could involve a whole class or in organized smaller groups to enable both the teacher and pupils exchange opinions based on valid reasoning. In order that learners see clearly how an idea applies to everyday life, they must be given the opportunity to use the

discussion approach, and that the teacher only acts as a catalyst during the interaction among the students. The focus of a discussion can be on either content-specific issues or general science-society-related topics just to provoke pupils‟ thought and stimulate them to fully participate in the lesson and also boost their confidence to express their opinions (Erinosho, 2008).

Discussion can be fruitful when the teacher is clear on the reasons for conducting discussions, adopts approaches for making the discussion productive, and is comfortable with the various roles the teacher must play in discussion.

Classroom discussion improves student learning and makes class more interesting as well. Students may engage in classroom discussion naturally, due to factors like group cohesiveness or familiarity with the topic. Other times, however, it may be challenging to engage students in lively discussion. To increase students' participation, you may need to employ different tactics tailored to your students' needs and desires. In the context of discussion, students make public their perspectives on issues arising from the text, consider alternative perspectives proposed by peers, and attempt to reconcile conflicts among opposing points of view.

Much time is spent on planning for the discussion as we do in conducting the discussion itself. The introduction is the most important part of the entire process. If a teacher introduces a discussion properly, students will jump on-board immediately.

Moreover, class discussions offer students opportunities to test their ideas and opinions against the ideas and opinions of their peers.

It is important to set the right tone for discussion in the classroom earlier in the term, and to establish a rapport with the students. Therefore, it is necessary to find ways to involve all students in the formative discussions of the course.

According to Applebee, Langer, Nystrand, and Gamoran, (2003) "The starting point for sociocognitive studies of literacy instruction has been in the exchange of ideas-the discussion-that takes place in a classroom, including reading, writing, and the talk that surrounds them". Furthermore, they may think that they do not know enough to make a contribution and fear being assessed negatively on the basis of their spoken contribution".

Science is a social process, one that involves particular ways of talking, reasoning, observing, analyzing, and writing, which often have meaning only when shared within the scientific community. Discussions are one of the best ways to help students learn to "talk Science" and construct understanding in a social context. Inquiry is another important strategy that elicits discussion in the teaching of integrated science.

Related ideas and theories on concept acquisition are seen to reveal that learners learn by active interaction initially with concrete objects and later with abstract entities. For instance, Weimer (2002) explains that, in accordance with the constructivist theory, students need not to wait until they have developed expertise before they interact with content. Instead they are to be encouraged to explore it, handle it, and relate it to their own experience. Weimer (2002) further explains that the goal is to involve the students in the process of acquiring and retaining information.

Discussion is a good way for us to be together. We use it to face our common perplexities about what to think and how to act. And we use it to form our young,

inducing them into these very goods. So discussion is a way for adults and children to be together in a fundamental human relation and essential educative activity".

2.6.6 Question and answer method

Question and Answer method of teaching science is also an important teaching strategy used to develop in pupils the essential attributes of scientific inquiry. Research finding by Walsh and Satters (2005), point to the positive effect of pupils-teacher classroom interaction through questioning. This means that questioning is the entry point to problem formulation in inquiry, promote participatory learning, good communication skills, and confidence building in pupils‟ learning process. One good strategy of engaging pupils in science lesson is by prompting them to answer questions or ask questions. This would then help the teacher to resolve misconceptions and check understanding. Questioning could arise as a spontaneous activity during instruction, or could be pre-planned. Although questioning technique is a valuable instructional strategy, badly formed or faulty questions can impede learning. A faulty question is vague (difficult to pin down the answer); not logical (not asked to follow a sequence that helps to build up knowledge); unconnected with instructional materials (asked without reflection); confusing (unclear wording or one that entails multiple tasks); and not adequately challenging to provoke thinking (focus on recall).

2.6.7 Concept mappings

The idea of concept mapping as a learning tool was developed by Novak (1991) when he was exploring the changes in children‟s knowledge of science. This idea was derived from Ausubel‟s (1968) cognitive theory which places central emphasis on the connection of pupils‟ existing knowledge as the anchor for subsequent meaningful

learning. Concept map is a useful tool for organizing and visually representing interrelated structure of concepts within a domain of knowledge. Concept mappings are very useful tools for helping pupils learn about the structure of knowledge, and tie new knowledge to current experience. They are valuable tools for stimulating pupils‟ thinking process and representing knowledge in meaningful learning patterns. Concept maps are also useful for cooperative learning, to make pupils support each other and strengthen their understanding of a subject matter, and as members of a group, to bring their thought processes to bear on the interpretation of concepts and relationships. In the learning of new ideas in science, concept mapping enhances pupils‟ achievement and improves their attitude. Danmole and Femi-Adeote (2004) found out that when concept mapping approach is employed in the teaching and learning of science at the basic level, it helps to reduce rote learning, and again help the teacher to negotiate meaning with pupils.

2.6.8 Cooperative learning

This is another form of collaborative learning technique that permits pupils to benefit from one another‟s abilities and knowledge as they interact in a small group within a non-imposing, non-threatening and non-competitive environment. Cooperative learning places emphasis on getting pupils to work together on a problem or task in small heterogeneous groups in order to achieve a common goal and support one another. Hartman and Glasgow (2002), working on cooperative learning among pupils observed that, pupils can work together to review a test or do a quiz, carry out a laboratory activity, solve a problem, or work on a project. Erinosho (2008) identified that cooperative strategies are useful in science teaching because it promotes positive interdependence spirit, face-to-face interaction, individual accountability, social skills,

and group learning process. Cooperative learning improves student achievement and enhances student enjoyment of and attitudes towards learning science. Cooperative learning works, because it is active, student centered and social (Johnson & Christensen, 2008). A cooperative learning activity might involve reading, writing, planning experiments, designing questions, or solving problems. This multi-layered approach toward student interaction with the content improves understanding and retention. Since, cooperative learning shifts emphasis from the instructor to the students, the latter have opportunities to build social support networks and to learn and practice many social skills, such as leadership, communication, inquiry, and respect for diversity (Cresswell, 2005). The development of social relationships and skills helps students to build confidence as learners and to build trust in their teammates. This leads to improved attitudes toward the subject and often to the retention of underrepresented populations in science programmes. Peer tutoring is a type of cooperative learning/instructional strategy. It is a personalized system of instruction which is learner rather than teacher-oriented.

2.6.9 An inquiry approach in teaching and learning of science

An understanding of the nature of science and scientific inquiry is crucial to defining the characteristics of scientifically literate persons. Bell et al. (2003) claim that developing scientific literacy for the citizens requires engaging learners in scientific inquiry for them to develop broad knowledge and understandings of the processes and nature of science.

Literature in science education describes three levels of inquiry-based teaching and learning. These include structured inquiry, guided inquiry and open inquiry (Colburn, 2000; Hackling & Fairbrother, 1996). Colburn describes **structured** inquiry as one

that involves the teacher engaging students in problem-solving activities and provides them with the procedures and materials to discover and generalize on their own from data collected.

Essentially, the approach prescribes what students are to observe and which data they are to collect. **Guided** inquiry on the other hand involves the teacher providing only the materials and problem to investigate while the students manipulate the materials and solve the problem on their own. **Open** inquiry is similar to guided inquiry with the addition that students also formulate their own problem to investigate. Open inquiry in many ways, is analogous to doing science and a typical example of student open inquiry being the science fair or science talent search projects (Hackling, 1998; Hackling & Fairbrother, 1996).

Thus the inquiry-based approach helps to develop higher-level cognitive skills in learners and improves learning outcomes among students.

For the purpose of this study therefore, scientific inquiry could be referred to as an approach in which teachers create an enabling environment for students‟ curiosity and engage them in scientific investigations to solve problems that satisfy their ideas about the natural world.

2.6.10 Simulation

Simulation technique involves initiating activity that resembles real life situations in teaching certain science concepts and ideas. Simulation technique can take the form of a role-play, games, and models (Yardley-Matwiejczuc, 1997). According to Erinosho (2008), pupils could act as scientists in a situation that requires a decision or planning to solve problem through role-play and develop basic /generic skills in

pupils. Yardley Matwiejczuc (1997), has observed that games and role-play helps pupils to develop analytical, communication, and decision-making skills, as well as to build confidence in discussions on science issues.

2.7 Empirical Evidence

Related studies on the teaching of science were reviewed. One of these is; a study by Akinyemi and Orukata (1995) which revealed that the performance of Nigerian students in Ordinary Level Biology was generally poor. This was attributed by the authors to many factors of teaching, of which availability of teaching aids was considered as an important factor. In addition, Jegede, Okota and Eniayelu (1992), reported factors responsible for students‟ poor performance in science, technology and mathematics are poor laboratory facilities, inappropriate teaching methods and inadequate numbers of learning facilities in schools as against consistent increase in the number of students. Teachers‟ use of instructional materials in teaching is paramount to students‟ improvement in academic performance. Findings reveal that a good number of sampled schools lacked basic instructional aids; where they are available, they are too few to go round and often in bad shape. Ferguson (1992) carried out a study on the effect of instructional methodology on students‟ performance. These instructional methods he referred to as technical skills of teaching. At the end of the study, he found that only effective method(s) of teaching can bring about effective learning, hence teachers creative should be and dynamic in this regard to ensure that there is an increase in average students‟ performance in their subject areas. A study conducted by Parku (2012) on a survey of some aspects of the teaching and learning of integrated science in junior high schools in the Central Region, came out with the findings that majority of the integrated science teachers

had Senior Secondary School Certificate Examination/ West Africa Senior Secondary Certificate Examination and ordinary level certificates as their highest academic qualification. This was an indication that only few of the teachers have higher academic certificate such as diplomas, degrees and postgraduate degrees. It came out that a majority of the integrated science teachers were qualified professional teachers but few had degrees in either science or education. None of the teachers had Masters Degrees in either science or education. It was realized that more than 50% of them specialised in science related subject and only 9.5% specialized in integrated science. On professional development programmes participated by integrated science teacher, it was revealed that the majority of the integrated science teachers had not participated in any form of in-service training.

