UNIVERSITY OF EDUCATION, WINNEBA

THE STATUS OF INTEGRATED SCIENCE TEACHING AND LEARNING IN SELECTED PUBLIC AND PRIVATE SENIOR HIGH SCHOOLS IN THE HO MUNICIPALITY

FRED KWAKU KWAMI

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DECLARATION

STUDENT'S DECLARATION

I, Fred Kwaku Kwami, declare that this dissertation, 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 dissertation as laid down by the University of Education, Winneba.

NAME OF SUPERVISOR: Prof. John K. Eminah

SIGNATURE: …….

DATE: …….

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DEDICATION

This thesis is dedicated to my parents Mr. and Mrs. Kwami. To my lovely wife Ms. Gladys Ami Kekesi. To my son Oscar Kwaku Kwami Jnr. and my daughters Moriah Kwami, and Gratias Kwami for their patience. Also, to my good friend Ms. Rejoice Mawuena Abra Adzokoto for her support and encouragement.

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ABSTRACT

This study investigated and described the status of Integrated Science teaching and learning in randomly selected five (5) public and three (3) private senior high school in Ho Municipality. The main reasons for selecting these schools were based on the target population, controlled environment and collaboration and this was done through defining the research questions and target population, identifying potential schools, contacting the schools involves, gaining approval from the schools authorities, and obtaining informed consent. Quantitative and qualitative research methods were used for gathering data. Quantitative data were obtained from the surveys of 56 senior high school integrated science teachers and 500 senior high school students from Ho Municipality. The study was a descriptive survey. Questionnaires, interviews and checklist were the main instrument used for data collection. Triangulation of data from the teachers and the students questionnaires, interviews of the head of selected senior high schools, and checklist were used to reveal actual status of integrated science teaching and learning in the selected public and private senior high schools in the Ho Municipality. The study revealed that all the teachers in the public school were professional and experienced but the private SHS teachers only 39% were professional and experienced. The selected schools within the Municipality lacked integrated science laboratories and lab assistants, also they did not have adequate instructional resources for teaching and learning of Integrated Science. Teachers within the selected schools attested to the need to use practical oriented method in teaching but for the fact that they are not having the necessary resources they result in the use of lecture method. Additionally, the teachers, the students and the headmasters confirmed overloaded content of curriculum, lack of funds from the government and negative attitudes of students toward integrated science within the municipality. In view of this, the researcher suggested only teachers who specialize in integrated science education should be employed to teach integrated science, the integrated science curriculum should be restructured to meet the needs and aspiration of learners. Also, the use of practical oriented methods in the teaching and learning of integrated science. It was further recommended that in-service training should be regularly organized for integrated science teachers. Effort should also be made by the government or the relevant authorities in education to ensure that adequate teaching and learning resources and integrated science laboratories exist at all SHS in the research area.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter includes background to the study, statement of the problem, objectives of the study, research questions, research hypotheses, significance of the study delimitation of the study, limitations of the study, and organization of the study report. The abbreviations and acronyms are also captured in the chapter.

1.1 Background to the Study

The National Council for Curriculum and Assessment (NaCCA) (2019) stated in the rationale for the introduction of the new school standard-based curriculum that "Science forms an integral part of our everyday life and it is a universal truth that development is hinged on science. Science and Technology is the backbone of the physical, socioeconomic, and political development of a country.

Integrated science as a broad subject may be categorised into various branches that include biology, chemistry, physics, and agriculture thus the combination of all the sciences with the fusion of technology, taught and learnt as a single subject.

In recent times, there has been a growing public anxiety and concern about the teaching and learning of integrated science in Ghanaian schools. Studies showed that large numbers of students seem to learn very little integrated science at school. Teaching and learning tends to be by teacher centered and rote learning approach and students find learning of integrated science to be difficult (Hodson, 2011) As a direct result, rather than being student-centered, integrated science education is increasingly teacher-centered. Integrated science teaching in Ho Municipality schools has been questioned

and criticised because of the poor performance of students in integrated science relative to their counterparts in other regions in Ghana.

This was evident from the result trend in the Integrated science released by the West African Secondary School Certificate Examination (WASSCE; WAEC, 2014, 2015, 2016, 2017 etc). Stakeholders in education and the general public have raised concerned about what actually might be the cause.

A number of factors have been identified to be responsible for these poor performances of students in integrated science from studies conducted in various countries. These include the lack of motivation for most teachers, poor infrastructural facilities, inadequate textual materials, the attitude of students to learning, lack of teaching skills and competence by integrated science teachers, and lack of opportunities for professional development for science teachers (Braimoh & Okedeyi, 2001; Folaranmi, 2002; Olaleye, 2002).

Some other researchers also attribute the low percentage of students who pass examinations in integrated science, to dissatisfaction with the syllabus, teachers' qualifications, and inadequate subject knowledge background which affects how the teacher develops pedagogical content knowledge, workload, experience, and disposition, general lack of teaching skills, and the ineffective style of delivery of subject matter (Parker et al, 2018). Results from researches on the teaching and learning of science revealed that teachers' lecture and give notes when teaching Integrated Science lessons.

Integrated science places emphasis on the process approach to teaching so as to enable the student acquire basic skills of observing, manipulating and classifying. If it is possible integrated science lesson/class are not expected to be classroom chalk-board and talk clarification, enter education approach problem solving concept mapping, Human material and natural resources, using stimulation, games because it is a subject that is designed to involve student in the acquisition of a series of process skills.

As Boakye and Ampiah (2017) noted, the result of investigations and research findings embarked upon by many educational researchers among other things showed beyond reasonable doubt that drawbacks or failure of many students is caused by (a) insufficient teaching and learning materials; (b) poor time management; (c) insufficient content knowledge; (d) students' challenges understanding the lessons taught; (e) student indiscipline; (f) students' disinterest in science courses; (g) science teachers' incapacity to finish the syllabus; and (h) insufficient hands-on activities in integrated science lessons.

This study investigated the current state, condition, and effectiveness of integrated science teaching and learning in selected public and private SHS in terms of availability of teaching learning materials TLMs, Lab technician, frequency of practical activities, instructional approaches and qualifications of teachers in the Ho municipality. The study aimed at determining the effect of these factors on the successful teaching and learning of integrated science in the selected senior high school in the research area.

1.2 Statement of the Problem

Everyone is concerned about the state of integrated science education in Ghana right now, including the government and the general public. As Kpodo (2011) noted, a lot of students found integrated science to be hard, boring, and uninteresting.

Adu-Gyamfi (2014) conducted a study on integrated science teachers in Ghana and found several general and particular difficulties. The curriculum's heavy content, a lack of science laboratory and inadequate number of teaching and learning resources for integrated science teaching and learning were some of the challenging issues. The aforementioned issues were found to have an impact on students' performance and interest in integrated science, teachers' choice of effective teaching strategies, and students' engagement in integrated science lessons.

Also report on the 2020 BECE and WASSCE results analysis by the Volta Regional Education Directorate, Ho, prepared performance by the planning unit (2021) observed a low performance from the Basic and Second cycle schools in the Basic Education Certificate Examination (BECE) and the West African Senior School Certificate Examination (WASSCE) respectively. Stating that the region has not seen a pass rate of 50% or above since 2009.

To solve these persisting lingering problems one needs to develop a realistic framework of what is the current state and conditions in the teaching and learning of integrated science in the Ho, Municipality schools and also to identify the factors that are limiting the quality of integrated science education. Furthermore, one needs to develop a reasonable ideal picture for which Ghana can strive within the existing resource limitations and financial stress in the SHS due to the introduction of the free SHS policy.

1.3 Rational for the Study

The literature on integrated science education presents a wide range of evidence, which makes it evident that the Ho Municipality's integrated science education system is confronted with a number of issues that must be resolved if the goal of preparing

students for success in the modern era of science and technology—expressed in the rationale for teaching integrated science in the integrated science syllabus (SHS), 2007—is to be realized. 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 by improving the quality of integrated science teaching and learning in SHS schools in the Ho Municipality is a laudable reform that should preoccupy the mind of the policymakers and all the key stakeholders in integrated science education generally in Ghana. This is the motivation for conducting this study.

1.4 Purpose of the Study

The purpose of this study was to determine the status of the teaching and learning of Integrated Science in selected public and private senior high schools in the Ho Municipality.

1.5 Objectives of the Study

The objectives of the study were to determine the:

1. extent to which the science teachers in the selected public and private senior high schools are qualified to teach Integrated Science.
2. type of human, material, and financial resources that are available for Integrated Science teaching in the selected public and private senior high schools.
3. challenges teachers and students faced during Integrated Science lessons.
4. main teaching strategies the teacher used during Integrated Science lesson delivery.

5. views of the teachers and students on the interventions that can be designed to improve Integrated Science teaching and learning in the selected public and private senior high schools

1.6 Research Questions

The following research questions were posed to guide the study:

1. To what extent are the science teachers in the selected public and private senior high schools qualified to teach Integrated Science?
2. What type of human, material, and financial resources are available for Integrated Science teaching in the selected public and private senior high schools?
3. What challenges do the teachers and students face during Integrated Science lessons?
4. What are the main teaching strategies used by the teachers during Integrated Science lessons?
5. What are the views of the teachers and students on the interventions that can be designed to improve Integrated Science teaching and learning in the selected public and private senior high schools?

1.7 Significance of the Study

In an effort to improving the teaching of integrated science in the Ho, Municipality senior high secondary schools and make the learning of integrated science more attractive to students, this study makes the following important contributions to knowledge and education.

In order to help with the planning and formulation of further policies for integrated science education in Ghana as a whole, this study first offers integrated science

educators, integrated science curriculum planners, and the government detailed information about the current state and conditions of integrated science teaching, integrated science learning, and educational practices in the Ho Municipality schools, as well as practical, affordable ways to improve the situation.

Secondly, it would also be primarily significant to teachers, heads of schools, parents, policy makers and all the key stakeholders in the education sector. From the perspective of policy makers, it would enrich their sense of focus as to how best they can formulate and implement educational policies. Parents would also find this research useful, because it would help them make informed choices as to where to educate their wards and the quality of education their wards would be receiving.

Thirdly, the findings would also be useful to all the universities in Ghana offering education programmes in designing their curriculum for training prospective teachers to handle the SHS students. The result of the study could be used to inform the government of the situation of integrated science educational status in secondary schools and what government can do to improve the situation.

1.8 Limitations of the Study

Since data were collected from only senior high schools selected for the study, there could be a possible loss of credible and authentic data.

1.9 Delimitations of the Study

Data for the study were collected from schools within the Ho Municipality, and schools in the nearby areas were excluded. In the Ho Municipality, there are many public and private senior high schools. Data were collected from only five (5) public and three (3) private senior high schools

1.10 Definition of Terms

a) Integrated: It means combine into a whole

b) Science: It is a branch of knowledge involving systematized observation and experiment.

c) Methods Of Teaching: Is a way adopted to improve effective teaching and learning process.

d) Teaching: It is an important activity in the educative process to impact information or skill to a person.

e) Learning: Is relatively permanent change in behaviour which is as a result of experience or is reinforced by practice.

f) Teaching Aid: This is considered as any device piece of equipment, graphic representation, sound reproduction or illustration that helps the student to learn thus making teaching and learning more meaningful and effective.

g) Status: The position or rank of something or someone in relation to other members of a group, organization, or society, etc. It refers to someone or something's present situation.

1.11 Organisation of the Study

The thesis was organized as follows: Chapter One (I) provides the background of the study, the statement of the problem to be researched, rationale for the study, purpose of the study, objective of the study, the research questions and the significance of the study. This follows by limitations and delimitations of the study. Chapter two (II) dealt with literature review of the study. By looking at the teaching and learning of integrated science. Chapter three (III) covered the methodology, which includes research design, population, sampling and sampling procedures, instrument used for the study, data collection and data analysis. Chapter four (IV)dealt with the results and discussion of

the study. Chapter five (V) dealt with the summary of key findings, conclusions and recommendations of the study.

1.12 Abbreviation and Acronyms

The following abbreviations and acronyms have been used in the study:

1. NaCCA : National Council for Curriculum and Assessment
2. WASSCE: West African Secondary School Certificate Examination
3. WAEC: West African Examination Council
4. SOQ: Science Opinion Questionnaire
5. MOE: Ministry of Education
6. SHS: Senior High Schools
7. TLMs: Teaching and Learning Materials
8. NTC: National Teaching Council
9. PFO: Personal Form of Observation

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

The Chapter begins with a review of science education as a core curriculum in senior high schools in Ghana, followed by the relevance of science at the senior high schools in Ghana, Teacher quality and academic performance, availability, and relevance of instructional material in schools. Within this chapter methods of teaching especially activity and lecture methods are explored. There is also a review of Students' interest and their academic performance in integrated Science, Science laboratory. Finally, the chapter examines theoretical framework (constructivist theory of learning) and conceptual framework.

2.1 The Nature of the SHS Integrated Science Syllabus

The Ghanaian SHS Integrated Science Syllabus had a goal of inculcating literacy an culture in students to enable them make informed choices in their career. It was further aimed at producing competent producing competent professionals in various scientific disciplines at the tertiary levels of education (Ministry of Education [MOE], 2012; Ministry of Education, Science and Sports [MOESS], 2007). The syllabus has been organized into five sections as diversity of matter, cycles, systems, energy, and interactions of matter. All the five section were carefully structured for the three-year programme to help achieve the main goals of teaching integrated science at the SHS level. Under each section for each year group, there were general objectives from which specific objectives and corresponding content were outlined. Teachers teaching SHS integrated science are expected to devote 20%, 40% and 40% respectively to Knowledge and comprehension, Application of Knowledge, and Experimental and

Process Skill in their teaching, learning and testing (MOE, 2012; MOESS, 2007). Suggested time allocation A total of eight periods a week, each period consisting of forty (40) minutes, is allocated to the teaching of integrated science in the first year. The time allocation reduces to five periods a week in the second year; to three periods a week in the third year. The time allocation and the recommended structure for theory and practical are as follows: Year 1: 8 periods a week: Theory - 5 periods per week (one double period and three continuous periods); Practical - Three continuous periods per Week Year 2: 5 periods a week: Theory – 3 periods per week (one double period and a single period); Practical – 2 periods as one double period, Year 3: 3 periods a week: Theory – 2 periods per week organized as one double period; Practical - 1 period per week. Almost all the teachers were of the view that the time allocated for integrated science teaching on their school timetable was insufficient for teaching the theory left only to conduct practical.

Suggestions for teaching the syllabus, For effective teaching and learning of integrated science, it is recommended that schools should keep farms for growing crops. It is also recommended that farm animals in at least one of each of the following groups must be reared, Chickens/ducks/turkeys, Goats/sheep/cattle, Rabbits and Guinea Pigs Plans must be made for visiting well established experimental and commercial farms, research institutes, and other institutions/organizations related to Science, Health and Agriculture. Visits must also be planned to scientific and manufacturing industries where students will observe scientific work and the application of science and technology in manufacturing. Video clips, digitized content or CD ROM on processes and systems could also be shown where these are available. Schools must adopt a team-teaching approach for this course since many science teachers of the moment are trained as physicists, biologists, chemists, agriculturists etc. This deficiency will be remedied

in the future if the universities start programmes in integrated science from where a new crop of integrated science teachers will be drawn. It was clear that almost all the schools visited were not adhering to the teaching suggestions of the integrated science syllabus.

