UNIVERSITY OF EDUCATION, WINNEBA

IMPROVING TEACHING AND LEARNING OF INTEGRATED SCIENCE PRACTICALS IN SELECTED SENIOR HIGH SCHOOLS.

DOE HARRY

2015

UNIVERSITY OF EDUCATION, WINNEBA

IMPROVING TEACHING AND LEARNING OF INTEGRATED SCIENCE PRACTICALS IN SELECTED SENIOR HIGH SCHOOLS.

DOE HARRY

7130130022

A DISSERTATION IN THE DEPARTMENT OF SCIENCE EDUCATION, FACULTY OF SCIENCE, SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES UNIVERSITY OF EDUCATION, WINNEBA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE MASTER OF EDUCATION IN SCIENCE

DECEMBER, 2015

DECLARATION

STUDENT'S DECLARATION

I, Harry Doe, declare that this dissertation, with the exception of quotations and references contained in published work which have all been identified and acknowledged, is the result of my own original research and that no part has been submitted, either in part or whole for another degree elsewhere.

Signature……..

Date…….....

SUPERVISOR'S DECLARATION

I hereby declare that the preparation of the dissertation was supervised in accordance with the guidelines for supervision of dissertation as laid down by the School of Graduate Studies, University of Education, Winneba.

Name of supervisor: Prof. Yaw Ameyaw

Signature……

Date……

ACKNOWLEDGEMENTS

My enormous thanks go to the almighty God, who gave me wisdom, strength and grace to go about my research, throughout my studies. I am very thankful to my dissertation supervisor, Prof. Yaw Ameyaw, who took it upon himself to guide me through the entire study, made corrections and provided the needed suggestions, which in many ways contributed to the completion of this dissertation report. I wish to express my appreciation to my wonderful wife, Joyceline Agbalenyo, whose constant encouragement supported me throughout the course of study. I thank friends and study group members, especially Marvin Acheampong-Marfo , Esther Dorcas Appau, Esther Nartey and Tadzo Richard, who in diverse ways influenced me on life issues. A great deal of thanks goes to all faculty members, who in diverse ways imparted unquantifiable proportion of knowledge to me during the study period. Finally, my appreciation goes to My Mum and Dad, who saw the need to take me to school. I salute those whose work I made reference to.

DEDICATION

This dissertation is dedicated to my wife, Joyceline, my lovely son, Deladem and all my aunties, and Mr. A. K. A. Abini, my former Headmaster.

TABLE OF CONTENTS

Content **Page**

CHAPTER TWO LITERATURE REVIEW

CHAPTER THREE METHODOLOGY

LIST OF TABLES

Table **Page**

LIST OF FIGURES

Figure **Page**

APPENDICES

Appendix **page**

ABBREVIATIONS

AGR = Agree

ATW = Adjustment in Time Allocated for Practical

DIS = Disagree

ELT = Educated Laboratory Technician/ Assistant

IMP = Inadequacy of Practical equipment

ITP = Insufficient Time for Practical Work

LCS = Large Class Size

LLT = Lack of Laboratory Technician

LSL = Lack of Standard Laboratory

PEM = Provision of necessary equipment and materials

PPL = Provision of Proper Equipped laboratory

PTA = Parents and Teachers Association

SHS = Senior High School

STRA = Strongly Agree

STROD = Strongly Disagree

TLM = Teaching and Learning Materials

WASSCE = West African Senior Secondary School Certificate Examination

ABSTRACT

The study investigated how to improve the teaching and learning of Integrated Science practical in selected Senior High Schools in the Afadjato South District. The survey design was used for this study. The simple random sampling technique was used to obtain the sample size of 90 students and 6 Integrated Science teachers from the three selected Senior High schools, (Jibmass, Ve SHS, Leklebi SHS). The main instrument used for the study was questionnaire, interview and observation. Data collected were analyzed using SPSS Version 16.0, and converted into frequency count and percentages. The results of the study were presented using tables. The research finding shows the lack of adequate teaching and learning materials, and equipment for practical lessons. It also came out that some teachers use lecture method to teach instead of activity oriented method. Again, it was also recorded that some students had poor perception and attitude towards Integrated Science practical with the notion that it is difficult, time wasting and boring. The implications of the findings are that the future of science education in Afadjato South District is very bleak and that measures should be taken immediately to curb the situation. The Ghana Government, Ghana Education service, Afadjato South District Directorate of education, P.T.A. and students as well should come together to find lasting solutions to all the problems that make teaching and learning of Integrated Science practical difficult.