Dzieketey (2010) in his study on the factors that hindered integrated science practical lessons in some selected Senior High Schools in the Yilo and Manya Krobo District of the Eastern region of Ghana, concluded that most of the teachers (about 90%) considered the lecture method as an effective method of teaching integrated science. Baidoo (2010) in his study on the factors that militated against the teaching of integrated science at the senior high school level observed that 38.75% of the teachers he sampled used the demonstration method frequently, 48.75% used the discussion method, whilst 50% of the respondent used the practical and activity-based methods. Adongo (2011) in his study on the aspect of the state of teaching and learning science in the JHS in the Bolgatanga Municipality came out with some findings that the best teaching strategies for effective teaching and learning of science at the basic level of education is the activity method. Activity method encourages hand-on activity that enhances comprehension and supplement learning either by lecture which is a

traditional way of teaching. He also indicated that most teachers teaching science at the basic level did not specialized in science during their training and therefore had no requisite skills and knowledge area of specialization and teaching strategies. From the above reviewed literature, it could be realised that some factors influence the quality of teaching and learning of science and pupils‟ performance in an educational institution. It is therefore important that school authorities and administrators should take the necessary measure to curb the situation by frequently giving professional training to teachers and also providing teaching and learning resources for use in the various institutions.

2.8.0 Importance of Teaching and Learning Materials

According to Lewis (2015), teaching and learning materials broadly refer to a spectrum of educational materials that teachers use in the classroom to support specific learning objectives as set out in lesson plans. Teaching and learning materials may be defined to include materials which can be seen or heard and contribute to the teaching and learning process.

Francis (2003) also defined teaching and learning materials as items or object in their natural state or manufactured state that a teacher uses in his or her teachings to make teaching and learning easier, more effective and meaningful. This study continued that teaching and learning materials enhanced understanding of a lesson. Thus, learners are able to recall or remember what they learn when teaching and learning materials are used in lesson.

Learning is done through five senses. Any medium which gives learners the opportunity to use as many senses as possible is the best medium of learning (Atiku,

2004). Teaching and learning materials save the teacher the trouble of explaining at length hence the teacher talks less. Teaching and learning materials save the teacher the trouble of explaining at length hence the teacher talks less. Teaching and learning materials also arouse the interest of the students in what is being taught and make understanding easier.

Awoyemi (2001) mentioned that the use of materials serves as focal point around which the teacher revolves for teaching. Teaching and learning materials attract learners‟ attention, invokes co-operation, supplement description and explain concepts. The use of teaching and learning materials in lesson delivery brings variety, curiosity and interest among learners to assist recall. Students tend to forget what they hear than what they see.

Etsey (2005) posited that teaching and learning materials stimulate ideas, demand an active response from the learners and provide enjoyment of science (integrated science) lessons. Again integrated science lessons become livelier and more understandable and grasping of the major concepts becomes easier. The use of teaching and learning materials must be encouraged in the learning process because it actually allows students to understand what is being taught. More so, instructional materials are very important because what students hear can easily be forgotten but what they see cannot be easily forgotten and last longer in their memory. In the contribution of Abimbola (2003) to the importance of instructional materials to the teaching and learning process, he stressed that the primary purpose of instructional materials is to make teaching and learning more effective and also facilitate it.

Anamuah-Mensah (2002) also noted that the absence of requisite teaching and learning resources might lead to stunted growth in science education and this might make teachers and students to face great frustration in the classroom. Teaching aids makes it possible for the subject to be presented on a logical and systematic manner provided it is carefully planned and prepared. Teaching and learning materials also help to overcome the limitation of the classroom teaching by making the inaccessible in the classroom rather accessible. As the teaching aids help the teacher to clarify the subject matter more easily, they also motivate learners so that they can learn better. In addition to the above, teaching aids open students to realism of concepts and help them to conceptualize and internalize scientific principles. Thus, they help in making lessons meaningful and more understanding because a good picture is worth a thousand words. Moreover, teaching aids have the capacity to motivate learners to use more of their senses to make learning take place at a greater pace. This goes a long way to enhance their observation as well as to manipulate skills.

As explained above, it can be concluded that learners‟ understanding of concepts in science for that matter biology, depends largely on effective utilization of the appropriate resources or materials during teaching and learning process.

Among the devices used are the physical environment, pictures, text books, computers and overhead projectors.

2.8.1 The physical environment

The physical environment can be considered as a resource place. That is, there are a lot of materials that could be found in the environment and can be used as teaching aids. The environment contains things like plants, animals, pieces of paper, electrical

connecting cables, electrical transformers, and empty tins as well as other materials which teachers can use to support the teaching and learning process. Teachers could also make use of public libraries, museums and educational parks.

2.8.2 Pictures

Pictures can be displayed on classroom board for learners to observe during the lesson or after related lessons. The use of pictures during instruction helps to improve the power of perception of learners.

A good picture is better than thousand words of verbal explanation. Without pictures, the teacher may be forced to use crude translation and unnecessary examples which may mislead and confuse the students. Educational pictures can always be obtained from calendars, books and newspapers for use in the teaching process.

2.8.3 Textbooks

Textbooks have a huge role to play and should provide the core elements in the teaching and learning process. Quality textbook when used as teaching and learning material, helps develop students' critical thinking and other generic skills through the information and activities that they provide. Textbooks can also assist teachers by providing a 'one-stop' shop for materials that will help them to plan the scope and sequence of their teaching.

2.8.4 Overhead projector

The overhead projector is one of the teaching machines that are used for visual communication. It helps to ensure verbal communication and comprehension of concepts. The overhead projector can be used to perform almost all the functions of the traditional chalkboard or whiteboard. The advantage of the overhead projector is

that the teacher can stand in front of the class to make his or her presentation while at the same time facing the class and even demonstrating on the board. It can also make certain biological explanations like the feeding behavior of insects visible to students when connected any video device or computer. As a result, abstract can simply be explained to the understanding of students making biology lessons realistic.

Teaching aids should have certain good qualities to enable them carry the message that is intended to carry to learners.

Some of good qualities of teaching aids are:

i. Teaching and learning materials should be able to provide the right information in the learning process.
ii. The size of the teaching aid should be large enough to be seen by all learners.
iii. Audio materials such as television or tape recorders should be clear and audible.
iv. Teaching aids should be able to motivate students and maintain students‟ interest throughout the lesson.
v. Teaching and learning materials should be free from bias. They should not be deceitful or misleading through omission. They should be appropriate for the age, culture and topic as well as the educational philosophy of the nation. It must show neutrality in gender related issues.
vi. The material should be durable and affordable.

The availability and use of teaching and learning materials affect teachers‟ motivation and the effectiveness of their lessons as well. Furthermore, the effectiveness of teachers‟ lessons may be a determiner of an improved academic performance. The use

of appropriate teaching and learning materials in a teacher‟s lesson makes the lesson more practical and well connected to the students‟ environment.

2.9 Importance of Science Practical Work in Teaching and Learning of Integrated Science

Theories describe a well-verified body of abstract knowledge that has a large number of practical applications. Practical work can help students develop a better understanding of and principles as a result of concrete experiences. Science practical work leaves a lasting impression on students. Teaching materials are described as aids materials used in teaching for illustrative purposes. Its ultimate goal is to facilitate and demonstrate an understanding of a lesson (Amoatey, 2000) Teaching and learning materials may be defined to include materials which can be seen or heard and contribute to the teaching and learning process. Learning is done through the use of five senses. Any medium which gives learners the opportunity to use many senses as possible is the best medium in learning (Atiku, 2004).

Practical work enhances concepts development and promotes scientific attitudes. It also breaks up the instructional period, which limit the amount of lecturing and adds a variety to the course. Sometimes, it is to link theory with practice, or to cultivate a scientific spirit in the students. If properly put to good use, it could lead to the acquisition of practical skills like planning, performing, observing and reasoning. Hence the major purposes of science practical work include the cultivation of science methods and the development of scientific attitudes.

Practical work motivates students to appreciate the distinction between science practical activities and the application of science and technology to real life cases.

Practical work helps students to develop the ability to use one or more science process skills. It can also be used to improve students‟ awareness and competence in using skills that are related to scientific reasoning. Science practical/laboratory work engages students in „finding out‟ and‟ learning how‟ through first-hand experience. It is an integral part of good science teaching, which involves students in the scientific enterprise-questioning, observing, classifying, gathering data, explaining, experimenting etc. This type of work permits students to plan and to participate in investigation or to take part in activities that will help them improve their manipulative skills Practical work would help improve students‟ manipulative skills. Practical work including hands-on activities, scientific inquiries, or experiments, always cited as the most powerful approach to helping students understand scientific knowledge.

2.10 Students Attitude towards Integrated Science

Learning a course is more complex than merely remembering what student have read or been told, students do not necessarily learn by one explaining to them how to solve a problem. In fact, it is frustrating to work out a problem elegantly, explaining all the steps clearly, and then find out that hardly any of the students has mastered the steps.

What happens in a particular course can be viewed as an interaction between the teacher‟s goals for what students should learn, views of students‟ characteristics and abilities, theory of how students learn, and assumptions about how students should be taught. Today, this is the guiding theory for much research and reform in ICT education.

Constructivists view students as bringing to the classroom their own ideas rather than „receiving" materials in class as it is given, students restructure the new information to fit into their own cognitive frameworks. The learner-centered teaching approach observed in Junior High School science classrooms was „question and answer method" with the teachers always asking or posing the questions and the pupils supplying the answers.

Cognitive research has shown that learners construct knowledge and that the knowledge they already possess affects their ability to learn new knowledge. If new knowledge conflicts with prior what will be taught. To ignore learners" prior knowledge will most likely mean that the message intended by the teacher will not be the message understood by the students.

According to Talabi (2007), students tend to remember more what they see, hear and touch. Instructional materials create interest which helps reinforce students" interaction with learning experience as the Chinese proverbs says what I see, I remember.

Instructional strategies that help students construct knowledge for themselves work better than strategies that keep learner"s passive. Approaches where students discuss science, do science, teach each other science, and offer problem-solving strategies for evaluation by their peers facilitate construction of science knowledge. This is not to say that lecturing should be abolished. Research suggests that students can reap significant benefits from lecturers, after they have been primed to learn from them.

There are numerous studies confirming that boys have greater interest in many aspects of science than girls have, with boys performing better than girls in most of

the sciences, and Physics in particular, has been bad (Avotri et al., 2000). This affects the readiness of the student to learn Physics. Attitude as explained by Hug, Krajcik, and Marx (2005) is a mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related. From this definition, it is obvious that the attitude of the student plays an important role in learning. It is imperative that teachers of Integrated Science should inculcate good attitude in the learners towards the subject so as to make them ready to learn the subject. It is recommended that science teachers should use a variety of teaching methods to sustain their learners‟ interest during lesson delivery.