2.2 Rationale for Teaching Integrated Science

The fast advances in science and technology have influenced the rate of economic development of nations, improved the quality of life in most parts of the world, and provided solutions to some major problems and needs of societies. The impact of science and technology is felt on education, health, nutrition, transport and communication. Our continued existence depends on the mastery of the knowledge and attitudes of science and technology. For Ghana to develop there is the need to do away with allegory and false notion of natural phenomenon, and rather support the rapid development of scientific and technological literacy among all individuals. Since the SHS is a terminal point for the formal education of most students, it is at this point that scientific knowledge and attitudes need to be strengthened.

The general aims for science education at SHS level (MOE, 2001; the teaching syllabus for integrated science SHS) aims to help students 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 disciplines.

There are three strands succinctly stated in the senior high school curriculum. The first is that the curriculum contains enough knowledge and skills for students terminating their education at the end of the senior high school to gain employment. The second strand assures students of self-employment while the third strand enables them to further their education.

The realities on the ground in relation to graduating senior high students are that few are able to further their education while the majority of them, about 90%, are "erroneously referred to as drop outs" (Ghana Education Service, 2010) creating about 60% unemployment among the youth and thus making youth unemployment rate one of the highest (Amankrah, 2014). It is worthy of note that there have been several educational reforms and reviews in Ghana with the purpose of providing skills necessary for descent employment in industries, self-employment and pursuit of further studies (Ministry of Education, 2002).

Research shows that only about 10% of school pupils passing through junior high school (JHS) to senior high school (SHS) gain admission to the universities with the remaining 90% being "erroneously referred to as dropouts" (MOE, 2002).

One of the keys aims for science education is to prepare pupils for science-related careers in, for example, medicine, engineering, industry and teaching professions (MEST, 2000; Aikenhead, 2005). It is the anticipation of science curriculum developers in general that pupils are able to incorporate scientific content into their own thinking so that this content is made available later in the science-related world of work (AAAS, 1989, cited in Aikenhead, 2005). However, it appears there is universality about the perceived mismatch between educational outcomes and the needs of the world of work. This has also been shown in some research studies in science education pointing to the fact that, in general, there is a pitiable match between the scientific content taught in school and university science courses; and the type of scientific understanding necessary for success in science-based occupations (Duggan and Gott, 2002; Coles, 1997).Despite the growing importance of science and technology in all realms of life in any society, many young people appear to lose their interest for it in schools. This happens mainly in highly developed societies. It seems they have developed ambivalent attitudes to and perceptions of science and technology (Schreiner and Sjøberg, 2006).

2.3. The Status of the Teaching and Learning of Integrated Science

According to Biggs (2003), planning and interpretation of teaching and learning should be done in a way that maximizes the quality of learning. According to Biggs (2003) on page 1, "all aspects of teaching and assessment are to support high level learning" in an effective educational system. The activities that connect the teacher and students are those of teaching and learning integrated science. It would be assumed that the focus of science education would be on learning objectives that advance scientific literacy. When the child is at the center of the learning process, teaching becomes meaningful. When the learning environment is structured, teaching and learning proceed smoothly. It is required of teachers to set up the classroom in a way that would promote learning.

If a teacher does not engage students in a range of activities, including experiments, demonstrations, concept explanations, conversation moderating, and problem solving, then science instruction is not adequately comprehended. The purpose of teaching activities is to make learning easier. In order for students to comprehend the concepts they teach in scientific classes, teachers must create new conceptual frameworks for the subjects they teach in integrated science education. Teachers must to give students plenty of chances to participate in a range of learning experiences.

Many studies on science education's teaching and learning indicate that in order to make the subject matter more meaningful, generate and maintain students' interest in learning it, and enhance their performance, teachers must use interactive and more engaging teaching strategies (Akpan, 1992; Anderson, 2006; Namrata, Amrita, & Singh, 2014; Antwi, Anderson, & Sakyi-Hagan, 2015). Research unambiguously demonstrates that both the medium of education and the teacher's instructional strategies affect students' performance (Senkoro, 2004 and Canton, 2007). The instructional strategies that teachers employ in the classroom are crucial to helping students learn and develop into competent, informed adults.

How well learning occurs depends on the quality of teaching and the quality of the teacher's interaction with the students. For example, a teacher may anticipate that certain activities will make students learn, such as using a plane mirror to teach reflection of light. However, the teacher cannot guarantee that learning actually occurs if the students are unable to perform related tasks effectively despite the instructional experiences.

Most SHS currently use an integrated scientific teaching strategy that primarily focuses on classroom and laboratory activities meant to satisfy test requirements. Regretfully,

the practical teaching of science and the integrated technology component of it have been hampered by the examination-driven approach of integrated science teaching. The method not only has a tendency to make studying integrated science dull and uninteresting. Students also find it challenging to apply their academic knowledge to real-world situations and the application of manipulative abilities. The majority of SHS professors employ the lecture style of instruction, which makes it challenging for pupils to comprehend the material being covered. Students consequently learned material by rote without comprehending the subject matter.

Three learning domains should be fostered in pupils through integrated science instruction. Because of this, it is crucial that teachers approach each teaching situation by clearly outlining the behavioral adjustments they want their students to make and by choosing exercises that are appropriate and will promote learning.

2.4 Teacher Quality and Academic Performance

The quality of education of any nation determines the development status of that particular nation. The most important person in a school setting is the teacher and he/she is the pivot of the education process. The teacher is the most important person in the entire education programme and he/she can make or ruin the best educational programme ever. Education therefore is what teachers make of it. Thus, competent, devoted and professionally qualified teachers are part of essential foundation for a good education system. In other words, the attainment of national objectives for the adequate preparation of students for their examinations and achievement of educational objectives depend largely on quality teachers. Uche (2012) in a study indicated that the students rated the quality of the academic staff high, especially in terms of professional competence, but rated their supervision low.

In Ghana, education is seen as an instrument of proportionate excellence for effecting national development. As such, education is expected to be of high quality in order to produce sound and quality products that can contribute to the growth of the national economy. The quality of education of a nation could be determined by the quality of her teachers. The most important factor in improving students' academic achievement in school is by employing seasoned qualified teachers in all schools (Abe & Adu, 2013). Teacher quality matters. In fact, it is the most important school-related factor influencing student achievement. The resource-intensive nature of teachers coupled with the empirical evidence documenting the critical role of teacher quality in realizing student achievement implies that teacher policy is a promising avenue toward better realizing goals of efficiency, equity, and adequacy in public education. Academical qualified teachers refer to those who have academic training as a result of enrolment into educational institution and obtained qualifications in various areas of endeavour such as HND, B.Sc, B.A, and Master of Art (M.A.) and so on; while professional qualified teachers are those who got professional training that gave them professional knowledge, skills, techniques, aptitudes as different from the general education. They hold degrees like, B.Ed, B.Sc. Ed, B.A. Ed, and M.Ed degrees and so on.

Studies also suggest that teachers with degrees in subjects different from the subjects they teach have little impact on students. There is no strong consensus about the value of pedagogical preparation for teachers, but findings suggest that teachers with advanced degrees in specific subjects can have an impact on student learning in those subjects in certain settings. Also, lot of studies show that teacher quality is the key central in student performance. The most questions arising on teacher characteristic is what kind of teacher attribute improving student quality. This question was explored by Darling-Hammond (2000), Milanowski (2004), Rockof (2004), and Rivkin

Hanushek and Kain (2005), Kane et al (2008). All of these studies have the same findings that teacher characteristic significantly affect the student learning. Teacher characteristic such as, education background, experience, certificate status, leadership experience, perseverance, teacher evaluation score, preparedness course work are the variables that must be given the necessary attention by the scholar in relation to student achievement. However, the method of assessing teacher quality in delivering teaching in classroom is still debating among the researchers.

What characteristics of teachers are predictive of student achievement? Some of the characteristics and attitudinal factors that bear the highest relationship to pupil achievement are first, the teacher's score on the verbal skills test, and then his educational background—both his own level of education and that of his parents. Also teaching experience (in years), professional journals read, and teachers' perceptions of the ability and effort levels of their students.

2.5 Availability and Relevance of Instructional Materials in Schools

Instructional materials are teachers' tactical tools in organizing and presenting instructional objectives to students. It aids students to learn more comfortably and it influences students positively in their academic performance. For effective teaching and learning to take place, there is the need for adequate instructional materials. Therefore, instructional materials are referred to as the resources which both the teachers and pupils use for the purpose of effective teaching and learning, instructional material are crucial to teaching and learning processes. Aguokogbuo (2000), asserted that the responsibility of every administrator is to ensure that every child had access to quality education and also ensure that school facilities and resources are available to enhance teaching and promote quality education. Also, Ogwo (2006) defined

instructional resources as those materials that teachers can use in teaching to facilitate the learning of a particular subject or lesson.

The list of instructional resources is inexhaustible and their limit is the teacher's level of resourcefulness, creativity, and imagination. Instructional materials are print and non-print items that are designed to impart information to students in the educational process. Instructional materials include items such as kits, textbooks, magazines, chalkboards newspapers, pictures, recordings, slides, transparencies, videos, video discs, workbooks, and electronic media including but not limited to music, movies, radio, software, CD-ROMs, and online services (Dahar and Faize, 2011).

According to Adeogun (2001), schools, whose teachers use more instructional resources perform better than schools, whose teachers do not use instructional materials. This corroborated the study by Babayomi (1999) that private schools performed better than public schools because students and teachers are provided with sufficient and quality teaching and learning resources. As a matter of importance and necessity, schools at all levels of education have been advised to have quality and adequate instructional facilities to raise academic performance of their students. The advice emanated from the fact that instructional facilities have a potent factor to qualitative education. The dictum is that “teaching is inseparable from learning but learning is separable from teaching.” This means that teachers do the teaching to make the students learn, but with quality and adequate instructional materials, students can learn without the teachers or with little guidance from the teachers. According to Bello (2012) that availability of school facilities cannot bring about improvement in students’ academic performance if they are not properly utilized, even though they may be in good conditions.

In a study conducted by Umaru (2011) on the influence of instructional materials on students learning of agricultural science in secondary schools in Kwara State, he pointed out the following salient points. He asserted that the essence of producing instructional resources is to facilitate the teaching learning process. The essence is not to use such instructional materials as objects of decoration in our classroom or as objects to be presented during award winning national exhibitions on improved instructional materials. Furthermore, he pointed out that utilization of instructional resources will enhance a concrete basis for conceptual thinking and makes learning more interesting. Instructional resources also enhance students' interest in their academics, they offer a reality of experience, which stimulates self-activity on the part of pupils. Instructional resources develop a continuity of thought, this is especially true of motion pictures, as they provide experiences not, easily obtained through other materials and contribute to the efficiency and variety of learning. The use of instructional materials gives the learner opportunity to touch, smell or taste objects in the teaching and learning process. Knowledge and skill can be passed into students with different types of relevant instructional materials. The use of instructional materials is very crucial in improving the overall quality of the learning experiences of students.

Instructional materials are also essential since they help the teacher and learners avoid overemphasis on recitation and rote learning that can easily dominate a lesson. Instructional materials allow learners to have practical experiences which help them to develop skills and concepts and to work in a variety of ways. Kochhar (1991) added that a teacher who has adequate and relevant teaching facilities is more confident, effective and productive. It is clear that instructional materials are essential for effective teaching and learning of Integrated science as it helps students to:

- acquired different skills
- have interest and become actively involved in the learning process
- retained and consolidate learning in the learners' mind and help them to recall things that would have been easily forgotten.
- makes learners employ most of their senses so as to make learning easier and a worthy experience.
- extend attention span of students also.

In summary, Instructional materials play a vital role in teaching and learning. They provide the necessary resources for teachers to plan and deliver effective instruction, and for students to learn. When used effectively, instructional materials can help to improve student achievement.

However, when they are used inappropriately or not at all, student learning can suffer. In order to ensure that instructional materials are being used effectively, it is important for educators to select materials that are aligned with the curriculum and meet the needs of their students. Additionally, educators need to be trained on how to use the materials effectively in order to maximize their impact on student learning.

There are many different types of instructional materials that can be used in the classroom. Some examples include textbooks, workbooks, manipulative materials, games, software programs, and websites. Each type of material has its own advantages and disadvantages, so it is important to choose those that will best meet the needs of your students. When using instructional materials in the classroom, it is important to remember that they should never take the place of good teaching practices. Materials should only be used as supplements to an engaging and well-planned lesson.

When selecting instructional materials, it is important to consider the content, pedagogy, and level of student development.

2.6 Methods of Teaching

The term **teaching method** refers to the general principles, pedagogy and management strategies used for classroom instruction. Teacher's choice of teaching method may depend on what fits him or her, his or her educational philosophy, classroom demographic, subject area(s) and school mission statement. Teaching theories can be organized into four categories based on two major parameters: a teacher-centered approach versus a student-centered approach, and high-tech material use versus low-tech material use.

In a teacher-centered (authoritarian) approach to learning, teachers are the main authority figure in this model. Students are viewed as "empty vessels" whose primary role is to passively receive information (via lectures and direct instruction) with an end goal of testing and assessment. It is the primary role of teachers to pass knowledge and information onto their students. In this model, teaching and assessment are viewed as two separate entities. Student learning is measured through objectively scored tests and assessments. In Student-Centered Approach to Learning, while teachers are the authority figure in this model, teachers and students play an equally active role in the learning process. The teacher's primary role is to coach and facilitate student learning and overall comprehension of material. Student learning is measured through both formal and informal forms of assessment, including group projects, student portfolios, and class participation. Teaching and assessments are connected; student learning is continuously measured during teacher instruction. The most basic teaching method is explanation. Explanation is characterized by its function as "a tool that is used by a

speaker for understanding or 'giving a sense' to the object of communication, of a debate, or a discussion ... The role of an explanation is to make clearer the meaning of an object (method, term, assignment) maintaining formally the necessary distance between the object of the action or study and the tools. In the learning/teaching process, explanation is a tool used by both, teacher and students. Its goal is to manifest comprehension.

The main objective of explanation in teaching is to enable the learners to take intelligent interest in the lesson, to grasp the purpose of what is being done, and to develop their own insight and understanding of how to do it (Rahman 2004). In addition, and with specific reference to technology education, explanation is used in classroom teaching to provide students with an understanding of the complex and interrelated nature of technology, which is technical, procedural, conceptual and social (Hansen and Froelick 1994). This involves the ability by the teacher to use explanation effectively in order to communicate information to students. From the standpoint of technology education, explanation in teaching is an intentional activity, which represents the discovery of truth, which is based on concrete deductive arguments.