CHAPTER ONE

INTRODUCTION

1.1 Overview

This section provides the general background to the study, the problem statement and the purpose of the study. The significance of the study, research questions and the objectives of the study are also in this chapter. The chapter concludes with the limitations and delimitation of the study.

1.2 Background to the Study

Education, according to Bishop (1985) is the process which entails an awakening of curiosity, the development of proper interests, attitudes and values, and the building up of such essential skills as independent study and the capacity to think and judge individuals. We live in a world of scientific and technological inventions, and human beings are therefore confronted daily with situations that require the use of scientific information to make intelligent choices and decisions. We encounter situations that require scientific ideas and technological information to engage intelligently in public discourses on many national and international issues. This demands a general scientific literacy for every citizen that requires the creation of a scientific culture in the society (Tom, 2013).

This explains why attention and interest are always taken by the Ghana Government in science practical lessons. Hence, a lot of funds have been allocated to the Educational Sector in connection with equipping the science laboratories in various Senior High Schools across the country to cater for the practical aspect of the subject (Antwi, 1992).

The rise of Japan into the status of an economic giant today (Evans, 1991) as well as the emergence of Singapore, Hong Kong, Korea, Taiwan and Malaysia recently into the modern economic limelight have all been attributed to the heavy investment these countries made in science education of their citizens (Ranis, 1990). The determination to realize this vision of making citizens of Ghana scientific and technological literate might be seen in the several changes that have occurred in the content of Integrated Science Education curricula at all Levels of Education over the years.

According Asiedu and Amoako (2010), Integrated Science at Senior High School level was specifically being designed to help students to:

i. Solve basic problems within their immediate environment through analysis and experimentation.
ii. Keep a proper balance of the diversity of the living and non-living things based on their interconnectedness and repeated patterns of change.
iii. Adopt sustainable habits for managing the natural environment for the society.
iv. Use appliances and gadgets effectively with clear understanding of their basic principles and underlying operations.
v. Explore, conserve and optimize the use of energy as an important resource for the living world.
vi. Adopt a scientific way of life based on pragmatic observation and investigation of phenomena.
vii. Search for solutions to the problems of life recognizing the interaction of science, technology and other disciplines.

According to Anamuah-Mensah (1989), the past decade had seen a growing desire to get more students to be fully involved in the study of science as well as integrate them into science related jobs.

This may perhaps be the brain behind the governments, organizations, and associations to get more students into the following fields such as medicine, agriculture and industry considering the roles these fields plays in the development of every nation.

The Ghana Government, through the Ministry of Education and the Ghana Education service has been carrying out interventions with the view of improving the quality of science education delivery. Some of these interventions are the establishment of Science Technology and Mathematics Education Clinics, and Information and Communication Technology (ICT) centres, Science Resources Centres and the encouragement given to schools to organize science fairs and exhibitions during their speech and prize giving days.

Notwithstanding the struggle by both the Ghana government and other stakeholders in education to finance quality education in science, a large number of students continue to perform poorly in their final examinations in Integrated Science (WASSCE, 1998-2012).

The West African Senior Secondary School Certificate Examination (WASSCE) Chief Examiners report reveals that more students fail or perform poorly in Integrated Science because they do not perform well especially in the Paper 2, which is the Integrated Science practical paper. The Integrated Science Paper 2 involves tests skills in drawing, identification, analysis of some processes and the interpretation of data as well as classification, (Chief Examiner's Report, 2005).

This gives the impression that the students were either not taken through practical work or were not serious with the practical work. Akinmade (1992), reports that on the average 78.8% of the students that sat for the West African Senior Secondary School Certificate Examinations (WASSCE) in Nigeria, Sierra Leon, Gambia and

Ghana failed Integrated Science, and the situation has not improved with time. For this reason, in recent times there has been public outcry on the declining standard of Science Education, especially in the area of Integrated Science.

In modern life, the rule is absolute, that any country that disregards the study of science is doomed to obsolescence (Ogunniyi, 1988). According to Anamuah-Mensah (1989), by having knowledge in Science Education, the economy and socio-cultural status of the nation will be transformed. This implies that Science Education with reference to Integrated Science is very important in producing the required human resources needed for harnessing the natural resources of the country.

Adjeitey – Adjei (2009) observed that the current approach to science teaching and learning in most Senior High Schools is not laboratory work. Most teachers want to help their students to complete the science curricula on time so that they can pass their examinations. This approach tends to make the study of Integrated Science uninteresting, boring and un-enjoyable, and students find it difficult to relate their theoretical knowledge with the practical realities of life, and the use of manipulative skills.