Most students perceive integrated to be a very difficult subject that has led to the poor performance in the subject. Although, the study of science in general may be complex, yet it is very important, not only to those who are interested in science-related careers, but also to every individual living today and to those who will be born in the future. Science is a key in developing new products and improving those on which we have become dependent. Most students find science difficult and physical sciences such as chemistry and physics are especially problematic. Many students are doing a given subject, say integrated science, not by choice but because it is required as part of the program they pursue. Such students have low interest towards studying integrated science.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter explains the research methodology used in this study. It begins with the description of the research design, followed by population, sample and sampling techniques and the research instruments. Validity and reliability of the instruments, as well as the data collection procedure and data analysis are discussed.

3.1 Research Design

This study used the descriptive survey design to which gives a clear picture about the status and quality of senior high school integrated science teaching and learning in Central Region of Ghana. The purpose of the descriptive survey research was to enable the researcher to observe, describe, and document aspects of situations as they occurred naturally (Amedahe &Asamoah, 2001). According to Fraenkel, Wallen and Hyun (2012), a survey collects information from a group of people in order to describe some characteristics (such as abilities, opinions, attitudes, beliefs, and or knowledge) of the population of which that group is a part of. Information in a survey can mainly be collected through asking questions; the responses to these questions by the subjects constitute the data for the study. Surveys are usually used to collect a large amount of data, for example, questionnaires, test scores, and results of public examinations etc. may be used in surveys, and all of these enable comparisons to be made over time or between groups. This design has the advantages of producing good number of responses from a whole range of people, being less expensive, producing findings more quickly and is more likely to get the cooperation of respondents since data is collected at only one point in time. Also, this approach made it possible for the

researcher to measure the reactions of many respondents to a limited set of questions, and therefore facilitated the comparison and statistical aggregation of the data (Kumekpor, 2002; Patton, 2002). The study utilized the descriptive survey design. Both quantitative and qualitative data gathering approaches were used to investigate the status and quality of integrated science in the selected senior high schools in the central region. This enabled triangulation of data to increase the quality and validity of findings especially as advocated by Patton (2002) and Creswell (2009).

The qualitative research methods enabled the investigator to gain an insight into the teaching and learning of integrated science in the classroom. Descriptive statistics such as frequency and percentages were employed to ascertain the prevailing conditions in the teaching and learning of science. Three instruments (observation, questionnaires and interviews) were used to collect data for the study. The use of the descriptive survey design enabled the researcher to tap the views of a greater variety of research subjects and over a wider research area than would have been possible with a single case study.

The survey questionnaire used in this study included both close-ended and open-ended items. The closed ended questions provided the advantage of generating frequencies of responses that are easy to code and analyse statistically (Cohen et al., 2007) while the open- ended questions gave respondents the opportunity to freely express their honest and personal comments providing information that otherwise might not have been provided by answers to the close-ended questions.

These are the procedural steps taken in the research. First and foremost, the questionnaires were designed. The items in the questionnaire were focused on what is

actually perceived as quality integrated science education in Ghana, and trying to compare that to what is presented in the real educational certain. Secondly, the questionnaires were piloted and fine-tuned and subsequently used to collect data from students and teachers. The data collected was then analyzed and conclusions drawn based on the findings.

3.2 Population and Sampling Procedures

The population of a study is the group that conform to a specific criterion and to which the researcher will like to generalize the result of the study (Fraenkel et al., 2012). A target population is classified as all the members of a given group to which the investigation is related, whereas the accessible population is looked at in terms of those elements in the target population within the reach of the researcher (Pole & Lampard, 2002). The target population for the study is made up of form three students in selected Senior High Schools and teachers who taught integrated science in the SHS of the Central Region. Fraenkel et al. (2012) explain accessible population to be the population to which the researcher is able to generalize findings results of the study. The accessible population in this study was some integrated science teachers and the selected form three students in the selected SHS in the Central Region of Ghana. The convenience sampling technique was used to select the six schools. Convenience sampling is a kind of non-probability or non-random sampling in which members of the target population, as Dörnyei (2007) mentions, are selected for the purpose of the study if they meet certain practical criteria, such as geographical, proximity, availability at a certain time, easy accessibility, or the willingness to volunteer.

The researcher considered 80 integrated science teachers from the six selected schools, a maximum of 15 integrated science teachers from each school to form the sample. The simple random technique was also used to select form 300 SHS students. Fifty students from each SHS formed the sample. The schools were selected from central region of Ghana because of its proximity and ease of access to the researcher.

3.3 Instrumentation

The three main instruments were used to collect data for this study. These include questionnaire for student, questionnaire for teachers and laboratory. These were combined and it is most suitable for purposes of triangulation. As Cohen, Manion and Morrison (2007) state, triangulation is the use of two or more methods of data collection techniques in a study while Brenner and Marsh (1985) asserted that triangulation techniques in social sciences attempt to map out or explain more fully, the richness and complexity of human behaviour by studying it from more than one standpoint.

3.3.1 Student questionnaire on the status and quality of integrated science teaching and learning

This questionnaire was used in this survey to secure information from the SHS3 students on how they integrated science is been thought and how they perceive and value the value of the content thought. The Student Questionnaire on the Status and Quality of integrated Science Teaching and Learning was carefully constructed to solicit for the students concern about how the subject is thought. The first section collected respondents‟ biographic data. The second section consisting of 10 items focused on how often those practices happen in the integrated science class. The third

section consisting of 4 items sought to collect data on what practices students perceive as thing that improve performance in integrated science. The last section grants the respondents the opportunity to explain how the study of integrated science could be improved and how will the study of integrated science help you now or in the future.

To respond to the items, the respondents were required to indicate their perception of understanding of each of the listed topics on a four (4) point Likert scale. The scales were: All the time. Most of the time, some of the time, not often and never for the section one (1) and strongly agree, agree, somehow disagree and strongly disagree formed the section two (2).

3.3.2 Teachers questionnaire on the status and quality of integrated science teaching and learning

This questionnaire was used to secure information from the SHS integrated science teachers on their perception of the status and quality of teaching and learning of integrated science. The teachers‟ questionnaire, which was similar to the student questionnaire included both closed-ended and open-ended items. The teachers‟ instrument was also made up of three sections; the first section sought information on teachers‟ biographic data as well as their educational background and teaching experience. The second section consisting of 5 items sought to find out **ideal** science lesson and a typical one of **their** Integrated Science **period of 60 minutes** and determine the relative amount of time spent on the following tasks. The teachers rated the section in percentage (%). The third section consisting of three folds which grants the teachers the privilege to express views about quality science teaching and learning. To respond to the items, four (4) point Likert scale, strongly agree, agree, disagree and strongly disagree were given. Teachers were made to tick the box to

show how often these things should happen under ideal circumstances. The final aspect of the section three also talked about assessments practices in Integrated Science teaching. This was also expressed in percentages.

The section four had to do with what teachers perceived as factors that limit the quality of integrated science teaching and suggested ways to improve the situation.

3.3.3 Laboratory checklist

The laboratory checklist was used by the researcher to investigate the Resources and facilities for teaching and learning Integrated Science in the various senior high schools in the region. The laboratory checklist was made up of two sections, the first section demanded a yes or no response and the other part demanded teachers used good, satisfactory and the explain how often and effective the laboratory facilities and resources were been used.

3.3.4 Validity of the instruments

While earlier definitions of validity were based on the view that it was the ability of an instrument to measure what it is designed to measure, a more accurate definition of validity is based on the defensibility of the inference‟s researchers make from the data collected through the use of the instrument (Cohen et al., 2007; Fraenkel et al., 2012). Expert judgment of senior members in the field of science education was sought on the content and face validities of the instrument. To ensure the face and content validity of the instruments, the instruments were given to the research supervisor and some teachers to read through, to determine the content validity, identify any ambiguities and also make the necessary clarifications to items. This was to ensure whether the items reflected the intent of the instruments. Some items were removed

after a thorough review by the supervisors. The comments and suggestions from the experts were used in restructuring the items. To ensure the validity of the instrument, the factors that contribute to low validity such as unclear directions, and ambiguities in language were eliminated. The questionnaires were also pilot tested. The pilot test was done specifically to help in checking the clarity of the items, give feedback on internal validity of the items and to ensure appropriateness of the data. For example, after the pilot testing, the researcher discovered that the questions in the section four of the student questionnaire, which requested that students state four way the teaching and learning of integrated science could be improve and how they think the study of integrated science would help them now or in the future were tedious of a work to most students so the numbers were reduced to two each.

3.3.5 Reliability of the instrument

Reliability refers to how consistent the scores obtained using an instrument are for each individual; from one administration of the instrument to another and from one set of items to another (Fraenkel et al, 2012). The data from the pilot test were used to test the internal consistency of the questionnaire.

To ensure the reliability of the research instruments, the interviews as well as the laboratory investigation were carried out on three different occasions in each of the ten sampled schools. To determine the reliability of the questionnaire for both students and teachers pilot test was conducted in one of the SHS in the Central Region of Ghana. The reliability of the teachers,, questionnaire was determined to be 0.69 and that of the students,, questionnaire was 0.75. According to George and Mallery (2003) a reliability coefficient of 0.70 or greater is acceptable for research purposes. The

above reliability coefficient estimates indicated that the instruments used for the study were reliable.

3.4 Data Collection Procedure

Before the data collection began, the researcher used one week to visit each of the selected schools to meet the selected teachers and students. An introductory letter was taken from the science department to the heads of the selected senior high schools to seek their permission to undertake the study in their schools. The visits were meant to enable the researcher establish rapport with all the respondents. The familiarization was done to enable the researcher explain the purpose of the study to the respondents and to elicit their maximum co-operation so that the objectives of the study could be achieved.

The researcher administered the questionnaire personally to the sampled teachers and students under study. The student respondents were put in classrooms and the purpose and relevance of the study were explained to all the respondents involved in the study immediately after the selection of the respondents. Respondents were given the opportunity to opt out if they did not want to be part of the study and also given the opportunity to ask the researcher to clarify issues concerning the study which were not clear to them. The instruments were then administered to the student respondents.

This was to ensure that the questionnaire got to the actual targeted respondents. These questions were then answered instantly for the researcher to collect. Two integrated science teachers and 5 students e each from all the ten schools was interviewed.