(i) Lecture method (teacher-centered)

Taken to its most extreme interpretation, teachers are the main authority figure in a teacher-centered instruction model. Students are viewed as "empty vessels" who passively receive knowledge from their teachers through lectures and direct instruction, with an end goal of positive results from testing and assessment. In this style, teaching and assessment are viewed as two separate entities; student learning is measured through objectively scored tests and assessments.

Teacher-Centered Approaches

- Direct Instruction

- Formal Authority
- Expert
- Personal Model

(ii) Activity method (student-centered)

While teachers are still an authority figure in a student-centered teaching model, teachers and students play an equally active role in the learning process. The teacher's primary role is to coach and facilitate student learning and overall comprehension of material, and to measure student learning through both formal and informal forms of assessment, like group projects, student portfolios, and class participation. In the student-centered classroom, teaching and assessment are connected because student learning is continuously measured during teacher instruction.

Student-Centered Approaches

- Inquiry-Based Learning
- Cooperative Learning
- Personal Model
- Delegator
- Delegator

(iii) High Technology Approach to Learning

Advancements in technology have propelled the education sector in the last few decades. As the name suggests, the high-tech approach to learning utilizes different technology to aid students in their classroom learning. Many educators use computers and tablets in the classroom, and others may use the internet to assign homework. The internet is also beneficial in a classroom setting as it provides unlimited resources.

Teachers may also use the internet in order to connect their students with people from around the world.

(iv) Low Technology to Learning

While technology undoubtedly has changed education, many educators opt to use a more traditional, low-tech approach to learning. Some learning styles require a physical presence and interaction between the educator and the student. Additionally, some research has shown that low-tech classrooms may boost learning. For example, students who take handwritten notes have better recall than students who take typed notes. Another downside of technology in the classroom may be that students exposed to spell check and autocorrect features at an earlier age may be weaker in spelling and writing skills. Ultimately, tailoring the learning experience to different types of learners is incredibly important, and sometimes students work better with a low-tech approach.

Some examples of low technology usage in different teaching methodologies:

- Kinesthetic learners have a need for movement when learning. Teachers should allow students to move around, speak with hands and gestures.
- Expeditionary learning involves "learning by doing" and participating in a hands-on experience. Students may participate in fieldwork, learning expeditions, projects or case studies to be able to apply knowledge learned in the classroom to the real world, rather than learning through the virtual world.
- Many types of vocational or practical training cannot be learned virtually, whether it be a laboratory experiment or woodworking.

Through these different approaches to teaching, educators can gain a better understanding of how best to govern their classrooms, implement instruction, and connect with their students. Within each category of teacher and student centeredness

and tech usage, there are specific teaching roles or "methods" of instructor behavior that feature their own unique mix of learning and assessment practices. Learn more about each one to find the best fit for your classroom.

2.7 Students' interest and their academic performance in Integrated Science

According to Ramsden (1998), many teachers consider pupils‟ attitudes and interests and how to make the pupils feel more positive about their science lesson as the most pressing area of research in science education. Students' interest towards science may be used to refer to as general and continue positive or negative feelings about science. Thus, the way a student thinks and the way they approach a problem. It also implies an attitude of wanting to find explanations that are secular and do not refer to authority (Schreiner and Sjoberg, 2006). Students' interest in a subject area are considered important outcomes from teaching and learning. Rutherford and Ahlgren (1990) also revealed that the content and practice of science education have not been connected with pupils‟ interests and experiences, leading to a sense of its irrelevance to their lives. A consequence of this is that school leavers may be ill-prepared by their school science education for personal decision making on the many controversial societal issues that continue to raise public debate and concern. However, a more interesting school science can lead to more motivation, engagement and participation (Schreiner and Sjøberg, 2004). The students will need to be strongly motivated and sense that they are learning something worthwhile, interesting and valuable to them.

2.8 Science Laboratory

Science educators have believed that the laboratory is an important means of instruction in science since late in the 19th century. Laboratory instruction is essential because it

provides training in observation, supplied detailed information, and aroused pupils' interest.

Shulman and Tamir, in the Second Handbook of Research on Teaching (Travers et al., 1973), listed five groups of objectives that may be achieved through the use of the laboratory in science classes:

1. skills - manipulative, inquiry, investigative, organizational, communicative
2. concepts - for example, hypothesis, theoretical model, taxonomic category
3. cognitive abilities - critical thinking, problem solving, application, analysis, synthesis
4. understanding the nature of science - scientific enterprise, scientists and how they work, existence of a multiplicity of scientific methods, interrelationships between science and technology and among the various disciplines of science
5. attitudes - for example, curiosity, interest, risk taking, objectivity, precision, confidence, perseverance, satisfaction, responsibility, consensus, collaboration, and liking science (1973, p.1119).

For every student, one of the common excitements of the school days remains associated with the discovery and introduction with the laboratory equipment in school labs., All the apparatuses are the pillars of every lab, be it in schools, colleges, research labs, or medical laboratories.

The earliest laboratory according to the present evidence is a home laboratory of Pythagoras of Samos, the well-known Greek philosopher and scientist. This laboratory was created when Pythagoras conducted an experiment about tones of sound and vibration of string. It is a place where scientific research and development is conducted and analyses performed, in contrast with the field or factory. Most laboratories are

characterized by controlled uniformity of conditions (constant temperature, humidity, cleanliness). Modern laboratories use a vast number of instruments and procedures to study, systematize, or quantify the objects of their attention. Procedures often include sampling, pre-treatment and treatment, measurement, calculation, and presentation of results; each may be carried out by techniques ranging from having an unaided person use crude tools to running an automated analysis system with computer controls, data storage, and elaborate readouts.

Laboratory techniques are the set of procedures used on natural sciences such as chemistry, biology, physics to conduct an experiment, all of them follow the scientific method; while some of them involve the use of complex laboratory equipment from laboratory glassware to electrical devices, and others require more specific or expensive supplies. Laboratory equipment refers to the various tools and equipment used by scientists working in a laboratory. Laboratory equipment is generally used to either perform an experiment or to take measurements and gather data. Larger or more sophisticated equipment is generally called a scientific instrument. The classical equipment includes tools such as Bunsen burners and microscopes as well as specialty equipment such as operant conditioning chambers, spectrophotometers and calorimeters.

2.9 Scientific Laboratory Technician

The role of a scientific laboratory technician is to provide all the required technical support to enable the laboratory to function effectively. This allows scientists to concentrate on, and perform, the more complex analytical processes in the laboratory. The technician will be involved in a variety of laboratory-based biological, chemical,

physical and life science investigations. Adhering to correct procedures and health and safety guidelines is essential.

The role of a teaching laboratory technician is similar, although this work takes place in educational institutions, where it's their job to support science teachers, lecturers and students.

However, you will typically need to:

a. perform laboratory tests in order to produce reliable and precise data to support scientific investigations
b. carry out routine tasks accurately and following strict methodologies to carry out analyses
c. prepare specimens and samples
d. construct, maintain and operate standard laboratory equipment, for example centrifuges, titrators, pipetting machines and pH meters
e. keep equipment in a clean and serviceable condition and ensure the safe removal of waste
f. record, and sometimes interpret, results to present to senior colleagues
g. use computers and perform mathematical calculations for the preparation of graphs
h. ensure the laboratory is well-stocked and resourced and that everything is clearly and correctly labelled
i. keep up to date with technical developments, especially those which can save time and improve reliability
j. conduct searches on identified topics relevant to the research
k. follow and ensure strict safety procedures and safety checks.

2.10 Theoretical Framework (Constructivist Theory of Learning)

Since the 1980s, science education has been strongly influenced by constructivist thinking (Taber, 2009). Constructivism emphasises the active role of the learner, and the significance of current knowledge and understanding in mediating learning, and the importance of teaching that provides an optimal level of guidance to learners. (Taber, 2011).

This research work is within the broad theory of constructivism traced to the work of Ausubel, Piaget, and Vygotsky. This theory currently dominates research in science education. It might not be realized immediately that constructivism theory could underpin a survey that involves the analysis of questions pertaining to attitudes, beliefs experiences and interests. This could be a legitimate declaration and assertion. However, constructivism is not in a literal sense a framework, the theoretical stance may be said to be constructivist. Constructivism may be defined as an epistemological theory which sees the learner as an active participant, construct knowledge rather than just passively takes in information the teaching/learning process. The learner comes into the learning situation with prior (experience) knowledge on the subject matter. It is based on this prior knowledge that the learner interprets the new situation presented. This means that the construction of new knowledge in science is strongly influenced by prior knowledge. It is also a process where motivation and interest in the subject matter may enhance or hinder such construction to take place. The new knowledge gained may be a replacement, addition, or modification of extant knowledge in the individual student. The construction of new knowledge takes place at an existing cultural context, such as geographical location, religion, social and economic class, language and ethnicity.

It is important to note that, constructivist framework requires that one should pay attention to attitudes, experiences and interests in a teaching and learning processes. The study framework, therefore, could be seen to be organized on the principle that individuals build or construct their own meaning of new information on the basis of their existing knowledge and that what a person brings to the learning environment is very critical. Each student brings learning outcomes that affect his or her view of the world and his or her ability to accept other views grounded in science concepts. In this way, science education can be contextualized and linked to the life world experiences of individual students. The new learning outcome experiences are used by the student to construct new meaning in new instructional indicators. This knowledge construction according Vygotsky (1986), is shaped through social interactions with members of the community. Thus, making teaching and learning meaningful for the student, one has to take cognizance of the social and cultural environments of the individual child. With awareness of the need for the individual child's environment in the classroom, school teaching and learning will largely be informed by the interaction between the conceptual domains of the home or community and school.

Social constructivist postulate that learners construct meaning through interactions with others, with materials, and by observation and exploration of events (Driver et al., 1994). According to Strike and Posner (1992), constructivist-based research put forward that informal science experiences lay the critical foundations for deep conceptual understanding (cited in Jones et al., 2000). As such, constructivists hold the view that learners‟ understanding of school science, to a large extent, is conditioned by their present common-sense experiences. This understanding, in turn is shaped by their prior encounters with various natural phenomena, even though their interpretations of such encounters may or may not be scientifically valid (Ebenezer and Connor, 1998).

Hence, it is essential that the curriculum should be constructed and shaped to reflect pupils‟ learning experiences in the affective domain (Driver et al., 1994).

In the concept formation process, what a learner already knows or believes interacts with a new conception to which the learner has been exposed. Through the use of language individual concepts can then be connected to build more complex concepts. Without both cognitive and social interaction though language, a new conceptual understanding will be difficult to achieve (Tobin and Tippins, 1993; Tobin et al.,1994). A constructivist instructor plays a key role at the interface between curriculum and student to bring the two together in a way that is meaningful for the learner. Thus, instructors with a constructivist viewpoint can influence the understandings of their students, and plan mediating events that assist students in moving from a current understanding, which is not scientifically based to a more scientifically accepted understanding (Brooks and Brooks, 1999; Driver et al., 1994). It is suggested that a good instructor can help with the process of conceptual change. But his or her task goes beyond clearly explaining the new theory, ideally, he or she plays the role of a “facilitator”.

Teaching strategies using social constructivism as a frame of reference relate to teaching in contexts that might be personally meaningful to students. These also involve negotiating understanding with students through class discussion in small as well as large groups of students (Wood et al., 1995, cited in Dougiamas 1998). The study is further underpinned by the affective factors of learning. This is because the whole being of the learner is involved in construction of knowledge from the perspective of social constructivism discussed above. In other words, learning involves both the cognitive and affective domains and that the latter plays an equally important role as the former

in the knowledge construction. The learner can only be motivated to engage in meaning making in science only if it is of interest and value to the learner. The nature of interest and value the learner has towards science leads to the development of attitudes towards the discipline. The learner is further motivated to engage in science learning only if the subject matter is relevant to the learner's daily activities.

2.11 Conceptual Framework

A conceptual framework includes one or more formal theories (in part or whole) as well as other concepts and empirical findings from the literature. It is used to show relationships among these ideas and how they relate to the research study.

The conceptual framework describes how professional development options for teachers relate to their knowledge and attitudes and how these affect the senior high secondary integrated science core curriculum is implemented for student-centered inquiry teaching. The contextual issues that are restricting the application of an integrated science curriculum and acting as obstacles to students' learning for acquiring scientific skills, knowledge and understanding are also discussed.

The poor learning of students in integrated science in the Ho Municipality cannot be solely blamed on the students as far as academic is concerned. One question that must be asked always is that are they not the same student that pass in other subject but may fail in integrated science? Figure 1 represents the conceptual framework for the study. The listed factors were believed to have effect on the overall performance of students in integrated science in senior high schools in the research area. Each of these factors have significant role to play in the teaching and learning of integrated science.

The conceptual framework outlines the relationships of teachers' professional learning opportunities on their knowledge and beliefs and how these influence the implementation of intended core curriculum in senior high secondary integrated science for student-centered inquiry teaching. Also, the contextual factors that are limiting the implemented integrated science curriculum and act as barriers to students' learning for developing scientific literacy are presented. To determine the current state and condition of teaching and learning of integrated science by students the variables listed in the conceptual framework shown in the Figure 1, were measured to determine the extent to which each of them affected integrated science teaching and learning in the research area.