For Integrated Science to be effectively and properly taught, the practical approach to teaching must be viewed as an essential component of studying Integrated Sciences. The "hands- on" approach has the potential to stimulate students' (pupils) interest in the subject matter, teaching laboratory skills enhance the learning of knowledge, and give insight into scientific attitudes and objectives. It also gives the students the opportunity to learn and practice all the activities involved in the inquiry processes of Integrated Science.

Therefore, the study is aimed at investigating some factors that influence the effective teaching and learning of Integrated Science practical lessons in Senior High Schools in the Afadjato South District with the view of improving on the performance of students in Integrated Science as a core subject.

The researcher is embarking on this work to bring to light the appropriate laboratory teaching strategies that are essential for students of all ages and ability levels.

1.3 Statement of the Problem

Most Senior High Schools within the district lack qualified teachers to handle Integrated Science (Afadjato South Educational Directorate, 2015). The schools within the district also lack adequate science materials for practical lessons, teachers practical hand books, laboratories and qualified laboratory assistants to help in practical lessons (Afadjato South Educational Directorate, 2015). Apart from the above problems, time allocated for practical lessons is not adequate and this hinders the organization of practical lessons and a critical look at the content of the Integrated Science syllabus shows that it is very loaded (Asiedu & Amoako 2010). This in effect causes many teachers to attempt to treat all the topics before the commencement of the West African Senior Secondary School Certificate Examination (WASSCE). As a result, majority of the teachers rush through the practical aspect and concentrate on the theoretical aspect of the topics. Although they are able to teach all the topics in the syllabus, the students are not able to make good grades in West African Senior Secondary School Certificate Examination (WASSCE), especially in the science practical examinations as captured in the chief examiner's report (2010 – 2015).

1.4 Purpose of the Study

The purpose of the study was to find out how to improve the teaching and learning of Integrated Science practical in selected Senior High Schools in the Afadjato South District of the Volta Region of Ghana.

1.5 Objectives

The following objectives were used to address the study:

i. To find out the state of the laboratories for Integrated Science practical lessons among the selected schools.
ii. To find out some strategies teachers adopt in the teaching and learning of Integrated Science practical lessons.
iii. To determine Students' attitude towards the Integrated Science practical lesson among the selected schools.
iv. To find out other factors that influences the teaching and learning of Integrated Science practical lesson.

1.6 Research questions

The following Research Questions were used for the study:

i. What is the state of laboratories for Integrated Science practical lesson among the selected schools in Afadjato South District?
ii. What strategies do teachers in Afadjato South District adopt in the teaching and learning of Integrated Science practical lesson?
iii. What are Afadjato South students' attitudes towards Integrated Science practical lesson?

iv. What other factors influence the teaching and learning of Integrated Science in Afadjato South District?

1.7 Significance of the Study

Since limited literature exist about improving teaching and learning of Integrated Science practical lesson, the finding of this study has potential to improve and contribute to the teaching and learning of the Integrated Science practical lessons Ghanaian Senior High Schools. Again, the outcome of the study will provide very useful information to the Ministry of Education, Government and other Educational Authorities as well as agencies to provide the needed interventions to promote practical lessons in Integrated Science in Senior High Schools. However, achievement levels could be elevated on a very wide scale when efforts are been made to improve the teaching of the practical lessons.

This study will also inform the Headmasters of the selected Senior High Schools in the Afadjato South District of the Volta Region of Ghana of the challenges both teachers and students have in the teaching and learning of Integrated Science practical lessons. Finally, it is hoped that the outcome of the study will serve as a reference point for other researchers who wish to research issues on improving teaching and learning of Integrated Science practical lessons.

1.8 Delimitation of the Study

Due to financial difficulties, it was not easy to cover all the Senior High Schools within the given time of the study. The study is also limited to only teachers and students who are teaching and learning Integrated Science respectively in the selected Senior High School in the Afadjato South District.

1.9 Limitations of the Study

The study was limited to only three (3) selected Senior High Schools in the Afadjato South District of the Volta Region of Ghana. Again, due to the large number of participants involved, the study focused on Integrated Science teachers and students. Also, because of the busy schedules of the teachers and the students they were reluctant to complete the questionnaire in good time. The study was further limited to 30 students from each school making a total of 90, and 2 Integrated Science teachers from each school making a total of 6

1.10 Organization of the Study

This research study was organized into five chapters. The first chapter was the introduction made up of the background to the study, statement of the problem, purpose of the study, research objectives, and research questions, significance of the study, limitation and delimitation of the study.