3.5 Data Analysis Procedure

The process of making data gathered in a study simpler in order to make it understandable is known as data analysis (Fraenkel & Wallen, 2003). The research questions were used to guide the analysis of the data. That is, the data was analyzed to answer the research questions. The data was organized and various number codes were assigned to each distinctive variable such as age, gender among others for students and also gender, age range, academic qualification among others with respect to teachers. For each item on the questionnaires, code numbers were assigned to the Likert scale. The five point Likert scale in section two and three of both the students" questionnaire were collapsed into 3 point scales with „strongly agree" and „agree" put together as „agree" and assigned a number code of 3, „somehow" was assigned 2, and „disagree" and „strongly disagree" were grouped as „disagree" and assigned a code of 1. For the section two of teachers" questionnaire, the percentages were compressed into 4 points „very good" for 80% to100%, „good" for 60% to 79%, „average" for 40% to 59% and „poor for" less than 40%. „very good" was coded as 4, „good" coded as 3, „average" coded as 2 and „poor" was also coded as 1. The 5 point Likert scale for sections three and four of the teachers" questionnaire was collapsed to 3 with „strongly agree" and „agree" grouped as „agree" which was assigned a number code of 3, sometimes was assigned a number code of 2, while „strongly disagree" and „disagree" were grouped as „disagree" and assigned a number code of 1.The coded data was fed into the Statistical Package for the Social Sciences (SPSS) computer software version 20 for analysis. Data was processed into frequencies and percentages. This was done to ensure clear description of gender, perception of students and perception of

teachers. Tables of frequencies and percentages obtained with the aid of SPSS were used to answer the research questions descriptively.

In addition to that, frequency count (percentages) was also the open ended questions in both the students‟ questionnaire and teachers‟ questionnaire. The details of the data analysis are presented in the next chapter (Chapter four).

3.6 Data Analysis

The process of making data gathered in a study simpler in order to make it understandable is known as data analysis (Fraenkel & Wallen, 2003). The research questions were used to guide the analysis of the data. That is, the data was analyzed to answer the research questions. The data was organized and various number codes were assigned to each distinctive variable such as age, gender among others for students and also gender, age range, academic qualification among others with respect to teachers. Data collected through interview and laboratory checklist were subjected to narrative descriptions in answer to the various research questionnaire. The data collected through the administration of questionnaire were first coded and the SPSS version 16.0 enhance the analysis. The frequency counts of the coded data were taken after which they were converted into percentages and used to answer the research questions.

3.7. Background information of respondents

The section A of the Teachers Questionnaire on the Status and Quality of Integrated Science Teaching and Learning sought to look for relevant information about the teachers‟ background. It was required that respondents indicated their background

information. These were collected in terms of frequencies and percentages and presented in Table 3.1.

3.7.1 Sex and Age Distribution of Respondents

Tables 1 showed the gender distribution of the teachers.

Table 3.1: Sex Distribution of Teachers

Sex	Frequency	Percentage
Male	56	70
Female	24	30
Total	**80**	**100**

It is observed from Table 1 that the teachers have a higher male population than female population. Out of the total number of respondents, 56 (70.00%) were males while female counterparts were 22 (30.00%).

3.7.2: Sex Distribution of Students

Tables 3.2 shows the gender distribution of the students.

Table 3.2 Sex Distribution of Students

Sex	Frequency	Percentage
Male	156	52
Female	144	48
Total	**300**	**100**

It is observed from Table 2 that out of a total number of 300 respondents, 156 (52.00%) were males while female counterparts were 144 (48.00%).

3.7.3 Age Distribution of Students

Tables 3.3 shows the age distribution of the students.

Table 3.3: Age Distribution of students

Age	**Frequency**	**Percentage**
Below 18	121	40.30
18 and above	179	59.70
Total	**300**	**100.00**

It is observed from Table 3 that out of a total number of three hundred (300) respondents, 121 (40.30%) were aged below 18 while 179 (59.70%) were age 18 years and above.

CHAPTER FOUR

PRESENTATION OF RESULTS

4.0 Overview

This chapter deals with the presentation and of the results from this study. The results are presented, based on the research questions.

4.2: Research Question 1: What is the level of qualification and experience of integrated science teachers in senior high schools?

The level of qualification and experience of the integrated science teachers are a key determinant of the academic outcome of the students.

4.2.1: Distribution of Teacher academic qualification

Section A of the teachers‟ questionnaire contained items that sought to elicit responses about teachers‟ qualification and experience of integrated science teaching, specialisation and number of years taught (experience). The type of degree held by teachers are captured under Table 4.1.

Table 4.1: Type of Degree Held by Teachers

Qualification	Frequency	Percentages (%)
Bachelor Degree in Science Education	39	48.8
Bachelor Degree without Education	21	26.3
Post Graduate Degree in Science Education	09	11.3
Post Graduate Degree without Education	11	13.7
Total	**80**	**100.0**

From Table 4.1, it can be seen a considerable number of students (39) representing 48.8% of the teacher sample had a Bachelor degree in science education and 21 teachers (26.3%) had no education component in their Bachelor degree. Also 20 teachers which is 11.3% had further pursued a post graduate programmes in education and are certified, some other 11 teachers representing 13.7% have had a post graduate certificate but not in science education.

Although a simple majority had education component in their preparation as teachers, the number of teachers who do not have teacher education skills, hence nonprofessional teacher, cannot be overlooked. Table 5 below indicates teachers‟ specialities in terms of subject areas.

Table 4.2: Teacher Specialised Subject Area

Specialisation	Frequency	Percentage (%)
Biology	26	32.5
Integrated Science	16	20.0
Agricultural Science	20	25.0
Chemistry	9	11.3
Physics	5	6.3
Others	4	5.0
Total	**80**	**100**

From the Table 4.2 above, 31% of the teachers (26) have Biology as their area of specialization, also 20 teachers that is 25.0% did a degree programme in Agricultural Science. The result also indicated that 11.3% and 6.3% also specialized in Chemistry and Physics respectively. Additional 4 teachers, thus 5.0% also specialized in other science related programme that is not captured in the table 4.1 above. Only few proportions of the sample teachers (16) representing 20.0% specialised in integrated science education. It could be inferred that few minorities of the teacher who teach integrated science specialised in the area of integrated science.

In the case teaching experience, as show in Table 4.3.

Table 4.3: Number of Years Taught

Number of years taught	Frequency	Percentage
Less than 5	14	17.5
5-10	50	62.5
11-15	11	13.8
Above 15	5	6.3
Total	**80**	**100**

It was observed that only 14 teachers (17.5%) had taught for less than 5 years, 62.5% of the teacher have between 5years and 10years, eleven teachers, representing 13.8% had taught for at least 11 year and at most 15 years and 5 teachers, thus 6.3% had taught integrated science for more than 15years. It could be inferred that less than one quarter (17.5%) of those teachers have had less than 5years integrated science teaching experience. This shows that most of the teachers (82.5%) have taught for at least 5 years or more. This shows that most of the teachers were very experienced.

4.3: Research Question 2: What are the instructional methods used for teaching Integrated Science?

The question sought to find out the common teaching methods used by teachers during integrated science lessons. Teacher were required to select at least two teaching methods which they thought would be most effective and preferred instructional approach of teaching and learning of integrated science in an ideal integrated science class within the time allocated (60 minutes per period).

The response offered by teachers are presented under Table 4.4.

Table 4.4: Teaching Methods used by Teachers

Teaching methods	Response	Percentages (%)
Teacher demonstration	31	38.75
Class discussion method	39	48.75
Teacher giving notes to students	09	11.25
Students working individually including working from the textbook.	42	52.50
Students doing practical and activity work in small groups.	40	50.00

The Table 4.4 deals with the presentation of results from teachers who taught the science lesson period of 60 minutes and what teaching method teachers mostly use in class.

Thirty-one (31) out of the eight (80), representing 38.75% teachers selected demonstration method as their preferred instructional approach. 48.75%, that is thirty-nine (39) of the teachers also stated that they prefer classroom discussion to the rest of the approaches, attributing reasons to the time allocated. Very few (11.25%) were of the opinion that teacher should copy notes for students during the classroom teaching and learning process.

Also, some of the teachers (39) representing 48.75% would combine classroom discussion with any one of the above listed approaches. Fairly, a number of teachers (31) that is 38.75% would use at least demonstration and one other teaching method in integrated science lessons.

Only 9 of them (11.25%) are insisting on the use of traditional note copying approach.

The views of teacher of teachers on how integrated science should be taught was sought. Under Table 4.5 are responses captured from teachers on issue.

Table 4.5: Teachers' Idea of how Integrated should be Taught

Statement	AT(%)	NV(%)
1. Students must carefully follow the teacher"s instructions for experiment to reach the correct conclusions	65(81.30)	15(18.80)
2. Students" existing knowledge is assessed to guide lesson planning	64(80.00)	16(20.00)
3. Students develop the skills which allow them to think independently	10(12.50)	70(87.50)
4. Teachers have knowledge and skills of teaching by inquiry	65(81.30)	15(18.80)
5. There is sufficient time to explain topics in depth	16(20.00)	64(80.00)
6. There is enough time allocated to discuss the main findings after practical work	10(12.50)	70(87.50)
7. We cover a lot of content to complete the syllabus	4(5.00)	76(95.00)

The four-point Likert scale were collapsed to only two points. The points "All the Time" and "Most of the Time" were kept as "**All the Time" (AT).** Also the points

"Not Often" and "Never" were kept as **"Never" (NV).** All 80 teachers responded to the seven items.

It can be seen that a considerable number of teachers (65) representing 81.3% of the teachers agreed that students must carefully follow the teacher"s instructions for experiment to reach the correct conclusions. Few (18.8%), of them, believe otherwise. The difference between the number of students who agreed that and those who disagreed is large so it can be inferred that most of the teacher sample understand that students must carefully follow the teacher"s instructions for experiment to reach the correct conclusions.

Also 80% of the teacher stated that students" existing knowledge is assessed to guide lesson planning. Only 20% of the teacher did no attribute the students existing knowledge as a requirement during the lesson planning. Because there was a huge difference but the teachers who agreed to those whose disagree, it can be inferred that most of the teachers consider the students pre-existing knowledge and factor them during lesson planning.

According to the result of this research, only 10 teachers representing 12.5% said that students develop the skills which allow them to think independently. Seventy (70) teachers representing a 87.50% said most student are not able to develop the requisite skill that will enable develop skill which allow them think independently.