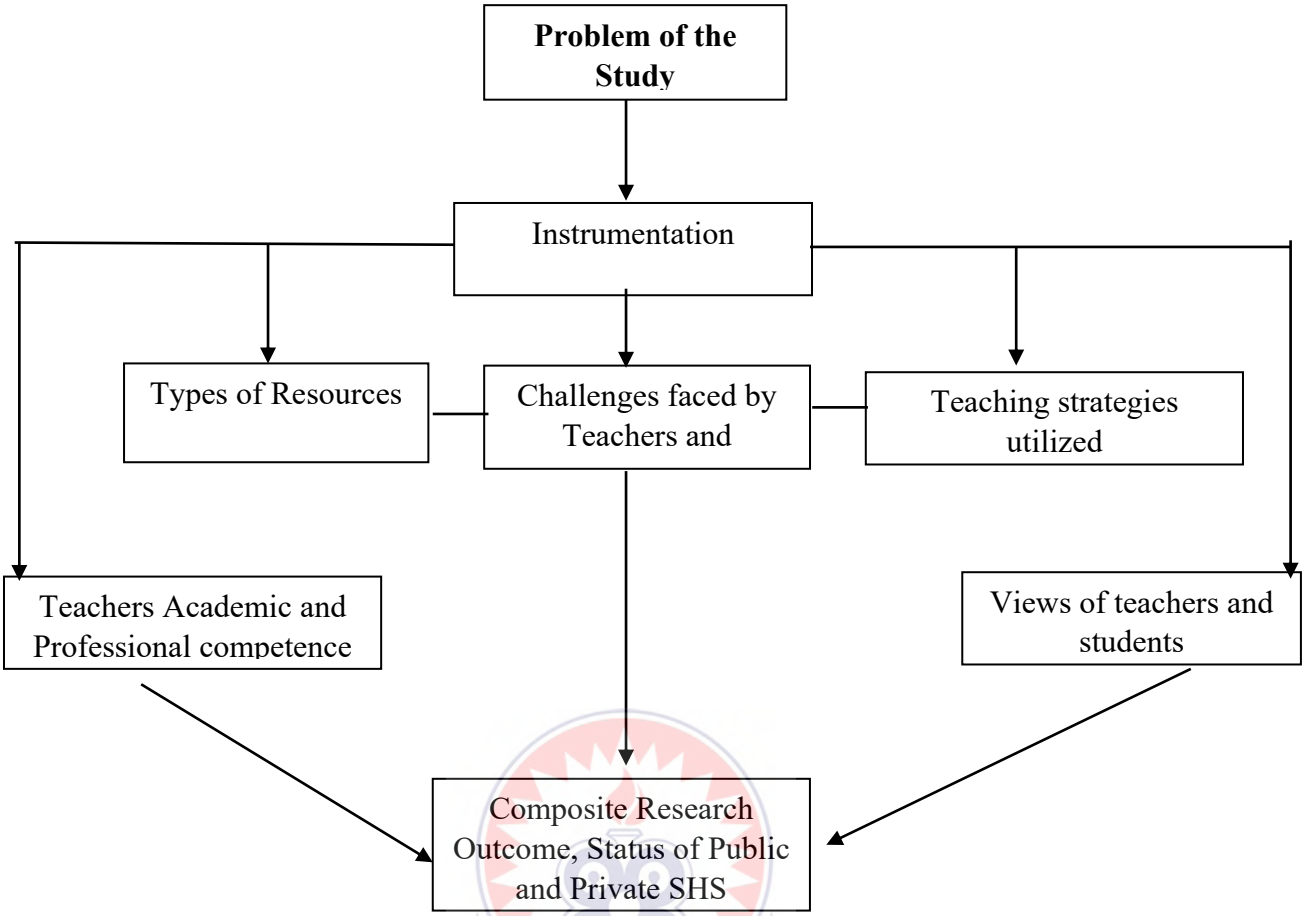

Figure 1: Diagrammatic form of the conceptual framework

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter describes the research design methods and procedures that were used to investigate and describe the Status of Integrated Science Teaching in Selected Public and Private SHS in Ho Municipality. The chapter also provides information on how the reliability and validity of the instruments were determined, the procedure for the collection of data and the method used for the analysis of the data.

The chapter comprises five sections. The first section deals with the research design which underpins the study and the rationale for adopting both quantitative and qualitative research methods. Section two focuses on the target population, the sample and sampling techniques. Sections three and four describe the research instruments and the procedures used for data collection. Section five outlines the data analysis procedures.

3.1 Research Design

The study is a descriptive survey. It compared the status of Integrated science teaching in selected Public and Private senior high schools in Ho municipality. The study used descriptive survey design, which is the systematic collection of data in standardized form from an identifiable population or representative (Oso and Onen, 2009). A survey attempts to collect data from members of a population in order to determine the current status of the population with respect to one or more variables (Gay, 1992). It provides a general picture of comparison of the performances of students in integrated science by determining and reporting the way things are in an institution or a given geographical area.

Looking at the descriptive research, its survey focuses on determining the status of a defined population with respect to certain variable. The study was also designed to describe the actual picture of what is happening in the various selected SHS. Data for the actual picture of what is happening in the various schools were generated through surveys of science teachers and students, availability of teaching resources, teaching methods etc. through focus group interviews meetings with teacher's headmaster and lab technicians.

The purpose of collecting data related to the status of teaching integrated science in selected public and private SHS in the Ho Municipality was to compare and come out with the actual happening in the various schools that making them not to perform well in the West African Senior School Certificate Examination (WASSCE), since 2009, and then to validly develop recommendations for closing the gap between the public and private and other regions at large. The research study involved both quantitative and qualitative approaches. The quantitative approach involves the use of questionnaires to survey both teachers and students. The teachers' survey helps to identify their qualifications, typical practice in curriculum delivery, teaching and assessment teaching, and possible factors limiting quality and acting as barriers to change. The students' survey further helped to gather students' views about their interest in and relevance of integrated science, the teaching methods used by their teachers and whether they are been engage in practical activity or not.

The qualitative approach on the other hand involved focus group meetings with science teachers and other key stakeholders associated with science education in the selected public and private SHS in Ho municipality. The focus groups were used to gather data that helped define the status in teaching and learning in the various schools, in order to

describe current practices in the selected schools. The questionnaire designed included both closed- ended and open-ended questions. This was administered to both public and private selected SHS integrated science students in their second year and their integrated science teachers.

Interviews were conducted to elicit information from SHS integrated science students and their teachers, the headmaster the lab technician the store keeper and other stakeholders of education about their views of integrated science teaching and learning in the municipality. The data from the interviews consist of information provided directly by the respondents about their experiences, knowledge and opinions about science teaching and learning in the selected SHS schools in the municipality.

A mixed method approach involving a combination of quantitative and qualitative data from different sources was used to analyzed findings in this study. Qualitative approach helps to provide answers to questions by examining various social settings of the selected various schools and individual's students who are in the various selected schools, this allow the researchers to share in the understandings of what is actually happening and been practice in the various selected schools. According to Giddens (1984), qualitative approaches help elucidate the frames of meaning of the actors and investigate the contextual action. Miles and Huberman (1994), also argue that, findings of qualitative approaches have a quality of undeniability, because they help create solid, visual permanent, vivid and meaningful flavour descriptions of incidents and events. Qualitative approaches are necessary for generalizing and to help allow the researcher to have more continuous reflection on the research in progress, more interaction with the participants in the research, and more room for ongoing alteration as the research proceeds (Bouma, 2000).

According to Bouma, (2000); Howe, (1985), the major setbacks qualitative approach is that they tend to produce large amounts of information that can only be focused and attained after data collection, less focused at the outset that is, assume less in advance which variables are relevant, more open-ended, and are operational to context that are likely to be geared on the intentions, explanations, and judgements of the participants, since it aims at providing the maximum opportunity for the researcher to learn from the respondents in the research.

In quantitative approached, the primary aim is to determine the relationship between an independent variable and another set of dependent or outcome variables in a population. House (1994) indicates that questionnaires in quantitative research give more precise, explicit, and predetermined measure and identification of relevant variables in advance. They are also economical and very easy to administer to sample large groups of respondents; it gives better potential to generalize findings because samples are larger; ensure efficient gathering of large quantities of baseline data; and also the responses gathered can usually be transformed easily by coding into data files that are ready for statistical analysis. One major challenged of questionnaires are it is very difficult and time consuming to construct and the success of using questionnaires depends on the honesty of the respondents (Bouma, 2000). Though quantitative approached is complex in nature, they are more quickly accomplished, producing more reliable conclusions and help provide reportable findings involving percentages of variable occurrences (Berg, 1989). Hence, quantitative approached are the best to used in educational research Quantitative and qualitative approaches are often use to gather valuable information on their own, and they complement one another in the content. apparently, no single approach either quantitative or qualitative approach can be perfectly effective (Berg, 1998) therefore, each method can be improved significantly through

triangulation of data from various sources. This approach is therefore significantly relevant to this study to triangulate and corroborate findings from both SHS integrated science students in the various selected public and private schools in their second year and their integrated science teachers.

3.2 Population

The target population comprised all public and private senior high schools in Ho Municipality which in total are fourteen (14) SHS. However, the accessible population comprises of five (5) public and three (3) private senior high schools in Ho Municipality.

3.3 Sample Size and Sampling Technique

A sample consists of a group of elements in a research study from which data are generated. It is a small proportion of the population that is selected for observation and analysis for research (Ndagi, 2002). The concept of sampling involves taking a portion of the population, making observations on this smaller group and generalising the findings to the large population (Dandy & Mensah, 2014). A random stratified sampling approach was used to select students from the five public and three private schools for the survey, such that, girls only and coeducational schools were represented for the study. Third year students made up of 258 students from public and 242 students from private schools were sampled. A total of 499 student completed the student survey questionnaires. According to Amedahe and Gyimah (2008, p.138), "in most quantitative studies, a sample size of 5% to 20% of the population size is sufficient for generalization purposes". Focus group participants included integrated science teachers, school headmasters, laboratory assistants. Letter of invitation outlining the purpose of the study and consent form was sent to them. (See Appendices F).

All the five (5) public and three (3) SHS private selected schools were visited to determine the extent to which the science teachers in the selected public and private senior high schools are qualified to teach integrated science. The type of human, material, and financial resources that are available for integrated science teaching in the selected public and private senior high schools. And to know the instructional approaches that were utilized by their teachers. The teachers were also served with questionnaires. Of the population of 70 integrated science teachers, 56 returned questionnaires for analysis. There was face to face interviews for the headmasters to ascertained the academic and professional qualifications of their integrated science teachers, the materials and financial resources that are available for integrated science teaching, and challenges teachers and students faced during integrated science lessons. Checklist was also used to check on the lab equipment and schools with or without lab assistant.

3.4 Research Instruments

The main research instrument used for the study for the collection of data was teacher and student questionnaires because it is an effective means of obtaining information from a larger number of respondents (Macmillan, 1996). The questionnaire was completed at the respondent's own convenience. Moreover, it offers assurance of anonymity. Also focus group interviews, observational schedule and finally checklist for collecting data on TLMs.

3.4.1 Questionnaires

One main reason of the survey questionnaire was to seek information about opinions of the respondents (May, 2001). Two forms of survey questionnaire were used in the data collection procedure; a teacher survey and a student survey. Both the teacher and

student questionnaires were adapted from the studies conducted by Goodrum, et al. (2001), Goodrum and Hackling (2003) and were modified by the Researcher to suit the purpose of this study. In the development of the questionnaires, particular attention was given to ensure that questions are unambiguous and precise, unbiased and specific, unloaded, relevant, succinctly conceptualized as well as avoiding vagueness (May, 2001). Also, care was taken to ensure questions were appropriate for the age limit of the teachers and student for better comprehension.

3.4.2 Teacher Questionnaire

The teacher questionnaire comprised five sections. The first section elicited information on demographic data regarding the teacher's age, qualifications, years of teaching experience, area of teaching specialization. The second section focused on the teacher's views of effective use of teaching and learning resources in presenting lessons. Section three examined what is actually happening in the teaching and learning processes of science. Section four focused on the constraints to effective teaching and learning of science in their schools. The final section sought the teacher's views as to what interventions can be designed to improve science teaching and learning in their schools.

3.4.3 Student Questionnaire

The purpose of the student survey was to investigate students' importance about science teaching and learning in secondary schools' education. The questionnaire comprised five sections. The first section asked for demographic data, including the student's school (boys/girls/co-educational), year and sex. Sections two and three elicited the students' views about what they see actually happening in science teaching and learning in his/her classroom. Section four asked students what they need to do, to be successful in science. The last part, section five contained open-ended questions in which students

were asked to write answers describing how the study of science could be improved and the purpose of learning science.

3.4.4 Interviews

Interviews were also conducted with the headmasters and laboratory assistants in the selected schools. They responded to a semi-structured interview that focused on the research questions. It is worth mentioning that during the interview with the headmasters and the laboratory assistants, other issues of importance that were relevant to the purpose of this study were raised.

To achieve rich and constructive discussions during the interviews, participants were provided with the focus questions to afford them the opportunity to be well prepared for the discussion to bring with them well-constructed and broadly representative views before the commencement of the interviews. At each interview section, the researcher wrote and recorded the views and responses on written material of the respondents. Each focus interview and discussion lasted for about thirty minutes.

3.4.5 Checklist

Checklists are assessment tools that set out **specific criteria**, which educators and researchers may use to gauge skill development or progress, or availability of items. Generally speaking, checklists consist of a set of statements that correspond to specific criteria; the answer to each statement is either "Yes" or "No", or "Done" or "Not Done". The researcher used a checklist for the purpose of cross-checking the availability of some teaching and learning resources in the various SHS visited for self-evaluation.

3.4.6 Observation Schedule

Participant observation is described as a strategy to inquiry and data gathering by Marshall and Rossman (2006). "The systematic noting and recording of events, behaviors, and artifacts (objects) in the social chosen for study," is how they define it (p.139). The researcher searches the observation instruments for student notebooks and exercise books that would have revealed the attitudes of both teachers and students toward integrated science instruction. For the purpose of this study, the researcher adapted a personal form of observation (PFO) which was used to collect data.

3.5 Validity of the Main Instruments

An instrument is considered valid when there is confidence that it measures what it is intended to measure in a given situation. Bell (2004) stated that validity of an instrument is about whether an item measures or describe what it is intended to measure or describe. To ensure validity of the survey questionnaires, the researcher presented the drafts to an expert in the field of integrated science education who is my supervisor to assess the questions for face and content validity. Based on his comments and suggestions the questionnaires were restructured to achieve the purpose of the study. Also, the questionnaires items were developed for both teachers and students and were confidential and anonymous. Thereafter, the survey questionnaires were found suitable by the researcher and were used to generate data for this research study.

3.6 Reliability of the Main Instruments

The consistency of the scores gained throughout time on a population of people, irrespective of time differences and the scorers, is the reliability of the instrument (Amedahe & Gyimah, 2008). To determine the reliability of the questionnaire for both teachers and students the research instruments were trial-tested in one public and one

private SHS. Fifty student respondents were selected randomly from the second-year students. It was done because they are the next to graduate to form three, and there was higher probability that they have completed more of the integrated science topics. Pilot testing of the instruments reduced ambiguity of items and therefore enhanced their reliability (Day, 1979; Meriwether, 2001).

The reliability of the teacher's questionnaire was determined to be 0.68 and that of the student's questionnaire is 0.76. A dependability co-efficient of 0.70 or above is considered adequate for research purposes, according George & Mallery (2003). Therefore, the reliability coefficient of 0.68 and 0.76, respectively from teachers and student's questionnaire using Cronbach-Alpha, obtained in the study confirmed that the questionnaire used in the main study were within the acceptable benchmark of instrument being reliable.

3.7 Data Collection Procedure

Data collection for this research study involved five stages, which were:

Stage 1- Schools access, teachers' and students' permission

An introductory letter was obtained from the HOD of Integrated Science Education - UEW, which was used to seek permission from School headmasters, integrated science teachers and the lab assistants. The researcher sent the introductory letter to the schools that have been sample for the study to discuss the purpose of the study and to seek their consent for completing the questionnaires and interviews. The researcher used one week to visit the various schools to meet the integrated science teachers to arrange the time that would be convenient for the questionnaire to be administered. The selection of respondents was done a day prior to the administration of the instrument.

Stage 2 - Distribution and administration of questionnaires

Teachers and students survey questionnaires were distributed to all the Integrated science teachers and the students in the selected public and private SHS in the Ho municipality that were involved in the study. To ensure a high return rate of the questionnaires, the Researcher personally supervised the distribution and collection from teachers and students. Most of the teachers preferred completing the questionnaires from home and so some failed to return the questionnaires for analysis. The return rate was 80% for the teacher survey. A 99.9% return rate was achieved for the student survey, since the students were asked to respond to the questionnaires during class time. The administration of the student questionnaires was personally supervised by the Researcher.