Chapter two was also made up of the relevant literature to the study, while chapter three provided details on the methodology of the study. The fourth chapter dealt with the presentation of the gathered data, analysis of the gathered data and discussion of the results. The last chapter covered the summary of the research findings, conclusions, recommendations and suggestions made from the evidence gathered via this project.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This chapter is devoted to the review of the literature related to the study. The review looks at Science in Ghanaian Schools, importance of science in schools and importance of laboratory. This review also looks at the importance of practical work in teaching and learning Integrated Science, importance of teaching and learning materials, methods and strategies of teaching science and time and period allotted for teaching Integrated Science practical.

2.2 Science in Ghanaian Schools

Every citizen of the country needs training in science to be able to develop scientific mind and scientific culture. This is the only way by which people of the country could deal objectively with phenomena and other practical issues as well as prevent reliance on superstition for explaining the nature of things, and help us to construct and build the present and the future on pragmatic scientific basis. Our humanistic past has been valuable, but cannot help much to usher the country into the age of science, invention and rapid economic development.

According to Renner and Strafford (1972), no matter how well a teacher knows, unless he is successful in promoting the learning of science by students, he has not taught. This assertion concords perfectly by the statement made by Sekyere (2013) that in Teachers Education guide emphasis is placed on “how to teach “ in order to

lead the pupils demonstrate and assimilate what is imparted or taught with little or no difficulty.

According to Asiedu and Amoako (2010), the teaching syllabus for Integrated Science is designed to make conscious effort to raise the level of scientific literacy of all students and equip them with the relevant basic scientific knowledge needed for their own living. Secondly, there is also the need to make valuable contributions to production in the country. Education in science also provides excellent opportunities for the development of positive attitudes and values in our youth (Asiedu & Amoako 2010). These include:

i. curiosity to explore the environment and question what they find.
ii. keenness to identify and answer questions through scientific investigations.
iii. creativity in suggesting new and relevant ways to solve problems.
iv. open-mindedness to accept all knowledge as tentative and to change their view if the evidence is convincing.
v. perseverance and patience in pursuing a problem until a satisfying solution is found.
vi. concern for living things and awareness of their responsibility toward maintaining the quality of the environment.
vii. honesty, truthfulness and accuracy in recording and reporting scientific information.
viii. love, respect and appreciation for nature and desire to conserve natural balance.

The general aims of the Senior High School Integrated Science curriculum is categorized into: concept, process approach and creativity, attitudinal, application and connection domains.

According to Asiedu and Amoako (2010), the Integrated Science syllabus is designed to help the student to:

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

The concept domain aims at grouping the observable universe into manageable units for study and to describe any physical relationships existing in the units (Yager, 1992). The current Senior High School Integrated Science syllabus developed in 2008 advocates this, and comprises facts, concepts, laws, and existing hypothesis and theories to be taught by integrated science teachers.

Marson (1998) also sees science as a process of dynamic interaction of rational inquiry and active play. According to Marson, scientist probe, poke, handle, observe, question, think up theories, test ideas, jump to conclusions, make mistakes, revise, synthesize, communicate, disagree and discover.

Agboala (1984) was also of the view that some of the specific important human abilities in this do domain are visualizing, thus producing mental images, combining objects and ideas in new ways; offering explanations for objects and events encountered, questioning, producing alternate or visual uses of objects, solving problems and puzzles, designing devices and machines, producing idea devising tests for explanations. With regards to the application and connections domain, Adedapo (1976) observed that science is related to everything, especially other curricula areas such as mathematics, the social sciences, vocational subjects and the humanities.

Practical work done during Integrated Science lessons helps students to acquire in-depth knowledge of scientific concepts in their everyday life as far as science is concern. It also enable students relate to their everyday experiences, and to commonly observed phenomena in nature. It further enables students to appreciate the links between seemingly different scientific topics and hence help them to be able to integrate ideas from various scientific sources and link them. Again, it enables students to apply the learned science concepts and skills to their everyday life and social problems, thoughtful scientific and technological principles involved in household technological devices, and the evaluation of mass media reports of scientific developments.

A diverse and growing body of opinion points to the need for an over hauls of Africa's public educational system to address the needs of Africans (Brown-Acquaye, 2001; Noye, 2001 & Ericnosho, 2001).

2.3 The Importance of Science in Schools

The world is not fragmented into discrete subjects and science is not isolated from everything else in our lives it crosses into all subjects. Not only do different types of

science interact (such as the concept of light energy, which links biology, chemistry and physics), but science can be found in subjects like history, geography, philosophy and all sorts of subject areas. For example, understanding time periods in history and societies includes learning about scientific innovations and technology used during those periods. Science is even dance and music; it allows us to understand how we hear music, how we move our bodies to dance, and how our eyes see art.