4.4: Research question 3: What are the attitudes of students toward the learning of Integrated Science?

The question tried to find out the attitude of students towards integrated science learning. The sections 2 and 3 of the students‟ questionnaire helped in answering this research question. Students‟ responses to items of questionnaire are indicated under Table 4.6**.**

Since the four-point Likert scale was collapsed to a two point, the points “All the Time” and “Most of the Time” were kept as “**All the Time” (AT).** Also, the points “Not Often” and “Never” were kept as **“Never” (NV).**

Table 4.6: Students' Attitudes towards Integrated Science

In my Integrated Science Class	AT(%)	NV(%)
1. I copy notes the teacher gives me.	198(66.00)	102(34.00)
2. I read science textbooks and form my own notes during my spare time	140(46.70)	160(53.30)
3. I ask questions on what is not clear to me during integrated science lessons	105(35.00)	195(65.00)
4. I get excited about what we do in integrated science class	190(63.30)	110(36.70)
5. I find integrated science interesting to learn	185(61.70)	115(38.70)
6. We work in groups	46(15.30)	254(84.70)
7. I carry out integrated science experiments with excitement	226(75.30)	74(24.70)
8. I feel sad when our integrated science teacher fails to come to class	276(92.00)	24(8.00)
9. Integrated science lessons deal with things I am concerned about	276(92.00)	24(8.00)
10. Science is related to my life	218(72.30)	82(27.70)

The first item was "I copy notes the teacher gives me". One hundred and ninety (198) of them, that is, 66.00% of the student said they copied notes. But one hundred and two (102) that is 34.00% also said they either do not copy not or even if they do they did not do that often. The minority of the students admitted they do not copy notes the

teacher gives, but number of those who responded otherwise (34.00%) cannot be easily over looked.

Again, the students were asked whether they read textbook and form their own note during their spare time. It was observed that 46.70%, of the students make integrated science notes for themselves and 53.30% of them did not make notes for themselves. Because more that 50% of the sampled students did not make their own notes, it could be inferred that their teachers were not encouraging them to read.

The third item sought information as to whether students ask questions to make concept clear during integrated science lessons. Only 105 students, representing 35.00% usually ask questions in class for clearer understanding, 195 students, thus, (65.00%) of the students did not ask questions.

Also, most of the students, 63.30%, were excited about what they did during integrated science lessons, whilst 36.67% of them did not enjoy what they did in integrated science classes. It can then be inferred that most of the student liked integrated science and, hence, had good attitude towards the subject.

Furthermore, one hundred and eighty-five (185) of the students, representing 61.70%, had interest in integrated science, the 115 (38.33%) of students had little interest in integrated science. It also showed that most of the student had interest in integrated science.

Most the student, 92.00% admitted that they were always not happy when their integrated science teacher fail the come to the class. Only 24.00% of them said otherwise.

The students were again asked about whether or not they perceive integrated science as a subject that deals with thing they were concerned with. The results showed that two hundred and seventy-six (276) students, representing 92.00% said the concepts taught during integrated science lesson are things they are concern about.

Finally, the last item of the student"s questionnaire was about the relationship between the integrated science concept and their real life. Approximately 72.30% thus, 218 of the students agreed that the concept they learn in integrated science has a relationship with their real life. The rest of 28.00% did not agree to that.

Students were asked to indicate what they think will enable them do well in integrated science class. The results are displayed under Table 10.

Table 4.7: Students' Opinion of what Helps them do well in Class

Statement	AG (%)	DA (%)
1. I remember lots of facts taught	191(63.70)	109(36.30)
2. I understand and can explain science ideas	120(40.00)	180(60.00)
3. I apply science to understand things in my life	73(24.20)	127(75.80)

The first item sought to investigate as to whether or no students are able to remember a lot of facts or not. Majority (63.70%) of the students said they were able to remember facts. It was also noted that 120 of the students, that is 40.00%, said they understand scientific ideas but only 24.20% could applied the scientific concept taught in integrated science lessons to life situations.

4.5 Research Question 4: What resources are available for science teaching and learning in Senior High Schools in Ghana?

This question sought to find out the available resources in the laboratories for practical work.

4.5.1 Available Laboratory Resources and Facilities

The section A of the laboratory checklist on the Status and Quality of Integrated Science Teaching and Learning sought to obtain information on human resources and facilities in the various laboratories. It was required that respondents indicated whether or not their school has the stated resource. In cases where the resources were available, its adequacy was also indicated. The data were collected in terms of frequencies and presented in percentages.

See Table 4.8 for details.

Table 4.8: Laboratory Resources and Facilities Available in Schools

Resources and Facilities	Yes (%)	No (%)
(a) We have a laboratory assistant	1(16.67)	5(83.33)
(b) We have been performing practical experiment for integrated science in our school.	1(16.67)	5(83.33)

It was observed that only one out of the 6 selected schools had laboratory assistant. Also, only one school, that is, 16.67%, of the sample schools admitted that they perform integrated science practical at the laboratory.

4.5.2 Availability of Laboratory Equipment for Practical Work in Schools

The section B of the laboratory checklist sought to obtain information on the availability of relevant laboratory apparatus and textbooks for teaching integrated science. It was required that respondents indicated whether or not their school has the stated equipment. In cases where the equipment was available, its adequacy was also indicated. **"A"** was used to indicate the availability of the equipment, **"AD"** indicated that the equipment was adequate and **"IA"** indicated inadequacy.

The laboratory checklist has four subdivisions, thus, general laboratory equipment and the equipment in the various branches (biology, chemistry and physics) of laboratories

4.5.2.1 Availability of General Laboratory Equipment for practical work in schools

The Table 4.9 shows the availability of some general laboratory equipment in the science laboratories of the schools.

Table 4.9: Availability of General Laboratory Equipment in schools

General Laboratory Equipment and apparatus	AV(%)	AD(%)	IA(%)
1. Balance (electronic)	6(100.00)	2(33.33)	4(66.67)
2. Beaker	6(100.00)	1(16.67)	5(83.33)
3. Benson burner	6(100.00)	1(16.67)	5(83.33)
4. Centrifuge	5(83.33)	1(16.67)	4(66.67)
5. Flask (round, flat and conical)	6(100.00)	2(33.33)	4(66.67)
6. Gas gar	6(100.00)	1(16.67)	5(83.33)
7. Knife	6(100.00)	1(16.67)	5(83.33)
8. Measuring cylinder	6(100.00)	1(16.67)	5(83.33)
9. Stirrers	6(100.00)	1(16.67)	5(83.33)
10. Test tube	6(100.00)	2(33.33)	4(66.67)
11. Thermometer	6(100.00)	0(0.00)	6(100.00)
12. Tripod	6(100.00)	1(16.67)	5(83.33)
13. Water bath	6(100.00)	0(0.00)	6(100.00)
14. Wire gauze	4(66.67)	0(0.00)	4(66.67)
15. Hot plate	4(66.67)	0(0.00)	4(66.67)
16. Quality of the student textbook(s)	4(66.67)	0(0.00)	4(66.67)
17. Computer	5(83.33)	0(0.00)	5(83.33)

From Table 4.9**,** all six (6) schools admitted that they have laboratory apparatus such as electronic balance, beakers, Benson burners, flask (round, flat and conical), gas gar, knifes, measuring cylinder, stirrers, test tubes, thermometers, tripod stands and water baths.

Although the apparatus stated above were present in all six (6) schools, only one out of the 6 schools in each case, representing only 16.67% testified that they had equipment such as beakers, Benson burner, Gas gar, hot plates, knifes, measuring cylinders and tripod stands in adequacy. The rest of the five (5) schools in each case stated that they did have the above stated apparatus but not in adequacy.

Also 33.33% of the schools, that is, two (2) out of the sampled schools had electronic balances, flasks (round, flat and conical) and test tubes. Again, 3 school had burettes in adequacy.

In the same section, 5 out of the sample schools, that is, 83.33% had the apparatus such as, centrifuge and computers but only one (1) out of those 5 schools had adequate centrifuge and also none of the schools had adequate computers in their science laboratories.

Four schools stated that they were provided with quality text books as well as wire gauze, but none of the schools had them in adequate.

4.5.2.2 Availability of some Biology laboratory equipment for practical work in schools

Table 4.10 shows the availability of some laboratory equipment for biology in the science laboratories of the schools.

Table 4.10: Availability of Biology Laboratory Equipment in schools

Laboratory Equipment	AV(%)	AD(%)	IA(%)
1. Forceps	6(100.00)	1(16.67)	5(83.33)
2. Hand lens	6(100.00)	1(16.67)	5(83.33)
3. Microscopes	6(100.00)	0(0.00)	6(100.00)
4. Petri dish	6(100.00)	2(33.33)	4(66.67)

Information in Table 4.10 indicate that**,** all six (6) schools stated that they have laboratory apparatus such as forceps, hand lens, microscopes and Petri dishes. But in the cases of forceps ad had lens, only one school had them in adequacy, the rest of the five (5) school representing 83.33% did not have in adequacy.

All schools did not have enough microscopes for experimental purposes. Although all school stated that they have petri dishes, only two out of the six schools stated that they have enough petri dishes for integrated school practical works.

4.5.2.3 Availability of some Chemistry Laboratory Equipment for practical work in schools

Table 4.11 shows the availability of some laboratory equipment for chemistry in the science laboratories of the schools.

Table 4.11: Availability of Chemistry Laboratory Equipment in schools

Laboratory Equipment	AV (%)	AD (%)	IA (%)
1. Burette	6(100.00)	3(50.00)	3(50.00)
2. Fume hoods	6(100.00)	1(16.67)	5(83.33)
3. Pipette	6(100.00)	2(33.33)	4(66.67)
4. Supply of chemical reagent	6(100.00)	1(16.67)	5(83.33)

From table 4.11, all six schools indicated that they had burettes, fume hoods, pipettes and supply of chemical reagents. Only one out of the six school, had adequate fume hoods and supply of chemical reagents. The rest of the five school did not have adequacy of such apparatus in each case.

Two schools, representing 33% of the total sampled schools has adequate pipette for experiment and three schools had adequate burette for experimental purposes.

4.5.2.4 Availability of some Physics Laboratory Equipment for practical work in schools

The table 4.12 shows the availability of some laboratory equipment for physics in the science laboratories of the schools.