Stage 3 - Interviews

This phase of this research data collection involved interviews with headmasters of the various selected public and private SHS, and the laboratory assistants. Consent forms and letters of invitation stating the purpose of the study were sent to individual heads and the lab assistant to seek for their consent to participate in the interviews.

Stage 4 – Checklist

The forth phase of this research data collection involved the researcher using a checklist to ascertain the availability of a laboratory assistant in the various selected SHS and also the availability of teaching and learning resources and to check whether they are in good condition or not.

Stage 5 – Students' notebooks and exercise books

In this phase, the researcher obtained students' notebooks and exercise books to ascertain the records of students' performance, with regard to what have been taught them.

3.8 Ethical Considerations

Ethical considerations are a set of principles that guide research designs and practices. According to Bryman and Bell (2007), one of the most important principles related to ethical considerations in dissertations is full consent should be obtained from the participants prior to the study. The researcher obtained from the appropriate authorities of the institution. Verbal consent was obtained from the individual respondents prior to the commencement of the study. All participants were given a guarantee of confidentiality and anonymity in reporting the information provided for the study.

3.9 Data Analysis

The data collected were grouped according to the research questions, where applicable, descriptive statistical methods involving frequency count and percentages means, were used to analyze the data from the teacher and student questionnaires. The frequency of teachers' and students' responses in each category was calculated after the responses to the open-ended questions were categorized into categories. The number and percentage of respondents who chose "always," "most of the time," "some of the time," "not often," and "never" were coded and converted into percentages and used to answer the research questions using the SPSS 22.0 statistical package. The qualitative data from the interviews of the audio recordings and discussions were listened to several times by the Researcher and transcribed verbatim. Transcripts were analysed by reading through several times by the Researcher to identify emerging themes that are relevant to the

study for interpretation and analysis. Data that occurred most frequently were emphasised in the reporting of findings.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter focuses on the presentation, interpretation, and analysis of empirical data derived from the study's sample of participant replies. Tables were offered to clarify and corroborate the conclusions. To analyze the data, descriptive statistics were employed. Based on the questionnaire, frequency distribution tables with percentages were created. The checklist and the interviews both underwent qualitative examination. Before beginning the discussion, the results are first presented in a table. The results are presented in prose when it is not necessary to present the responses in a table.

4.1 Demographic Data on the Respondents

In the Ho Municipality there are about twelve (12) SHS. The schools involved in this study are five public schools and three private schools. The entire population of 70 integrated science teachers were surveyed and of these 56 filled and submitted the questionnaires giving a total of 80% return rate (Table 1). The sample for the study consists of 499 senior high secondary integrated science students as intact class groups, (SHS3) completed the student questionnaires. 258 questionnaires from public schools and 241 questionnaires from private schools, and of these 383 were from co-educational, 116 from girls' only schools. The sample comprised form 3 classes, and these were 32% males and 68% females for coding and analysis. The sample was therefore representative of the population. The mean ages of the respondents from 13 - 18 years were 82% and 19-22 was 18% (Table 2).

Table 1: Background data on the research subjects (teachers, N= 56)

Variable	N	Percent
Public	36	64
Private	20	36
Total	56	100

Table 2: Background data on the research subjects (students, N= 499)

Variable	Category	Frequency	Percent
School	1	62	12.4
	2	76	15.2
	3	61	12.2
	4	121	24.2
	5	59	11.8
	6	30	6.0
	7	40	8.0
	8	50	10.0
Type	1	258	51.7
	2	241	48.3
Type of school	2	116	23.2
	3	383	76.8
Sex	1	161	32.3
	2	338	67.7
Age	13-18	409	82.0
	19-22	90	18.0
Form	3	499	100.0

Note: Schools: 1 = Public, 2 = Private; Type of school: 1= Boys, 2= Girls, 3 = Coeducational; Sex: 1= Male, 2= Female

4.2 Presentation of the Results by Research Questions

4.2.1 Research Question 1:

To what extent are the integrated science teachers in the selected public and private senior high schools qualified to teach integrated science?

Items 1.4, (i), (ii), and 1.5 of Section 1 of the teachers' Questionnaire (Appendix A) were used to analyze the responses in regard to the academic qualification and area of specialization of integrated science teachers. The information gathered concentrated on the teachers' academic and professional backgrounds as well as their years of teaching experience.

The professional qualifications of the teachers are shown in Table 3. The results indicate that all the teachers in the public SHS had a preservice teacher education in science and education; however, only 39% were trained in science and education in the private schools.

Table 3: Professional qualification of integrated science teachers

Teacher Qualification	Public SHS		Private SHS	
	N	Percent	N	Percent
Trs. Cert 'A'	0	0	0	0
HND	0	0	6	10.7
B. Ed	20	35.7	12	21.4
B.Sc. (Ed)	16	28.6	2	3.6
Total	36	64.3	20	35.7

Note: Trs. Cert 'A'– Teacher Certificate 'A'; HND-Higher National Diploma; B. Ed-Bachelor of Education, B. Sc. (Ed) – Bachelor of Science in Education

In the areas of higher degree, majority of teacher had no higher degree in either integrated science or education (90%) in the public SHS in the municipality. Only five teachers had a master's degree in education and two had a master in science. In the private SHS, none of the teacher had master degree at all. The area of specialization or major subject areas of integrated science teachers' qualifications are presented in Table 4.

Table 4: Integrated science teachers with higher degrees (n=56)

Teacher Qualification	**Public SHS**		**Private SHS**	
	N	Percent	N	Percent
None	29	51.8	20	35.7
M. Ed	5	8.9	0	0
M. Sc./MPhil Sc.	2	3.6	0	0
PhD.	0	0	0	0
Total	36	64.3	20	35.7

On an area of specialization, of the 36 Integrated science teachers in the public school, less than (25%) majored in Integrated science, and more than (50%) majored in biological science. For the private SHS teachers, none of them had a major in Integrated science. This is shown in Table 5.

Table 5: Teacher's area of subject specialization (n=56)

Variable	Public SHS		Private SHS	
	N	Percent	N	Percent
Integrated Science	3	5.4	0	0
Physics	5	8.9	2	3.6
Chemistry	8	14.3	5	8.9
Biology	14	25	7	12.5
Agricultural Science	6	10.7	4	7.1
Mathematics	0	0	2	3.6
Total	36	64.3	20	35.7

The results showed that, none of the teachers in the public school had less than five years of teaching experience. More than half of the teachers (60%) had between 11-20 years of experience. In the case of the Private schools, almost all of the teachers had less than five years in teaching (Table 6). This indicate that there were more experience teachers teaching integrated science in the municipality.

Table 6: Integrated science teachers teaching experience (n=56)

Teaching experience	Public SHS		Private SHS	
	N	Percent	N	Percent
5 years and below	0	0.0	15	26.8
6-10 years	5	8.9	5	8.9
11-15 years	20	35.7	0	0.0
16-20 years	10	17.9	0	0.0
Above 21 years	1	1.8	0	0.0
Total	36	64.3	20	35.7

The interview schedules the heads of institutions also revealed that all the teachers teaching integrated science in the public school holds Bachelor degree in education and some about seven (7) of them have master's degree. Under area of specialization only three of the teachers had specialization in integrated science education, while the rest of the teachers teaching integrated science in the public SHS had specialization in physics, chemistry, biology and agricultural science. The participant from the selected private SHS, stated that not all their teachers had Bachelor degree in education, stressing that some have HND in Physics and mathematics, but majority have Bachelor on education. Also, the respondent from the private school indicated that none of their teacher had second degree.

Findings: 4.2.1

All of the teachers in the sample public SHS had higher education. Most teachers were trained in science education and had teaching qualifications in integrated science, chemical sciences and biological sciences. Only a few teachers had master degrees in education or science. Almost two-thirds of teachers had 11-20 years teaching experience and more than one-third had less than six years of experience. In the case of the private SHS, almost all the teachers had less five years working experience, none had specialization in integrated science education. And none of them held second degree.

4.2.2 Research Question 2:

What type of human, material and financial resources are available for integrated science teaching in the selected public and private senior high schools?

Teachers' responses regarding the quantity and quality of resources available in their schools for teaching integrated science and the availability of textbooks and lab

assistants reveal that in the public SHS only (12%) of the respondents reported there are laboratory assistants in their schools and only (5%) of the respondents in the private SHS reported there are laboratory assistant in their schools. The data also reveal that about (68%) of the public SHS schools do not have laboratory assistant, and (15%) of the private SHS also have no laboratory assistant. (64.6%) more than half of the respondent indicate that most students had no textbooks for teaching and learning integrated science in both public and private SHS in the Ho municipality. The results have been summarized in Table 7.

Table 7: Teacher's response on the availability of resources for teaching integrated science in schools (n=56)

Resources	Public SHS		Private SHS	
	Yes	No	Yes	No
We have a laboratory assistant	12.0	68.0	5.0	15.0
There is enough textbook for most students	15.4	55.5	20.0	9.1

On the rating of the state of the facilities and resources for integrated science teaching and learning it was found that more than half of the respondents believe that schools had inadequate laboratory resources (66%); condition of laboratory equipment and facilities (70%); inadequate provision of chemical reagents (71%); the number of experimental tools for practical work (63%); More than half (61%) indicate the amount and high quality of the student's textbooks was good or satisfactory. The results have been summarized in Table 8.

Table 8: Resources for teaching and learning integrated science in schools as rated by teachers (n = 56)

Availability and condition of resources and facilities	Good	Satisfactory	Poor
Adequate laboratory resources	18.5	15.5	66.0
Condition of laboratory equipment and facilities	5.0	25.0	70.0
Provision of chemical reagents	10.6	18.3	71.1
Number of experimental tools for practical work	16.4	20.4	63.2
The amount and high quality of the student's textbooks	19.1	42.0	38.9

The study also investigated the type of materials available for the teaching of integrated science in the selected schools using checklist. It was enquired from the lab assistants whether they had some resources like chemical (e.g., anhydrous copper (II) sulphate and or cobalt chloride paper) that could be used by the integrated science teachers to enable them teach some topics that needs hands-on activity. From Table 9, it was realized that all schools visited had equipment (M), apparatus (N), and glassware (Q). Only two schools had chemical (O) and reagent (P). In schools which had the materials, the materials were not sufficient for the student during practical lessons. This may be the reasons why the teachers do not conduct hands-on activities during practical lessons but rather preferred demonstrating which leads to the used of lecture method in teaching integrated science. According to the laboratory assistant when interviewed, it was clear that they only received chemicals or reagent when they are about writing WASSCE.

Table 9: Science materials available in the selected public and private schools

School	Materials				
	M	N	O	P	Q
1	+	+	-	-	+
2	+	+	+	-	+
3	+	+	+	-	+
4	+	+	-	-	+
5	+	+	-	+	+
6	+	+	-	+	+
7	+	+	-	-	+
8	+	+	-	-	+

Note: key *M = Equipment, *N = Apparatus, * O = Chemicals , *P = Reagent, *Q = Glassware, (+) = material present (-) materials not present

From the interview, participants' responses about human, material and financial availability for teaching integrated science showed that, In the public SHS all the participants responded that they have insufficient teacher for teaching integrated science, they also lamented on the fact that they do not have lab assistant for integrated science as subject, but they do have lab assistant for say physics and chemistry. For the private SHS all the respondents stated categorically that they do have enough integrated science teacher nor lab assistants. The respondents also made it clear that, there was lack proper funding for building of new classroom and well-equipped laboratories, lack of well-stocked libraries, have insufficient resources including chemicals, reagent, equipment and textbooks and there is a general lack of maintenance of school facilities. All the respondents attributed these current challenges to the introduction of the free

SHS policy, which has given rise to student enrollment and government unable to provide inadequate funds for schools even if it will provide the funds do not come on time for the headmaster to use in running administrative purposes. The private SHS visited respondent also lamented bitterly about materials and facilities in their school, according to their responses since the introduction of the free SHS school policy they are face with students' enrolment, hence have reduce their source of funding which they mostly depend of purchasing materials and facilities.

Also, the data gathered from the interview with the laboratory assistants showed that, they had teaching and learning material but were not enough, those that were available majority of them were not in good conditions. For reagents and chemicals, they stated that they hardly get them. These had an adverse effect in that they were not able to perform some simple practical lessons that they used to perform. They also stated that there was inadequate funding coming from the school management and this have been the trends since the introduction of the free SHS policy and that they only get funds to buy chemicals and reagents during WASSCE.

Finding 4.2.2

More than half of the schools did not have a laboratory assistant. The presence of a laboratory assistant was associated with only a small increase of teaching time allocated to practical work. Teachers from schools with laboratory assistants reported much higher levels of satisfaction with the availability and state of repair of equipment and facilities than teachers without laboratory assistants. Almost two-thirds (65%) of the respondents rated the quality of student textbooks as either good or satisfactory, however, two-thirds of teachers believe that most students have no textbooks for science.

4.2.3 Research Question 3:

What challenges do the teachers and students face when teaching and learning integrated science?

The questionnaire asked teachers of integrated science to tick any four (4) significant factors that they believed prevented the teaching and learning of integrated science at their respective schools. The six most important factors restricting effective teaching and learning of integrated science mentioned by the respondents include insufficient teaching and learning resources, lack of well-equipped laboratories, poor students' behavior towards integrated science, non-conducive classroom environment, insufficient time for teaching integrated science, and work overload. The provision of impress to buy teaching and learning materials, inadequate motivation and lack of lab assistants also got some significant weighting as factors that restrict effective science teaching and learning.

According to the teachers, it was found that the most important factors limiting effective integrated science teaching and learning in schools are insufficient teaching resources, a lack of well-equipped laboratories, a poor students' attitude toward integrated science, a non-conducive classroom environment, insufficient time for teaching integrated science lessons, and a lack of an integrated lab assistant.

Table 10 shows the total weighted rank for each element as well as a ranking summary of importance.

Table 10: The proportion of teachers who name problems that prevent successful teaching, their importance rankings, and the factor's overall weighted ranking.

Restricting factors	Number of teachers respondent				Total weighted rank
	First (x4)	Second (x3)	Third (x2)	Four (x1)	
Lab equipment (including textbooks, charts, specimens, chemical reagents)	30	25	4	2	205
Lack of school farm animals and crop farm	0	0	2	0	4
Lack of Integrated science lab	20	10	2	1	115
Provision of impress to buy teaching and learning materials	2	5	4	2	33
Insufficient Integrated science textbooks	0	0	0	2	2
Lack of lab assistant	2	7	3	3	36
Insufficient time allocated for teaching of Integrated science lesson.	8	5	4	3	58
Work overload	4	7	3	4	47
I don't get administrative support	1	4	3	2	24
Demonstrated command of the subject matter	4	1	0	2	21
School learning environment	8	4	6	6	62
Poor teaching skills and methods	1	0	2	2	10
Students' behavior to integrated science	5	10	4	21	79

Note: *The total weighted rank was calculated by multiplying the number of teachers who selected the restricting criteria by the weighting assigned to the rankings and then adding these weighted ranks.

From the interview with the heads of institutions regarding the what challenges do the teachers and students face when teaching integrated science? Participants' views about

the challenges inhibiting the teaching and learning of integrated science in their respective Senior High Schools in the municipality were identified and organized into themes. These included: funding, resources, facilities and class size constraint; curriculum and pedagogy constraints; teacher knowledge, skills, attitude and professional learning constraints; and, community support constraints. According to their responses There were inadequate funding for schools and these had an adverse effect in that there are not sufficient resources for the large number of students. The participants mentioned that science education is poorly funded by government; schools lack enough classrooms, well-equipped laboratories and reagents, libraries, insufficient curriculum resources including textbooks, class sizes are large, and many schools do not have a laboratory assistant.

Also, ineffective teaching and assessment strategies had a negative impact on students' interest in integrated science and these factors constitute major hindrances to the quality of science education in schools. The participants emphasized that the integrated science curriculum was overloaded with content; hence are taught in abstract; there are insufficient time for integrated science learning and lack of effective assessment and follow-up. Most schools do not have sufficient human resources and qualified and dedicated integrated science teachers. Also, teachers were not adequately committed to teaching and to support students' learning because they had limited opportunities for participation in professional learning activities and thereby, had limited skills for teaching integrated science. Lack in-service training, effective pedagogical knowledge and teaching skills. Lastly, the integrated science teachers were not adequately supported and were poorly remunerated by the government. Teaching and teachers are not valued by the community and so teachers were not so dedicated to their profession. The participants remarked that integrated science learning in schools are not valued and

recognized by the community and teachers were paid lower salaries and allowances compared to their colleagues in other professions.

Findings 4.2.3

The teachers indicated that the most important factors inhibiting effective teaching and learning of science in schools include insufficient teaching resources, lack of well-equipped integrated science laboratories, poor students' attitude to integrated science, non-conducive classroom environment, insufficient time for teaching integrated science and work overload.

4.2.4 Research Question 4:

What are the main teaching strategies the teacher used in the integrated science lesson?

The responses of the integrated science teachers on their teaching strategies were tapped using item section C of the students' questionnaire (Appendix B). From Table 11 below, the results revealed that what actually happens during the teaching and learning of integrated science lessons in class is teacher explanations and demonstrations and note copying by the students. About 40% of the time were used to engaged students in whole-class discussions with the teacher while only 12% of the lesson time are used for students taking part in group practical activities. And only 5% of the respondents agreed that teacher organizes hands-on activities for student.

Table 11: Students estimated average percentages of various teaching-learning strategies in a typical integrated science lesson. (n= 499)

Variable	All of the time	Most of the time	Some time	Not often	Never
Listening to the teacher explaining/or demonstrating to the whole class	194 (38.9)	185 (37.1)	98 (19.6)	14 (2.8)	8 (1.6)
Copying the teacher's note from the board	44 (8.8)	86 (17.2)	199 (39.9)	132 (26.5)	38 (7.6)
Preparing my own notes from the textbook	74 (14.8)	146 (29.3)	218 (43.7)	39 (7.8)	22 (4.4)
Performing practical activities	31 (6.2)	61 (12.2)	176 (35.3)	117 (23.4)	114 (22.8)
Teacher demonstrates activities on lesson taught	66 (13.2)	88 (17.6)	235 (47.1)	56 (11.2)	54 (10.3)
The teacher organizes hands-on activities for students	26 (5.2)	63 (12.6)	146 (29.3)	143 (28.7)	121 (24.2)

Table 12 showed of the frequency in which various teaching-learning activities occur in Integrated science lessons. From table 12, the data indicated that students copy notes all or most of the time (70%), read the textbook and make their own notes (62%) all or most of the time. However, fewer students indicated that they asked questions concerning things or words that were not clear to them (38%) and 43% indicated that they watched the teacher conduct an experiment all or most of the time respectively. Only (12.8%) indicated that they carry out practical experiments on their own all or most of the time. The frequency of group work (33%) and discussion with other students (36%) were also low. Also, all or most of the time they followed the teacher's instructions in practical work (60.6%). In addition, about half of students believed that integrated science dealt with what they are concerned with (44%) but does not relate much to their life (20%). It could be inferred from these data that instruction is highly teacher-centered, students are passived listeners to teachers' instruction and there are limited opportunities for students to conduct hands-on activities. The results in totality

showed that practical activities were not performed as regularly as required by the developers of the SHS integrated science programme and that teachers used lecture strategies in their lesson delivery.

Table 12: Students' rating of the frequency of various teaching-learning activities in integrated science lessons

Variable	All of the time	Most of the time	Some time	Not often	Never
I copy notes the teacher has given us.	213 (42.7)	140 (28.1)	96 (19.2)	38 (7.6)	12 (2.4)
I read Integrated science textbooks and make my own salient notes	120 (24.0)	191 (38.3)	157 (31.5)	28 (5.6)	3 (0.6)
I ask questions concerning thing or words that are not clear to me	110 (22.0)	79 (15.8)	203 (40.7)	89 (17.8)	18 (3.6)
I watch the teacher perform an experiment	142 (28.5)	70 (14.0)	66 (13.2)	97 (19.4)	124 (24.8)
I carry out integrated science experiments on my own	22 (4.4)	42 (8.4)	124 (24.8)	126 (25.3)	185 (37.1)
I work in groups with other students during experiment	62 (12.4)	103 (20.6)	118 (23.6)	65 (13.0)	151 (30.3)
I find Integrated science interesting to learn	204 (40.9)	116 (23.2)	99 (19.8)	39 (7.8)	41 (8.2)
I am bored with the Integrated science we do in class	48 (9.6)	50 (10.0)	133 (26.7)	131 (26.3)	137 (27.5)
I follow instructions during practical activities	186 (37.4)	116 (23.2)	94 (18.8)	47 (9.4)	56 (11.2)
I have class discussions with other students on various Integrated science topics	65 (13.0)	113 (22.6)	140 (28.1)	142 (28.5)	39 (7.8)
Science lessons deal with things I am concerned with	105 (21.0)	117 (23.4)	155 (31.1)	80 (16.0)	42 (8.4)
Science is not related to my daily life	55 (11.0)	43 (8.6)	93 (18.6)	92 (18.4)	216 (43.3)

The data gathered from the interview on the instructional strategies that are utilized by the integrated science teachers in delivery lessons indicated that, due to a lack of possibilities for involvement in professional learning activities, their integrated science teachers had a limited range of pedagogical abilities. The participants explained that most teachers do not have enough background knowledge in the integrated science they teach; this is due to the fact that most of the teachers do not have a specialization degree in integrated science, for instance, a teacher may have specialization in physics and maybe teaching integrated science, such teacher may not have the knowledge and skills of drawing in biology and this had a detrimental effect on students' interest in integrated science.

One matter of the respondents, that was of interest, that was stated by the participants in the public schools was the fact that their teachers are undergoing a professional learning program named Professional Learning Community (PLC) which is a new professional development program undertaken by all the SHS teachers to enhance their teaching pedagogy. But the respondents from the private school stated that they have not stated anything like that yet. (Appendix C)

Also, from the data gathered form the interview with the laboratory assistants it is clear that integrated science teachers do not engage their students in hands-on activities this is because, according to the participants practical activities for all students were not normally conducted, the reason they gave was practical activity is not allocated for integrated science teachers on their school time table.

Findings 4.2.4

In integrated science lessons, teachers devote more than two-thirds of lesson time to teacher-centered activity by giving notes to students and less than one-third to student-centered activity thus less than half the respondents believe that practical work is used to illustrate the concepts that have been introduced.

4.2.5 Research Question 5:

What are the views of the teachers and students on the interventions that can be designed to improve integrated science teaching and learning in the selected public and private senior high schools?

Improving Teaching and Learning

Finally, the questionnaire asked the teachers to identify several approaches to improve integrated science teaching and learning in their schools. The most common suggestions for improving integrated science teaching and learning by the respondents included: providing more or better equipment and facilities (75%); regular supply of consumables (68%); provision of qualified integrated science laboratory assistants in schools (63%); better quality scientific textbooks for students and in school libraries (45%); encouraging students to develop interest and better attitudes in integrated science learning (39%); more and better-integrated science scheduling in schools' timetable (36%); need for integrated science laboratories (34%); better government and community support for integrated science education and teachers (14%); and more time for students to participate in hands-on integrated science activities (13%). Table 13, summarizes the numerous suggestions made by teachers.

Table 13: Suggestions from teachers for improving integrated science teaching and learning (n=56)

Suggestion for improvement	N	Percentages of respondents
Resources		
- Supplying enhanced or more equipment and facilities	42	75.0
- Consumables, like as reagents, must be replenished on a regular basis.	38	67.9
- Provision of qualified integrated science laboratory assistants in schools	35	62.5
- Better quality scientific textbooks for students and in school libraries are required.	25	44.6
- Need for integrated science laboratories	19	33.9
- Employing more qualified and dedicated integrated science teachers	5	8.9
Teachers		
- More professional learning opportunities for integrated science instructors are required.	8	14.2
- Motivating integrated science teachers through incentives such as science teaching allowances, study leave with pay, housing and automobile loans, and so on.	5	8.9
- Teachers must learn to improvise equipment that is not provided in schools from the local communities.	4	7.1
- Need for teachers to teach subjects in their areas of expertise	3	5.4
- Regular surveillance of integrated science teaching and learning in schools is required.	2	3.5

Curriculum and instructional methods		
- More and better-integrated science scheduling in schools' timetable is required.	20	35.7
- More time for students to participate in hands-on integrated science activities.	7	12.5
- Integrated Science curriculum content needs to be decreased	4	7.1
- Students require regular assessments and feedback.	2	3.5
Governmental and parental support		
- Encouraging students to develop interest and better attitudes in integrated science learning.	22	39.3
- Better government and community support for integrated science education and teachers is required.	8	14.3
- Better concerns by parents about their children's education and the provision of textbooks for their children are required.	5	8.9
- Increasing student understanding of the significance of integrated science	1	1.7

Suggestions for Improving the Study of Integrated Science

Students were asked to respond to various items about what needed to be done to improve the study of integrated science (item 5.1 section 5 of the students' questionnaire). The six most common suggestions for improving integrated science lessons were: sufficient resources for learning availability (57%); having qualified, competent and interested teachers (48%); more practical experiment (43%); using of good pedagogy (21%); having laboratory technician for integrated science lessons (11%) and more student group work (10%). Summary of students' responses are presented in Tables 14.

Table 14: Percentage of students' responses to the question: How could the study of integrated science be improved? (n=499)

The study of integrated science can be improved when	N	Percent
Resources		
- Resources for learning are available (laboratories, science facilities, equipment, access to textbooks)	285	57.1
- There is a conducive school environment (not noisy, well ventilated and good lighting system)	15	3.0
- Computers are used to support teaching-learning	12	2.4
- Students have their own materials to study at prep and home (textbooks, writing materials, charts)	10	2.0
Teachers		
- There are good teachers (qualified, competent and interested)	240	48.1
- Teachers use good teaching approaches (from simple to complex, discuss new ideas and demonstrates)	105	21.0
	56	11.2
- There is lab assistant for integrated science.	15	3.0
- Teachers are friendly and respond to students' problems		
Curriculum and instructional methods		
- Students are engaged in more practical experiment group discussion learning (being attentive, reading notes, doing homework, carrying out own observation, asking and responding to questions)	215	43.1
- Students do group work (assignments, practical and projects)	50	10.0
- Tutorials and extra lessons are organized for students	10	2.0
	5	1.0
- More time is allotted to science teaching-learning		
Management and government support		
- Teachers are supervised regularly on work done	10	2.0
- Lab are build for integrated science practical lessons	5	1.0

Note: Many students made more than one suggestion for improving the study of integrated science in their various schools. The 499 students made a total of 1033 suggestions for improvement.

Table 15, compared teachers' and students' suggestions for enhancing academic instruction and learning in integrated science. Data in Table 14 revealed that the most common suggestions by teachers for improving the teaching-learning of integrated science included provision of resources and equipment (75 %), need for integrated science lab (33.9%) and create more and better timing for integrated science in the school timetable. However, 48% of the students suggested that more qualified and dedicated integrated science teachers should be employed and that they need to engage in hands-on activities (43%).

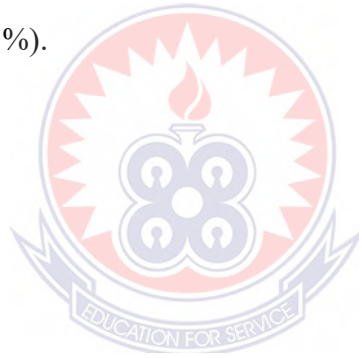

Table 15: Percentage of teachers and students mentioning various ways for improving integrated science teaching and learning activities.

Variable	Suggestions for improving integrated science in percentages	
	Teacher (n=56)	Student (n=499)
Resources		
- Supplying enhanced or more equipment and facilities	75.0	57.1
- Need for integrated science laboratories	33.9	57.1
Teachers		
- Employing more qualified and dedicated teachers	14.2	48.1
- Provision of qualified integrated science laboratory assistants in schools	62.5	11.2
Curriculum and instructional methods		
- Need to engage students in hands-on activities	12.5	43.1
- Need for more and better timing for science in the school timetable	35.7	1.0

The interview schedule for the heads of the various SHS schools visited about what interventions could be designed to improve the quality of teaching and learning of integrated science in SHS schools in the municipality, the participants made broad recommendations (such as better funding) for enhancing integrated science teaching and learning. According to their responses effective teaching and learning of science require adequate funding to build more new classrooms and laboratories and also to

provide facilities and equipment including curriculum resources such as textbooks and consumables for the teachers to engage students in practical and activity work. The participants remarked that government should provide enough funds to schools and science education in particular for more classrooms, laboratories, libraries and curriculum resources including equipment, facilities, and textbooks, and that there should be manageable class sizes.

Also, in order to improve the teaching and learning of integrated science, the curriculum should be simplified and more time should be allotted for it in the school schedule. This will give teachers the chance to engage students in practical work and activity work along with appropriate classroom interactions like discussing, questioning, and student excursions. The participants stressed the need to alter the integrated science curriculum from being didactic and teacher-centered to being inquiry-based and student-centered. (Appendix C)

Finding 4.2.5

The findings revealed that the most common suggestions by teachers for improving the teaching-learning of integrated science included provision of resources and equipment (75 %), need for integrated science laboratory (33.9%) and create more and better timing for integrated science in the school timetable. However, 48% of the students suggested that more qualified and dedicated integrated science teachers should be employed and that they need to engage in hands-on activities (43%).

4.3 Discussion of Findings

Teachers Qualification and Areas of Specialization

The research sought to find out the extent to which teachers were professionally and academically qualified to teach integrated science at the S.H.S. level in the Ho

municipality. It was realized that all of the teachers in the public school sampled had at least four years of higher education. Most teachers were trained in another field of science and not in Integrated science. Almost two-thirds of the teachers had 11-20 years of teaching experience, but in the private SHS, only 1% had a higher degree in education. Almost all had just a maximum of five years of teaching experience (see Tables 3 & 6).