Table 4.12: Availability of Physics Laboratory Equipment in Schools

Laboratory Equipment	AV(%)	AD(%)	IA(%)
1. Balances (top pan, beam spring and chmical)	6(100.00)	0(0.00)	6(100.00)
2. Electrical components	6(100.00)	2(33.33)	4(66.67)
3. Length measuring instruments	6(100.00)	1(16.67)	5(83.33)

From the Table 4.12, although all six schools had balances (top pan, beam spring and chemical) none of the schools had in adequacy. Again, all six schools had electrical components, only two schools had adequate.

Length measuring instruments were also available in the laboratories of all school but only one school had adequate.

4.5.3 Available laboratory safety equipment

The Section C of the laboratory checklist on the Status and Quality of Integrated Science Teaching and Learning sought to obtain information on the availability of relevant laboratory equipment in their various science laboratories. It was required that respondents indicated whether or not their school has the specified safety equipment. In cases where that specific safety equipment was available. Its adequacy was also indicated. **"A"** was used to indicate the availability of the equipment, **"AD"** indicated that the equipment was adequate and **"IA"** indicated inadequacy. The data were collected in terms of frequencies and converted into percentages and presented in Table 4.13.

Table 4.13: Laboratory Safety Equipment in School

Safety Equipment	A(%)	AD(%)	IA(%)
1. Fire Extinguisher	2(33.33)	0(0.00)	2(33.33)
2. Helmet	1(16.67)	0(0.00)	1(16.67)
3. Gloves	3(50.00)	1(16.67)	2(33.33)
4. Goggles	3(50.00)	1(16.67)	2(33.33)

It is observed from Table 4.13 that out of the six schools only two, representing 33.33% had fire extinguishers at their science laboratories. But the quantities available were not adequate.

Also, only one school, thus, 16.67% had helmet at their science laboratory but that was also in adequate quantity. It was also observed that 50% of the schools had goggles and glove. One out of these three schools had adequate goggles and gloves.

CHAPTER FIVE

DISCUSSION OF RESULTS

5.0 Overview

The results presented above are discussed below using the research questions to guide the discussions.

5.1.1 Research Question 1: What are the Levels of Qualification and Experience of the Integrated Science Teachers in the selected Senior High Schools?

The study set out to find the level of qualification and experience of integrated science teachers in senior high schools. Findings with respect to the level of qualification, because some teachers were nonprofessional teacher. This might have influenced the status and quality of teaching and learning of integrated science.

The difference between the number of teachers who have at least a degree in education and those without education shows that every 4 out 10 randomly selected integrated science teacher are without education component in their certification.

Also, 31% of the teachers (26) have Biology as their area of specialisation, also 20 teachers that is 25.0% did a degree programme in Agricultural Science. The result also indicated that 11.3% and 6.3% also specialised in Chemistry and Physics respectively. Additional 4 teachers, thus 5.0% also specialized in other science related programme that is not captured in the table 4.1 above. Only few proportions of the sample teachers (16) representing 20.0% specialized in integrated science education. It could be inferred that few minorities of the teacher who teaches integrated science specialised in the area of integrated science.

This finding was similar to that reported by Parku (2012), a survey that showed that only few teachers of Integrated Science in the Central Region of Ghana in the junior high schools hold a Diploma or Degree in integrated science. According to Parku (2012) out of the 50% of the specialized teachers sampled, only 9.5% specialised in integrated science, a figure that is insignificant as far as integrated science is concerned. This issue must be addressed to ensure that the right personnel with integrated science background taught the subject to enhance effective learning process and a lifetime kownledge acquisition.

5.1.2 Research Question 2: What Instructional Methods are used for Teaching Integrated Science?

The research also focused on the predominant instructional approaches utilized during science lesson by teachers.

It could therefore be inferred from the tale 7 that, on the average every teacher, would use at less one of the follow teaching approaches during integrated science lessons

i. Students working individually including working from the textbook.
ii. Students doing practical and activity work in small groups.

Also, almost half of the teachers (39) representing 48.75% would combine classroom discussion with any one of the above listed approaches. Fairly, a number of teachers (31) that is 38.75% would use at least demonstration and one other teaching method in integrated science lessons. Not much of the teacher, only 9 of them (11.25%) are insisting on the use of traditional note copying approach.

Responses indicates that to make the teaching and learning of integrated science more meaningful and interesting, the use of varied teaching methodologies is very important.

Many teachers and students recommended that instead of teachers using only the lecture method in teaching integrated science, teachers should look at using more demonstrations, practical work in the laboratory, working in groups and classroom discussion. These methods if used will facilitate students‟ understanding of concepts and help them remember what has been taught better than if only the lecture method is used. Chiu (2005), confirms that conducting experimental activities helps in developing positive students‟ attitudes in learning integrated science. Practical work needs to essentially be about stimulating and challenging students to think and understand the relation between evidence and theory (Yunus & Ali, 2013) and students who learn by these inquiry approaches are responsible for developing their own answers to questions rather than exclusively relying on the teacher and or textbooks (Klopfer, Aikenhead & Robinsen, 2001).

It could also be inferred from Table 8 that most teachers use approaches that would enable them put students at the central point of the teaching and learning process. This is matches with international standards which recommend that teachers of science plan inquiry-based programmes for their students and should also interact with students to focus and support their inquiries, recognise individual differences and provide opportunities for all students to learn (Bencze, Alsop, & Bowen, 2009; Bybee, Carlson-Powell, & Trowbridge, 2008; Centre for Inspired Teaching, 2008). The findings also agree with the recommendation of teaching for effective learning where students take responsibility of their own learning through active construction

and reconstruction of their own meanings for concepts and phenomena (Borich, 2007).

From the Table 8 teachers were presented a four-point Likert scale where they ticked against the provided options whether or not the list practices were occurring in their actual integrated science classes. The four-point Likert scale was collapsed to two, where "All the Time" and "Most of the Time" were kept as "**All the Time" (AT).** Also, the points "Not Often" and "Never" were kept as **"Never" (NV).** All 80 teachers responded to the 7 items.

It could be seen that a considerable number of teachers (65) representing 81.3% of the teacher sample agreed that students must carefully follow the teacher‟s instructions for each experiment to produce the correct results. Few 18.8%, that is 15, believe otherwise. The difference between the number of students who agreed that and those who disagreed is large so it can be inferred that almost all the teacher sample understand that Students must carefully follow the teacher‟s instructions for experiment to reach the correct conclusions.

Also 80% of the teachers stated that the students‟ existing knowledge was assessed to guide lesson planning. Only 20% of the teacher did not considered the students‟ existing knowledge as a requirement for lesson planning. Because there was a huge difference between the teachers who agreed to those whose disagree, it can be inferred that most of the teachers consider the students‟ pre-existing knowledge and factor them in lesson planning.

According to the result of this research, only 10 teachers representing 12.5% said that Students develop the skills which allow them to think independently. Teachers

representing 87.50% said most student are not able to develop the requisite skill that will enable develop skill which allow them think independently. These reasons were given by some teachers for the students‟ inability to develop skill which allow them think independently.

1. Teacher factors

Some of the teachers attributed the inability of the students to develop skill which allow them think independently to the teaching methods of their teachers. While some complained that the teachers rushed through lessons, others said teachers only used the lecture method to teach without any practical work. It is important to note that a teacher‟s ability to explain concepts well using appropriate methods goes a long way to enhance students‟ understanding. Teachers not teaching into details, teachers not teaching all topics and teachers giving explanations which are different from what is in textbooks are some other reasons that students gave for their inability to develop skill which allow them think independently.

2. Student factors

Some teachers asserted that the lack of interest in studying integrated science on the side of the students accounted for their difficulty in developing skill which allow them think independently. There is a relationship between the students‟ interests and the items they considered difficult. This means that if a student does not have interest in a particular subject, they will not pay attention to that subject and will therefore find it difficult understanding the subject. Also, students‟ attitudes towards learning science related topics could also be a contributing factor for the difficulties they face in understanding the topics. For example, some students simply gave their reason for ot

studying as “laziness”, “I did not love studying science at junior high school so I hate reading integrated science”, “I did not put much effort into reading and researching”. With these negative attitudes towards learning, it is not surprising that some students find integrated science difficult since the effort you put into studying usually determines your level of understanding and performance.

Teachers attributed these characteristics to lack of confidence on the part of the students. Some teachers stated that only few General Science and Agricultural Science students showed some level of confidence. The majority of the non-science students exhibited high levels of lack of confidence. It could therefore be inferred that independency on the part of the students in the integrated science classrooms was almost absent. This was because teachers observed a very small proportion of their students as independent thinkers with respect to problem solving in integrated science classrooms.

3. Lack of teaching and learning materials

One major challenge identified by most of the teachers was the lack of textbooks with for students. Although there is abundance of SHS integrated textbooks on the market, students claimed the prices of these books were so high that they could not afford to buy them. Under the current free SHS policy of the government of Ghana, students are supplied with free textbooks for the core subjects. Teachers claim most of the books are scanty in content. Some of these textbooks could however be found at the schools‟ reference libraries but the quantities are not enough for all students to get access to them. This means that if a parent or student cannot afford to buy and supplementary textbook, the student will have to almost solely rely on notes given by teachers in class which might not be detailed enough.

The item number four of the Section B of teachers‟ questionnaire sought know whether Teachers have knowledge and skills of teaching by inquiry. These characteristics of teachers would aid the student to recapture their ability to think and solve problem independently. The result of this research showed that a greater majority of the teachers (65) representing 81.3% stated that they had the capacity to lead student to learning integrated science by inquiry. Only 18.8% of the sample teacher said they don‟t or have little knowledge of guiding the students towards inquiry learning. This mean that it could be inferred that teacher have the capacity to teach by inquiry.

The sufficiency of time allocated for explaining scientific concepts was also considered in the Section B of the teachers‟ questionnaire. Only 20.0% of the sample teacher accepted that they had sufficient time during teaching and learning. The greater portion of teachers (80.0%) that is 64 of the sampled teachers said the time allocated was not sufficient to enable the explanation of scientific concepts. It could be inferred that the time allocated for integrated science teaching and learning on the time-tables of most schools is sufficient.

The final item in the Section C of the teachers‟ questionnaire sought to gather information about content coverage by teachers in integrated science. Only 4 teachers, representing 5.0% of the sample teachers said they are able to complete syllabus. The greater 95.0% admitted that it always difficult to cover much of the syllabus within the time allocated. Almost all the sample teachers said they are not able to complete much within the time allocated.