Of the 36 Integrated science teachers in the public school, less than one-third specialized in Integrated science, and more than half majored in biological science, for the 20 private SHS teachers none of them had a specialization in Integrated science (see Table 5). This finding was comparable to that made by Parku (2012), who found that just 9.5% of the sampled 50% of specialized teachers were integrated science specialists—a negligible percentage in the context of integrated science. In order to create the necessary groundwork for the study of pure science at the S.H.S. level, it is imperative that this issue be addressed and that the proper professionals with integrated science backgrounds teach the subject.

Availability of Material, Financial Resources for Integrated Science Teaching in the selected SHS.

Quality integrated science teaching and learning requires that there are sufficient classrooms and laboratories, adequate curriculum resources, modern equipment and facilities and manageable class sizes. Teacher questionnaire and the checklist data reveal that during integrated science teaching and learning there are not enough science classrooms and laboratories, science classes are very large, science laboratories have inadequate facilities and equipment, and supplies of chemicals and reagents for experiments are quite low (Tables 7, 8 & 9). In addition, more than two-thirds of the

integrated science teachers indicated that currently their schools lack laboratory assistants (Table 7) and the condition of science facilities and equipment in their schools is very poor due to lack of maintenance because of the lack of laboratory assistants in schools. Teacher questionnaire data reveal that the quality of student textbook(s) was quite satisfactory; however, about 60% of teachers indicate that most of their students do not have their own textbook(s) to study at home (Tables 7).

Teachers data further reveal that for effective integrated science lessons there is the need of financial support such as impress with additional funds to build integrated science laboratories and classrooms so that the class sizes would be reduced for effective teaching and also to provide schools with enough relevant teaching resources so that the teaching-learning environment is characterized by enjoyment, fulfillment and mutual respect between the teacher and students and for teacher to regularly engage learners in practical and activity work (Table 10).

In addition, this study argues that laboratory assistants are essential in schools to support teachers in preparation for practical work and for ensuring regular supplies of chemical reagents and the maintenance of laboratory equipment and facilities, these findings support a recent report in science teaching and learning in Australia by Goodrum et al. (2001) that quality science is supported by excellent facilities, equipment and curriculum resources including instructional technologies, and with manageable class sizes.

This study revealed that lack of resources for effective teaching and learning of integrated science in Ho Municipality schools has contributed to the poor state of science education in the country so that teacher-centered and teacher-directed activity predominates because learners have limited opportunity to engage in practical and

activity work. In developed countries of Australia and Japan information and communication technologies are exploited to enhance learning of science for scientific literacy of the citizens. Also, a large number of schools in these countries are well-resourced with curriculum materials including computers connected to the Internet for students to find information beyond the resources of the school.

Challenges that Teachers and Students Faced when Teaching and Learning Integrated Science

The teachers indicated that the most important factors inhibiting effective teaching and learning of science in schools included insufficient teaching resources, lack of well-equipped laboratories, poor students' attitude to science, non-conducive classroom environment, insufficient time for teaching science and large class sizes. This affirms the findings with Idiaghe (2004) that students in schools with inadequate instructional resources performed poorly as compared with their counterparts in schools with adequate facilities. The interviews with the head of the institutions also reveals that integrated science curriculum is overloaded with content, there is no enough time for integrated science learning in the school timetable. Integrated science teachers lack sufficient opportunities for in-service training to improve their teaching, thereby making them not competent enough to regularly engage their students in practical and activity work. According to Anamual-Mensah (2004), there are many reasons for this situation of Ghanaian students' failure and ambivalence in science education.

Main Teaching Strategies Teachers Uses in the Integrated Science Lesson

Quality teaching of science requires regular inquiry-oriented hands-on practical and activity work for all students so that they can develop inquiry skills and an appreciation of the nature of science. For that matter the research also focused on the predominant

strategies utilized during integrated science lessons. The results from Table 11 from the student's data revealed that what actually happens during the teaching and learning of integrated science lessons in class was teacher explanations and demonstrations and note copying by the students. About 40% of the time is used to engaged students in whole-class discussions with the teacher while only 12% of the lesson time was used for students taking part in group practical activities. And only 5% of the respondents agreed that teacher organized hands-on activities for student. The low percentages indicated that activity and demonstration methods were not regularly employed in the teaching of integrated science. According to Pell and Jarvis (2001) children preferred practical activities to verbal activities in science. This attested to the fact that demonstration and activities-oriented methods should be employed in the teaching of integrated science for the students to developed interest in the subject.

Views of the Teachers and Students on the Interventions that can be Designed to Improve Integrated Science Teaching and Learning in the Selected Public and Private Senior High Schools

Intervention is a set of actions taken to support students or an individual who are struggling academically or behaviorally. Some of the suggestion made by the teachers in other to improve their teaching were that, there should be an increased allocation of funds for education by government to build new classrooms and laboratories so that class sizes can be reduced. There should also be sufficient funds to equip the laboratories with chemicals and reagents, for regular maintenance of laboratories and equipment, and to provide quality textbooks for the Library (see Table 13). There should also be a reduction in the integrated science curriculum content and more time allocated for it per week in the school timetable to provide opportunities for inquiry-oriented student practical work. There should be a regular assessment and a one-year

internship in all SHS for pre-service integrated science teachers to ensure they are dedicated and competent for teaching. Also, more qualified science teachers should be employed by government in all schools and they should be supported to regularly participate in professional learning activities in order to improve their teaching of science.

Data from the student's questionnaire suggest that integrated science can be improved by providing sufficient science facilities and equipment; qualified, competent and interested teachers; engaging students in group work; and students being actively engaged in learning. (See Table 14).

Discussion on Interviews

The researcher also employed interview to enhance the understanding of the findings obtained. The headmasters and the laboratory assistants were interviewed. Teaching integrated science was expected to be purely practical and experimental in outlook, but the situation was not different when the various heads of institution visited and the lab assistants affirmed that improper funding led to insufficient resources. Hence teachers do not have the needed material to conduct hands-on activities.

All the 8 headmasters interview lamented and wished they could have integrated science laboratory assistants that could be helping the integrated science teachers in conducting experiment as the integrated science teachers always complained of not having time for practical activities because of workload.

On the issue of challenges, the participant stated overloaded integrated science curriculum, lack of in-service training opportunity for teacher to enhance themselves, lack of funds to stock the science lab and lack of motivation for integrated science

teachers. Most respondents agreed that the best/most effective integrated science instruction method required hands-on group activities, frequent interactions between students and teachers, and manageable class numbers as well as suitable facilities and resources.

The lab assistant lamented that schools' labs and materials are not in good condition, there are not enough chemicals and reagents, for conducting experiment. These finding explained why the teaching and learning of integrated science in the Ho municipality is not effective, resulting in the poor performance of some of the students in the WASSCE as stated in the report of the result analysis (2021) by the Volta Regional education Directorate, Ho.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Overview

This chapter focuses on the summary of the research study, the research findings identify implications and limitations, conclusions and gives recommendations on how to handle the teaching and learning of integrated science at the SHS level. Finally, it makes suggestions for future study.

5.1 Summary of the Major Findings of the Study

The study's main objective was to investigate the status of integrated science teaching and learning in selected public and private SHS in the Ho Municipality. It focused on the professional and academic qualification of teachers who teach integrated science at the SHS level, the type of human, material, and financial resources that are available for integrated science teaching, challenges that hindered the teaching and learning of integrated science, the main teaching strategies the teacher used in the presentation of an integrated science lesson and finally, the views of the teachers and students on the interventions that can be designed to improved integrated science teaching and learning in SHS in the municipality.

The picture of the actual status of integrated science teaching and learning was based on reports provided by teachers, students heads of institutions, and lab technicians. Triangulation of data from various sources corroborated the findings; however, a limitation of the study was the lack of classroom observations that may have provided further insights into current classroom practice. The evidence gathered in this study has been used to create an actual status of integrated science teaching and learning.

Recommendations are made to bring about change in integrated science education in Ho municipality.

Academic and professional Competency of teachers teaching integrated science in the Ho municipality.

The main findings were:

On average 50% of the teachers teaching integrated science at the selected schools were academically and professionally competent to teach integrated science. All the teachers at the public SHS had taught integrated science for more than five years, while the private SHS integrated science teachers had less than five-year experience.

Type of human, material, and financial resources that are available for integrated science teaching

The finding of the research showed that there were no proper laboratories, integrated science lab technicians, practical equipment and teaching materials, and chemical and reagents. Lack of these resources prevented the teachers from engaging their students in hands-on activities.

Challenges that hinder the teaching and learning of integrated science

Important factors that teachers, students, and heads of institutions mentioned that limited the quality of integrated science teaching and learning included overloaded curriculum content and inadequate time allocated on the various school's time-table for teaching integrated science practical activities; poor teaching skills and lack of effective approaches for inquiry-based teaching; learners' poor communication skills, poor attitude of students to integrated science. limits the quality of teaching and learning of integrated science.

Furthermore, insufficient funding for integrated science, lack of laboratories, and lack of enough teaching resources including modern textbooks further limit the quality of integrated science teaching and learning. More so, lack of enough qualified, dedicated, and knowledgeable teachers and laboratory assistants; insufficient laboratory facilities and equipment; and poor maintenance of laboratory facilities and equipment.

Main teaching strategies the teacher uses in the presentation of integrated science lesson

Teacher-centered or teacher-directed activity predominates in lessons and there is less frequent independent student practical works or student discussion in integrated science lessons. It could be inferred from teachers and students' data that instruction is highly teacher-centered, students are passive listeners to teachers' instruction and there are limited opportunities for students to do hands-on activities.

Views of the teachers, students and headmasters on the interventions that can be designed to improve integrated science teaching and learning in SHS in the municipality.

Various ways for improving the quality of teaching and learning of integrated science in Ho municipality were suggested by teachers, students, and heads of institutions. These include that the integrated science curriculum content should be reduced and the content that should be relevant to the needs and aspirations of the learners and their real-life physical environment so that learners develop scientific literacy. They also indicated that there should be more time allocated to integrated science in the school timetable for teachers to do more hands-on inquiry-based practical and activity work for students.

Every week, learners should participate in inquiry-based hands-on practical and activity work, lessons should connect science to students' everyday lives, teachers and learners should regularly interact, and teachers should keep an eye on learners' progress by giving them useful feedback on their learning. Only with more integrated science teaching time, smaller class sizes, and improved teacher knowledge and abilities would the improvements be feasible.

Additionally, there needs to be enough funding for integrated science to build additional classrooms with seating for students, laboratories with facilities and equipment, more curriculum resources like contemporary textbooks, and supplies for laboratories like chemicals. In order for teachers to give students more inquiry-based, practical, and activity work each week, there should be provisions for laboratory assistants for integrated science, good upkeep of laboratory facilities and equipment, and well-managed class numbers.

More so, there should be more qualified, competent, knowledgeable, and dedicated science teachers, better or more regular assessment and monitoring for teachers, and provision for an internship year for new teachers under a mentor teacher during their initial teacher education to ensure that teachers are competent and dedicated to integrated science teaching and the teaching profession more incentives and scholarships for teachers for further education. Also, there is a need for students to develop better attitudes toward integrated science

Finally, in order to improve their teaching practices, teachers should have access to sufficient opportunities for ongoing professional learning activities, collaboration with other teachers and experts on curriculum materials and policy, as well as adequate support from school administrators, colleagues, parents, and the larger community.

5.2 Conclusion

The picture of actual current state of integrated science teaching and learning was based on reports provided by teachers, students, laboratory assistants, headteachers and the used of checklist. The evidence gathered in this study has been used to create a picture of the actual status of integrated science teaching and learning. Constraints that limit the actual quality of integrated science teaching and learning have also been identified. Recommendations are made to bring about change in integrated science teaching and learning in the Ho Municipality so that constraints are reduced to it minimum best.

5.3 Recommendations

From the research findings of this study conducted in Ho municipality, it is vividly evident that the quality of teaching and learning of integrated science in the Ho Municipality is in a awful state. The following recommendations provide direction for the reform of integrated science education.

i. Teachers who specialize in integrated science education should be employed to teach subjects in the selected SHS in the municipality and other schools in the region. There should be professional standards regulating the teaching profession in the country. That is the National Teaching Council (NTC) should make it mandatory that all categories of teachers in the country are registered for teaching. The NTC should ensure that all public and private schools employ only registered teachers. Also, there should be regular monitoring and supervision of all teachers in the school system to ensure accountability and quality by the Heads of institutions.

ii. Resource allocation for education and integrated science education should be improved. All schools should have laboratories for integrated science with adequate supplies of equipment and reagents for practical work in science. Also, there should be laboratory assistants in all schools to help with the proper maintenance of laboratory facilities and equipment and also to assist in the preparation for practical experiments so that teachers include more inquiry-based practical work for students in science.

iii. The integrated science curriculum should be restructured to meet the needs and aspirations of learners; future citizens and the nation. The curriculum needs to be streamlined and reduced to incorporate only those aspects of instructional content knowledge that would enhance learners' conceptual understandings. Also, the amount of time allocated to integrated science teaching and learning in the school timetable should be increased so that students can participate in inquiry-based practical and activity work

iv. The Regional or the Municipal Education Service in collaboration with other stakeholders in Education organizes annual in-service training on the improvisation of local instructional resources for integrated science teachers in the municipality. This will help students appreciate their natural environment and develop scientific concepts on their own. Also most teachers will be exposed to the new ideas and pedagogies in teaching and learning integrated science.

v. Science teachers should be motivated and supported by colleagues, school administration, parents, and the larger community. A cohort of outstanding educators who can lead in education should be developed by giving out about 20 scholarships per year to teachers to pursue higher education. Also,

there should be regular monitoring and supervision of all teachers in the school system to ensure accountability and quality by the Heads of institutions.

5.4 Suggestions for further research

The study's conclusions have led to the following recommendations for further research:

1. The study was limited to selected public and private SHS in Ho Municipality. There is therefore the need for further replication in parts of the municipality or the country.
2. It is necessary to perform a comparative analysis of the scientific teaching strategies used in multiple public and private high schools in the research area.
3. In the study domain, a survey on integrated scientific educational resources that are already available should be carried out.
4. The integration of information and communication technology (ICT) in integrated science education needs further investigation.
5. A study on the content understanding and instructional requirements for SHS integrated science education in the Ho municipality should be conducted.

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APPENDICES

APPENDIX A

UNIVERSITY OF EDUCATION, WINNEBA

DEPARTMENT OF SCIENCE EDUCATION

TEACHERS' QUESTIONNAIRE

Dear Sir/Madam,

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 thought, opinions and concerns about teaching and learning of Integrated science at SHS. There is no right or wrong answer to each question. Information from this questionnaire will be used to improve the teaching and learning of science in Ho municipality SHS. The information gathered will be aggregated and summarized for inclusion in research reports. No person or school will be identified in any reports.

Thank you for your participation in this study.

SECTION 1: Background Information

1.1 School type: (i) Public ☐ Private ☐

(ii) co-education ☐ single sex ☐

1.2. Your age: 20 yrs and below ☐ 21-30 yrs ☐ 31-40 yrs ☐

41-50 yrs ☐ 51 yrs and above ☐

1.3. Sex: Male ☐ Female ☐

1.4. . (i) What is your academic qualification? Trs. Cert 'A' ☐ HND ☐

B.Sc ☐ B.Sc(Ed) ☐

(ii) what is your area of specialization?

Integrated science ☐ Biology ☐ Chemistry ☐

Physics ☐

Agric science ☐ Others (specify) ☐

(iii) Any additional qualification(s)? M. Sc ☐ M Ed ☐ M.Phil. ☐

PhD ☐

1.5 Years of Teaching Experience:

0-5 yrs ☐ 6-10 yrs ☐ 11-15 yrs ☐ 16-20 yrs ☐

21 yrs and above ☐

1.8. The total number of students I teach is .....

SECTION 2

2.1 In your view what is the main purpose of teaching Integrated science to SHS students?

.....

.....

.....

2.2. Under normal circumstances, how should Integrated science be taught in senior high schools? List three characteristics of effective Integrated science teaching.

(i).....

(ii).....

(iii).....

2.3. How is Integrated science taught in your school?

……

……

2.4. (i) how many periods is allocated for teaching of Integrated science in your school

1- Hour ☐ 2 - Hours ☐ 3- Hours ☐

(ii) For effective teaching and learning of Integrated science in your school, how many periods would you prefer?

1- Hour ☐ 2 – Hours ☐ 3 - Hours ☐

SECTION 3: Integrated science teaching and learning delivery processes

3.1 Examine the following statements carefully and decide how they correspond with your

views about quality Integrated science teaching and learning. Tick the box to show how often these things happens under normal circumstances.

Integrated Science teaching should be taught effectively by	**All the time**	**Most of the time**	**Some time**	**Rarely**	**Never**
(a) Students plan their own experiments to investigate their own questions					
(b) Practical work is used to illustrate the concepts that have been introduced					
(c) There is not enough time after the experiment to discuss the main findings					
(d) I use the learners' previous knowledge as a guide in lesson planning					
(e) I use locally available materials for my lessons					
(f) Students discuss among themselves during lesson					
(g) I organize hands-on activities for the students					
(h) I get administrative support					

(i) The time allocated for Integrated science is sufficient					
(j) In order to complete the syllabus, I use the lecture method					

3.2. Resources and facilities for teaching and learning Integrated Science in SHS in your school

Recourses	**Yes**	**No**
(a) We have a laboratory assistant		
(b) Most students have a text book		

Recourses and facilities	**Good**	**Satisfactory**	**Poor**
(c) Sufficient laboratory facilities			
(d) State of repair of laboratory facilities and equipment			
(e) Supply of chemical reagents			
(f) Number of equipment for experiment			
(g) Quality of the student's textbook(s)			

SECTION 4: Limiting factors to effective teaching and learning processes

What factors hinder effective teaching and learning of integrated science in your school?

(Please tick the most important **four (4)** as applicable)

Factors	Tick
1. Lab equipment	
2. Lack of school farm animals and crop farm	
3. Lack of Integrated science lab	
4. Provision of impress to buy teaching and learning materials	
5. Insufficient Integrated science textbooks	
6. Lack of lab assistant/technician	
7. Insufficient time allocated for teaching of Integrated science lesson.	
8. Work overload	
9. I don't get administrative support	
10. Demonstrated command of the subject matter	
11. School learning environment	
12. Lack of motivation	
13. Students' behavior	

SECTION 5: Suggestions for improvement

In your opinion, what interventions (actions) can be designed to improve the teaching and learning of Integrated science from the factors ticked in section 4 above?

(i).....

.....

(ii).....

.....

(iii).....

.....

(iv).....

.....

Thank you

APPENDIX B

UNIVERSITY OF EDUCATION, WINNEBA

DEPARTMENT OF SCIENCE EDUCATION

STUDENT SURVEY QUESTIONNAIRE

Dear Student,

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

There is no correct or wrong answer to any of the questions. This is not a test or an exam 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 significant to improve the ways of teaching and learning of Integrated science in your school and other schools in the municipality as a whole. Your answers will remain confidential and any reports about this research will not name any students, teachers or schools.

Thank you for participating in this study.

SECTION 1: Background Information

Name of School:.....

Type of School: Boys' only ☐ Girls' only ☐ Co-education ☐

Sex: Male ☐ Female ☐

Age: .....Years

Class Level: SHS ☐

SECTION 2: Please indicate by ticking the appropriate options: how often the following

activities happen in your Integrated science class during teaching and learning?

Teaching-learning activity	All of the time	Most of the time	Some times	Rarely	Never
1. Listening to teacher explaining/or demonstrating to whole class					
2. Copying the teacher's note from the board					

3. Preparing my own note from the textbook					
4. Performing practical activities					
5. Teacher demonstrates activities on lesson taught					
6. Teacher organizes hands on activity for students					

SECTION 3: Please indicate by ticking the appropriate options how often the following

activities happen in your science class?

In my science class	**All of the time**	**Most of the time**	**Some time**	**Not often**	**Never**
1. I copy notes the teacher has given us.					
2. I read Integrated science textbooks and make my own salient notes					

3. I ask questions concerning thing or words that are not clear to me					
4. I watch the teacher perform an experiment					
5. I carry out integrated science experiments on my own					
6. I work in groups with other students during experiment					
7. I find Integrated science interesting to learn					
8. I am bored with the Integrated science we do in class					
9. I follow instructions during practical activities					
10. I have class discussions with other students on various					

Integrated science topics					
11. Science lessons deal with things I am concerned with					
12. Science is not related to my daily life					

SECTION 4: Please indicate by ticking the appropriate options:

To perform well in Integrated science, I need to be able to:	Strongly agree	Agree	Disagree	Strongly Disagree
1. think and ask questions when needed				
2. remember lots of facts				
3. understand and explain science phenomenon and facts				
4. apply scientific knowledge to understand things in my life				

SECTION 5: Please provide answers to these questions in the spaces provided bellow.

5.1 How could the study of Integrated science in your school be improved ?

.....

.....

.....

.....

5.2 How will the study of Integrated science as an individual student help you now or in the near future?

.....

.....

.....

.....

Thank you, “Akpe”.

APPENDIX C

Sample Interview Data (Headmasters)

INTERVIEW CONDUCTED ON THE 23RD JUNE, 2023

Preamble: Good afternoon, sir.

Response: Good afternoon.

Question: Can I please know your name and your status in the school?

Response: I am Mr …….. the headmaster of …….. school.

Prologue: I'm grateful, Sir. The goal of this interview is to ascertain the current state of integrated scientific teaching and learning in our senior high schools by determining the real activities taking place in our secondary school. By responding to the following questions, I hope we can determine what is truly going on in integrated science education. But, there's a chance we'll have more queries later on.

Question 1: What do you think actually happening in the integrated science teaching and learning at the present time in your schools?

Responses:

The majority of senior high schools today have extremely large class sizes. Since the free senior high policy was implemented, the population ratio of one teacher to approximately 80 students in a classroom has replaced the previous population ratio of

one teacher to 40 or fewer students, which makes integrated science instruction and learning challenging. This is the case in the majority of our secondary schools. The enormous number of students in each class makes the subject matter dull for the teachers.

Because of the way that society views education in general and integrated science education in particular, our society's value system for education is flawed. Values like having the correct attitude, being honest, and so forth are therefore in short supply among students these days. This is because courses like accounting, medicine, law, and many others have a more positive attitude than schooling. Essentially, integrated science educators and educators in general are despised by society.

Question 2: To what extent is your integrated science teacher qualified to teach integrated science?

To effectively teach integrated science, teachers must possess strong qualifications, extensive subject-matter expertise, effective pedagogical techniques, and the ability to creatively connect classroom activities to the surrounding community. Every member of the public attests to the teacher's credentials, saying that some of them even hold master's degrees in science. However, very few teachers in the private high school obtain a first degree in science.

Question 3: What are the factors that inhibit the quality of teaching and learning of Integrated science in your schools?

Responses:

The main issue is the population. The free senior high policy has resulted in a notable rise in enrollment. The majority of schools lack laboratories, and there are insufficient facilities to teach integrated science to the vast number of students that attend these days. I wonder what kind of science is being taught when integrated science is taught without a lab. Even in laboratories, there are insufficient and deficient facilities. The majority of the time, there is no lighting system in place to use the microscopes, and occasionally slides are not easily accessible.

The majority of integrated science instruction in our schools is abstract due to a lack of resources, which is another issue. Because there is insufficient equipment to effectively transfer scientific knowledge, teachers end up talking endlessly and repeating what they are teaching multiple times.

Question 4: How could the factors inhibiting the teaching and learning of integrated science be addressed?

Responses:

The government's integrated science education and science teacher value system is inadequate and needs revision. Science instructors should be highly compensated, and the government should support integrated science education. Furthermore, science teachers ought to receive extra funding for research so that they can develop a project by the end of the term. It is important to support science educators in their professional development by sending them to workshops, conferences, and seminars.

A concerted effort should be made to ensure that funds designated for education are appropriately tracked and directed toward the acquisition of the necessary tools and resources for integrated science instruction in classrooms.

Despite having few resources at their disposal, science teachers should be encouraged to improvise the necessary materials in order to improve their instruction and students' learning. In order to enhance integrated science teaching and learning, educators should also be free to collaborate, come up with ideas, offer answers to issues, and change the curriculum.

Question: What can you say about the availability and quality of textbooks for the students?

Responses:

This is yet another crucial matter that must be taken into account. The majority of students are unable to purchase textbooks and even those who can may not be able to afford high-quality ones. Most students cannot purchase textbooks, even in spite of the fact that our current textbooks are either of poor quality or most likely do not satisfy the standards of teaching and learning of integrated science. Therefore, I think that our parents are not making things better and that there are not enough high-quality textbooks available for our senior high schools to use in the teaching and learning of integrated science. The majority of parents don't want to or are unable to buy textbooks for their kids or wards. What is it that educators want students to read or practice in the classroom? Then, since what you practice is what you know better, it makes learning and teaching harder. Practice is necessary, but the majority of parents do not have the

resources available to them so that their wards or children can put what they have learned in school into reality once they get home from school. Thus, these make the issues with teaching and studying integrated science more severe because the majority of students cannot purchase textbooks, and even those who can don't have access to high-quality, standard integrated science textbooks in our schools.

Question: Thank you, sir, let us go to the third question: What do you think are the most important factors that inhibit the quality of teaching and learning of integrated science in our senior high schools at the present time?

Response:

Well, factors that inhibit the teaching and learning of integrated sciences in our senior high schools are numerous. Firstly, the quality of the teacher, that is, how sound and knowledgeable the teacher is determines how far he or she can carry the students. It is one of the major factors that inhibit the teaching and learning of science in our secondary schools. Also, we need to talk about the teaching and learning resources. Teaching and learning resources are other major factors that inhibit the teaching and learning of integrated sciences in our senior high schools. In our schools, there are lack of teaching and learning resources especially resources for integrated science. When there is availability of the teaching and learning materials, that is teaching resources, then our teaching and learning of integrated science in senior high schools will go to a greater extent and this would bring about a change in our technological development.

Lack of personal development by our teachers is another factor that inhibits the teaching and learning of integrated science. Most of our teachers have failed to develop

themselves. So, when a teacher is not professionally developed, how could such a teacher be adequately informed about the new discoveries in sciences? Most of our teachers have been teaching a particular subject for over a decade and yet are not conscious of the latest discoveries in their fields. The inability of teachers to develop themselves will result in them being deficient in the latest methods, approaches, and strategies of teaching and learning integrated science. Self-development is very necessary for teachers of integrated science and as such the school authorities or the government should make room for teachers to develop themselves professionally through regular meetings, such as attending seminars, conferences, and workshops or having focus group meetings where they can discuss the problems encountered so far in the course of their teaching and students' learning.

Question: Before we round up this interview. Sir, what would you say about the number of teachers to students? Do you think there are enough integrated science teachers in our senior high schools?

Response: Saying that we have enough integrated science teachers in our senior high schools is a fallacy. If you look at the present teacher-to-student ratio of 1:80, you will notice that we do not have enough integrated science teachers. Take, for instance, our senior high schools; we have just a teacher to teach chemistry, a teacher to teach physics, and just a teacher or two to teach biology. Then we know there is a problem and that is what we have at hand now. So, we don't have enough integrated science teachers because these chemistry, physics, and biology teachers normally are the same teachers who teach integrated science. Normally, we should have at least 3 or 4 teachers per subject. For instance, we should have at least 3 science teachers for each of physics,

chemistry, and biology, that is, a teacher to SHS1, SHS2, and SHS3. However, subjects like integrated science that all the students offer should have more teachers, say about 6 or 9 integrated science teachers. Presently, we do not have enough integrated science teachers so there is a need for more integrated science teachers to cope with the large student population in our senior high schools.

Thank you very much, sir.

Question 5: How do you think that integrated science teachers can be helped to overcome these barriers that you have mentioned?

Response: Well, helping integrated science teachers overcome the barriers is like one starting a job that he cannot finish, but something drastic might be done. I think it is somehow difficult to do but we can only provide suggestions or probably make recommendations for improvement. Presently, with the situation of things, a class size of more than 80 students to a teacher. The government needs to build more classrooms, laboratories, and libraries for the students. It is the shortage of classrooms that leads to a class size of 80 or more students per class. But when the government builds more classrooms, we are going to have a reduced number of students in the classroom. When there are more classrooms that will accommodate students in ratio of 40:1 and standard laboratories with equipment. These will go a long way to help the teachers. Also, the government needs to provide quality science textbooks for teachers and students and pay teachers good salaries and allowances for them to perform.

Furthermore, the government should implement initiatives through the Ministry of Education that will improve the effectiveness of all teachers, not only those who teach

integrated science. topic association meetings involving different topic teachers could be one way to do this.

APPENDIX D

Interview schedule for Lab Assistance

The purpose of this interview it to help identify how often to integrated science teachers carried out hands-on activity in the laboratory. Kindly answer the following questions. Your responses will be treated confidential. Thank you for your cooperation.

Questions for the interview

1. Do you have a well equip integrated science laboratory for carrying out experiment?
2. How many times do you perform experiment in integrated science a week?
3. Do you have sufficient teaching and learning resources at the lab, reagents, chemicals …..?
4. Do you get funds or imprest to buy things needed for the lab, such as chemicals reagent etc.?

APPENDIX E

Observation Checklist instrument

Materials / Equipment	Present	Absent
1. Textbooks		
2. Test-tubes		
3. Beakers		
4. Funnels		
5. Hand lenes		
6. Spring balance		
7. Reagents		
8. Chemicals		
9. Electronic microscope		
10. Burnson burner		
11. Diodes		
12. Transistors		
13. Fuse		
14. Biological chart		
15. Periodic table chart		
16. Others		