It could be inferred that teacher are not able to complete the syllabus and that may negatively affect to quality of integrated science teaching and learning.

5.1.3 Research Question 3: What are the Attitudes of Students toward the Learning of Integrated Science?

Findings with respect to research question three showed attitudes of students towards the learning of integrated science. It was obvious that student‟s performance would increases as the number of activity-based strategies used in the lesson increases and students are put at the central part of the teaching and learning process.

The section 2 of the students‟ questionnaire collected information about students‟ practices during integrated science lessons. Since the four-point Likert scale was collapsed to a two point, the points “All the Time” and “Most of the Time” were kept as “**All the Time” (AT).** Also, the points “Not Often” and “Never” were kept as **“Never” (NV).** The first item was “I copy notes the teacher gives me”. The response of students showed that 198 of the students, that is, 66.00% of the student said they copied note. But 102 also said the either do not copy not or even if they do not do that often. Although minority of the students‟ samples admitted they do not copy note the teacher give, but their number 34.00% cannot be easily over looked. This may affect the performance of those student because, teacher questioned the availability and the adequacy of good integrated science. It could be inferred that those students do not take note in class are most like to possess limited revision items.

Again the students were asked whether they read textbook and form their own note during their spare times. It was observed that only 140, 46.70%, of the students make integrated science notes for themselves. 160 of the students, representing 53.30% did

not make note for themselves of do not often do so. Because more that 50% of the sampled students did not make their own not, it could be inferred that either teaches were not encouraging student to read. The teachers could have encouraged student through giving them more exercises (both in school and after school exercises) or the teachers did not give them more reading assignments.

Another reason may be laziness on the part of some students. Such students do very little after the instructional process in the class room. Teacher also need to encourage students to do this extra work to aid their pass rate.

The third item out of the nine sought information as to whether students ask questions to make concept clear during integrated science lessons. Only 105 students, representing 35.00% usually ask questions in class for clearer understanding. One hundred and ninety-five students, thus, 65.00% of the students did not ask question. From the data, it can be inferred that, most of the students do not ask question during integrated science lessons.

Also, most of the students, 63.30%, were excited about what they did during integrated science lessons. One hundred and ten out of the sampled students did not enjoy what they did in integrated science classes. It can then be inferred that most of the student liked integrated science and, hence, had good attitude towards the subject.

Furthermore, 185 of the students, representing 61.70%, had interest in integrated science, the 115 students saw little interest in integrated science. It also showed that most of the student had interest in integrated science. It could be inferred that the interest the students have in integrated science would motivate them to learn the

subject. So, teachers can do well to motivate student who have little interest in integrated science to develop interest in order to accelerate their performance.

Almost all the student, 92.00% admitted that they were always not happy when their integrated science teacher fails to come to the class. Only 24 out of the total sample said otherwise. It could therefore be inferred that the interest of the students towards science is positive

The students were again asked about whether or not they perceive integrated science as a subject that deals with thing they were concerned with. The results showed that 276 students, representing 92.00% said the concepts are thig they are concern about. It showed that the finding also agreed with Olusola and Rotimi (2012) who reported that students have positive attitude towards the study of physics in College of Education.

Finally, the last item of the section 2 of the student questionnaire was about the relationship between the integrated science concept and their real life. 72.30% thus, 218 about the sampled student agreed that the concept they learn in integrated science has a relationship with their real lift. The rest of 82, 27.7% did not agree to that. It was therefore concluded that the students are able to relate what they learn with their lives. This will enable them realise the worth of learning the subject and hence positively affect their attitude.

The section C of the students‟ questionnaire was about what the students perceive would enable them do well in integrated science class the Table 4.2.3 contains the results of the finding.

The first item sought to investigate as to whether or no students are able to remember a lot of facts or not. 63.70% of the sample students said they were able to remember

facts. It was also noted that 120 of the students, that is 40.00%, said they understand scientific ideas but only 24.20% could applied the scientific concept taught in integrated science lessons. It could therefore be inferred that most of the students who are able recall facts were not able to either understand or are not able to apply what they learn in integrated science lessons.

These results reaffirm the findings of the study by Blake, Hosokawa and Riley (2000), who agreed that students who were taught through activity-based learning performed significantly better on both basic and clinical sciences than those taught through lecture method.

Students made it clear and profound that the use of practical activities in teaching was paramount to their liking of measurements which appear to be purely mathematics. For them it provided a room for non-performing students to also contribute in the teaching and learning process and also helped the good students to broaden their horizon as they share ideas and help each in every activity they were engaged in.

5.1.4 Research Question 4: What are The Resources Available for Science Teaching and Learning in Senior High Schools in Ghana?

The laboratory checklist helped to gather together information on the science resources for the teaching and learning of integrated science. The resources were sub-divided into resources facilities, laboratory equipment (general laboratory equipment, laboratory equipment for specific subjects, thus, biology, chemistry, physics and safety equipment.

It can therefore be inferred that although all the school had most of the listed apparatus, most of the school did not have enough apparatus to perform integrated

science experiment. This deficiency has a negative impact on the teaching and learning of integrated science. Several researchers (O"Dwyer & Childs, 2017; Uchegbu, Ahuchaogu & Amanze, 2017) have stated similar reasons for students" difficulties in understanding some science topics.

Out of the six schools used for this study, only three of them had a well-resourced science laboratory with little challenges. The rest of the schools had some makeshift laboratories with inadequate laboratory equipment. The lack of laboratory facilities and equipment hinders practical lessons which contributes to difficulty in understanding on the part of students, especially, if the topic requires practical or demonstrations.

Most integrated science teachers use abstract teaching which most students find it difficult to understand. This is because of the inadequate or lack of teaching and learning materials. But with the help of the teaching and learning materials, understanding of integrated science will be much easier to understand and remember as well as recall making the subject very interesting.

Integrated science teachers" attitude towards the use of teaching and learning materials emerges the same way as other professional attitudes emerge. That is, practically deciding on how teaching and learning materials can effectively be used for the benefit of the students. It is not worthy that when we speak of science teachers as being creative, persistent, fastidious, open-mindedness and knowledgeable, their teaching should not be theoretical approach but involve the use of teaching and learning materials to enhance their teaching. All these traits can be cultivated in the teacher when the teacher gets good attitude towards the use of teaching and learning materials. Teachers must be trained to be eager to improvise teaching and learning

materials in case of shortages of materials to enhance good delivery of lessons and better understanding of students.

In fact, the teaching materials used by teachers are still in the form of study materials fragmentary and bear no relation to one another. Teachers still use learning resources that are available in the form of textbooks from different publishers. In addition, teachers also still have limited ability to construct teaching and learning materials in an integrated manner.

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

6.0 Overview

The chapter includes the summary of the findings, conclusions drawn from the study, and recommendations based on the findings.

6.1 Summary of Work

The purpose of this study was to investigate The Status and Quality of Senior High School Integrated Science Teaching and Learning, The study addressed the:

1. level of qualification and experience of integrated science teachers in Senior High Schools in the selected school in the Central Region.
2. instructional methods used for teaching integrated science.
3. availability of resources in science laboratory and whether teachers use them in teaching.
4. attitude of students toward the learning of integrated science.

Questionnaires were given to both students and teachers. Responses to the questionnaires were put into SPSS version 20 software and analysed using descriptive statistics (frequencies and percentages). Likewise laboratory checklist was also used to collect data on the status of the science laboratories in the selected schools. The results were then presented in tables and discussed.

6.2.0 Summary of Key Findings

The following are key findings from this study.

6.2.1 Academic and professional competency of the selected science teachers at the SHS level in the Selected Schools in Central Region.

Teachers were very experienced. It was observed that less than one quarter (17.5%) of those teachers have had less than 5years integrated science teaching experience. This shows that most of the teachers (82.5%) have taught for at least 5 years or more. Few (20.0%) of the teachers specialised in integrated science education. Also, most of teachers had graduate certificate.

6.2.2 Difficulties teachers and students encountered during science lessons

1. Students had a fairly positive attitudes of integrated science but performance still remain low, and very little students see science as relevant to their lives. Only eight percent (8.00%) of the student sample agreed that the integrated science they learn at science are relevant to their lives. The remaining 92% did not see any relevance of their taught content in integrated science to their lives.
2. It was found that all schools had science laboratories but the standard of the laboratories were poor, based on facilities and equipment available. Only one out of the schools selected had a laboratory assistant. Most of the schools lacked relevant laboratory apparatus and safety equipment.

6.2.3 The availability of instructional materials and use during science lessons

The main findings were:

i. Most of the schools had insufficient materials for science teaching and learning.

ii. Most of the students responded ―No to the performance of practical activity and this may be attributed to the inadequate material to go round during practical lessons.

iii. Most of the students within the selected schools had inadequate textbooks.

6.2.4 The predominant instructional approaches utilised during science lessons

Teachers were asked to identify which teaching method they taught was effective. Each teacher was asked to select at least two methods.

The findings were:

1. About 38.75% of the science teachers supported the use of demonstration and 48.75% also supported discussion.
2. Further 50% practical activity, 11.25% giving and finally, 52.5% supported Students working individually including working from the textbook.

6.2.5 Quality of Human Resources within the Central Region for Science teachers in the selected schools

The findings were:

1. Only 20% of the respondents (science teachers) confirmed that they had specialized in integrated science education at the university.

2. The remaining 80% had specialized in different fields, either one branch of the integrated science constituents (biology, chemistry, physics or Agricultural science) or some other science related programmes.

6.3 Conclusions

This study was aimed at investigating the status and quality of senior high school integrated science teaching and learning in selected schools in the Central Region. The study specifically considered the level of qualification and experience of integrated science teachers in Senior High Schools, the instructional methods used for teaching integrated science, the resources available for science teaching and learning in senior High Schools in Ghana and the attitude of students toward the learning of integrated science.

On the basis of the results obtained in this study the following conclusion were reached:

1. The professional and academic qualifications of the selected SHS teachers were inadequate for integrated science teaching.
2. Some teachers still utilized the lecture method during science lessons.
3. Most students have positive attitudes toward integrated science in the selected senior high schools in the central region.
4. Most of the selected schools within the Central Region did not have standard laboratories for undertaking science practical, leading to the poor performance in integrated science at the WASSCE.

6.4 Recommendations

Considering the findings and conclusions drawn from the study, the following recommendations have been made for consideration.

1) Only teachers who are specialized in science should be posted to teach the subject in the selected schools and other schools.
2) Stake holders in education must ensure the provision of well-equipped laboratories for the senior high schools in the study area to enhance the teaching and learning of science.
3) The government, G.E.S, M.O.E and other stake holders of education must ensure that there are adequate teaching and learning materials at the SHS level for use by both teachers and pupils to make science interesting.
4) Since students cited their teachers‟ methods of teaching as a contributory factor to their difficulty in understanding integrated science topics, it is recommended that SHS integrated science teachers should vary their teaching methodologies and include more student oriented methodologies like discussions, using molecular models, using computer simulations and videos to teach. All these methods have been proven by research to enhance students‟ understanding in various concepts. Also, heads of senior high schools can from time to time organize in service trainings and workshops for their teachers on innovative ways of teaching the various integrated topics. This will go a long way to help teachers to teach better.
5) Textbooks and other teaching and learning resources should be acquired to complement what is already in the schools so that more students will have easy access to these resources. To this end, heads of the senior high schools can appeal to old students of the schools and even educational non-governmental

organizations for support to acquire these teaching and learning resources to add up to whatever the government has provided in the schools already which are inadequate. The provision of more integrated science textbooks would ensure that students would have easy access to textbooks and will not have to depend only on the notes given to them by teachers. Students can then read wider on topics and get exposed to more examples than what is given in class. This may go a long way to help students especially if they are able to read ahead before going to class to understand what is taught in class better.

6) The following recommendations was given to integrated science teachers;

i. Using varied teaching methodologies

Many teachers and students recommended that instead of teachers using only the lecture method in teaching integrated science, teachers should look at using more demonstrations, practical work in the laboratory, letting students use molecular models and using audio visuals in their teaching. These methods if used will facilitate students‟ understanding of concepts and help them remember what has been taught better than if only the lecture method is used. Chiu (2005), confirms that conducting experimental activities helps in developing positive students‟ attitudes in learning chemistry. Practical work needs to essentially be about stimulating and challenging students to think and understand the relation between evidence and theory (Yunus & Ali, 2013) and students who learn by these inquiry approaches are responsible for developing their own answers to questions rather than exclusively relying on the teacher and or textbooks (Klopfer, Aikenhead & Robinsen, 2001).

ii. Solving of more examples and prompt feedback

Students suggested that teachers should solve more problems on organic chemistry with them in class rather than just giving of notes and explanations. In solving examples in class, students are exposed to possible examination questions and also learn how to solve problems/ answer integrated science questions. Students also suggested that whenever assignments are given, teachers should do well to provide prompt feedback. This would help students see how they are performing, see their mistakes and correct them with the help of teachers.

iii. Adapting content to students' cognitive abilities and use of appropriate language level

What may be easy for teachers to understand may not be easy for students to understand because of their differences in cognitive abilities. Although the content of the integrated science curriculum has been designed with students" age and cognitive abilities in mind, it is important that in explaining concepts, teachers adapt the content to suit their students cognitive ability and to the understanding of the average student. The students in this study suggested that their teachers should teach so that the average performing students in the class understand. Also, with English language as the medium of instruction, it was suggested that if possible, teachers should break down the "scientific" language to their level of understanding, preferably in the local language.

iv. Relating content to real world situations

a. Many students stated that they could not see the link between what they are being taught in class and the real world situations and would appreciate the subject better if they could see the application to real world situations as much

as possible teachers should try and point out real life applications of what they teach to students.

6.5 Suggestion for Future Research

This study looked at the Status and Quality of Senior High School Integrated Science Teaching and Learning in selected schools in the Central Region of Ghana.

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

1. This study should be replicated using larger numbers of research subjects in the Central Region.
2. A comparative analysis of integrated science instructional approaches in selected senior high schools in the study area should be conducted.
3. A survey of available integrated science instructional materials (including textual materials) should be conducted in the research area.
4. A study on the instructional and content knowledge needs of SHS integrated science teaching in the Central Region should be undertaken.
5. In future research, a diagnostic test based on the topics in the SHS Integrated Science syllabus could be added to ascertain whether the perceived difficult topics are actually difficult for students to answer questions on. This would help teachers to separate perceived difficulties from the actual difficulties and be able to address them in their lessons.

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APPENDIXES

APPENDIX A

Teachers' Survey Questionnaire

The Status and Quality of Senior High School Integrated Science Teaching and Learning, in Some Selected Schools in Central Region of Ghana

Dear Teacher,

This is an anonymous questionnaire. Do not write your name, or any other comments that could identify you on this questionnaire. By completing the questionnaire you are consenting to take part in this research. Please read the information below which explains the purpose of the research.

This questionnaire seeks your opinions and concerns about teaching and learning of integrated science at SHS 1-3. There is no right or wrong answer to each question. Information from this questionnaire will be used to improve the teaching and learning of integrated science in Senior High Schools in Ghana. The information will be aggregated and summarized for inclusion in research reports. No person will be identified in any reports.

Thank you for your participation in this study.

SECTION 1: Background Information

1.1. Location of your school:

Rural ☐ Urban ☐

1.2. Sex:

Male	Female

1.3. (i) What is your academic qualification?

HND	B.Sc	B.Sc(Ed)	Post Graduate (with Education)	Post Graduate (without Education)

The major subject area in your qualification is: (specialisation)

Integrated science	Biology	Chemistry	Physics	Agric science	Others

1.4 Years of Teaching Experience:

0-5 yrs	6-10 yrs	11-15 yrs	16-20 yrs	21 yrs and above

1.5 The average number of students in my classes is

20 or less	21 -40	41 to 60	60 and above

SECTION 2

2.1 Consider **your** science lesson **period of 60 minutes** and determine what teaching method you mostly use in class. (Tick not more than 2).

Teaching methods	
1. Teacher demonstration	
2. class discussion method	
3. Teacher giving notes to students	
4. Students working individually including working from the text.	
5. Students doing practical and activity work in small groups.	

2.2 Please think about **actual** Integrated Science classes you have taught. Examine the following statements carefully and decide how they correspond with your experiences in the classroom. Please tick the box that best represents how often these phenomena occur in your Integrated Science classes.

In your actual Integrated Science classroom	**All the time**	**Most of the time**	**Not often**	**Never**
1. Students must carefully follow the teacher‟s instructions for experiment to reach the correct conclusions				
2. Students‟ existing knowledge is assessed to guide lesson planning				

3. Students develop the skills which allow them to think independently				
4. Teachers have knowledge and skills of teaching by inquiry				
5. There is sufficient time to explain topics in depth				
6. There is enough time allocated to discuss the main findings after practical work				
7. We cover a lot of content to complete the scheme of work				

Thank you.

APPENDIX B

Student Survey Questionnaire

The Status and Quality of Senior High School Integrated Science Teaching and Learning, in Some Selected Schools in Central Region of Ghana

Dear Student

This anonymous questionnaire asks for your opinions about the teaching and learning of science in your school. Do not write your name, or any other comments that could identify you on this questionnaire.

There is no right or wrong answer to any of the questions. This is not a test and your answers will not affect your scores and grades. By completing the questionnaire you are consenting to take part in this research. Please read the information below which explains the purpose of this research.

The information you provide will be useful to improve the ways of teaching and learning integrated science. Your answers will remain confidential and any reports about this research will not name any students, teachers or schools.

SECTION 1: Background Information

Sex: Male ☐ Female ☐

Age:

17years or below	Above 17 years

SECTION 2: Please indicate by ticking the appropriate options how often the following things happen in your integrated science class?

In my science class	**All the time**	**Most of the time**	**Not often**	**Never**
1. I copy notes the teacher gives me.				
2. I read science textbooks and form my own notes during my spare time				
3. I ask questions on what is not clear to me during integrated science lessons				
4. I get excited about what we do in integrated science class				
5. I find integrated science interesting to learn				
6. We work in groups				
7. I carry out integrated science experiments with excitement				
8. I feel sad when our integrated science teacher fails to come to class				
9. Integrated science lessons deal with things I am concerned about				
10. Science is not related to my life				

SECTION 3: Please indicate by ticking the appropriate options, what will enable you do well in integrated science class

To do well in science, I need to be able to:	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**

1. remember lots of facts taught				
2. understand and explain science ideas				
3. apply science to understand things in my life				

Thank you for participating in this study.

APPENDIX C

SECTION 1: Resources and facilities for teaching and learning Integrated Science in SHS at your school.

Resources and Facilities	**Yes**	**No**
(a) We have a laboratory assistant		
(b) We have been performing practical experiment for integrated science in our school.		

SECTION 2i: Availability of Biology Laboratory Equipment in school

Indicated whether your school has the under listed basic laboratory equipment (and also whether they are adequate of not)

General Laboratory Equipment and apparatus	**Available**	**Adequate**	**Inadequate**
Balances (electronic)			
Beaker			
Benson burner			
Centrifuge			
Flask (round, flat and conical)			
Gas gar			
Knife			
Measuring cylinder			
Stirrers			
Test tubes			
Thermometers			

Tripod stand			
Water Bath			
Wire gauze			
Quality of the student textbook(s)			
Computers			

SECTION 2ii: Availability of Biology Laboratory Equipment in school

Indicated whether your school has the under listed basic laboratory equipment (and also whether they are adequate of not)

Laboratory equipment	**Available**	**Adequate**	**Inadequate**
Forceps			
Hand lens			
Microscopes			
Petri dish			

SECTION 2iii: Availability of Chemical Laboratory Equipment in school

Indicated whether your school has the under listed basic laboratory equipment (and also whether they are adequate of not)

Laboratory equipment	**Available**	**Adequate**	**Inadequate**
Burette			
Fume hoods			
Pipette			
Supply of Chemical Reagent			

SECTION 2iv: Availability of Physics Laboratory Equipment in school

Indicated whether your school has the under listed basic laboratory equipment (and also whether they are adequate of not)

Laboratory equipment	**Available**	**Adequate**	**Inadequate**
Balance (top pan, beam, spring and chemical)			
Electrical component			
Length measuring instruments			

SECTION 3: Indicated whether your school has the under these laboratory safety equipment (and also whether they are adequate of not)

Safety Equipment	**Available**	**Adequate**	**Inadequate**
Fire Extinguisher			
Helmet			
Gloves			
Goggles			