According to Chalmers (1994), scientific knowledge is proven knowledge. He continues further by saying that, scientific theories are derived in some rigorous way from the fact of experience acquired by observation and experiment. Thus Science is based on what we can see and hear and touch. For example, personal opinion or preferences and speculative imagination have no place in science. Science is objective. Scientific knowledge is reliable knowledge because it is objective proven knowledge. Learning opportunities linking science to other subjects provide a rich context for integrating science, technology, mathematics, and language concepts and skills.

Integrated Science programme help learners understand concepts across different subjects and make connections within a particular subject area. Integration of different sciences can help learners connect concepts to concepts, topics to topics and explicitly link different disciplines of science.

The teaching of science offers students the ability to access a wealth of knowledge and information which will contribute to an overall understanding of how and why things work like they do. Science is able to explain the mechanics and reasons behind the daily functioning of complex systems, which range from the human body to sophisticated modern methods of transport. Children and students are able to use this

knowledge to understand new concepts, make well-informed decisions and pursue new interests. Science also helps to provide tactile or visible proof of many facts we read about in books or see on the television; this helps to increase understanding and helps children and teenagers to retain that information.

The importance of science in our daily lives may not be obvious, yet we make science-based choices every day. Science is involved when we choose what to eat, or choose products with the least impact on the environment or make informed decisions about our health-care. Science is the foundation of an innovative culture and at the core of significant political decisions. Understanding science is crucial for all Ghanaians so we can be informed and active in our country's future. Many students find science extremely inspiring and interesting. Science instills a sense of intrigue and enables students to develop understanding and form questions based both on the knowledge they already have and the insight they wish to gain in the future. Students who excel in science lessons are likely to develop a strong ability to think critically.

Science as described by Blough and Schwartz (1990) is essential to understand that we live in and it is about learning how to take care and protect the things in it. They have also seen science as the method of gathering knowledge through observation and recording the knowledge gathered by using them to find answers to questions that humans ask every day. It has been recognized globally that development and application of science and technology are vital for a country’s economic development strategy and policy aimed at improving the living conditions of its people (McKinsey 2013). In general, science helps man to understand the natural environments by interacting with living organisms and also to help eradicate ignorance in the areas of superstition and other progress and development (Blough & Schwartz 1990).

Another aspect of science is that it helps people to develop the ability to operate simple appliances and gadgets that are commercially used in our everyday lives. It also helps people to acquire the spirit of science attitude and to promote our agriculture by developing early and high yielding varieties of crops (Quarm, 2001).

2.4 Importance of laboratory

According to Bernard and Epp (1987), the laboratory is described as a workshop for students, the place where they get firsthand knowledge of physical principles and experimental methods through the handling of apparatus designed to demonstrate the meaning and application of these principles.

Integrated Science involves the study of the world around. Students need laboratory experiences to explore that world and to bring understand to science so that they can make sense of their world around. Hofstein and Lunetta (2003) argue that the laboratory allows students to learn with understanding and offers an opportunity to engage in a process of constructing knowledge by doing science. Moreover, laboratory work enhances attitudes, stimulates interest and motivates students to learn science. However, Hudson (1990) expressed the opinion that "practical work as conducted in many schools, is ill-conceived, confused and unproductive .It provides little of real education value". Moreover, Hofstein and Lunetta (2003) argue that "formal teaching results in greater understanding when students study a limited number of topics, in depth and with care rather than a large number of topics much more superficially, as is the practiced in many science classrooms". The teaching laboratory has great potential as a place of learning but there is a risk that what is done does not allow the potential to be reached. The research laboratory in physics, Biology and Chemistry seeks to make genuine explorations of the physical world to

lead to new understandings. This is difficult to achieve in the teaching laboratory in Integrated Science. Thus, Wellington (1998) considers that teachers can do no more than simulate the methods followed by scientist. This is because the hypothesis is established by the teachers, and the student task can often end up arriving at predicted results. Thus, the aims for a research laboratory are very different when compared to a teaching laboratory. The methods of science can be illustrated in the teaching laboratory. Learners can be encouraged to develop hypotheses and test them. However, it is more or less impossible for students to follow a research paradigm in a teaching laboratory for many reasons. Firstly, students are, by definition, still at an early stage of learning. Secondly, the organizational, financial and safety implications of genuine scientific enquiry make it very difficult, even at undergraduate level. Nonetheless, the teaching laboratory should be consistent with scientific enquiry, avoiding experiments which centre only round routine verification of known quantities. The aim has to be to promote a more effective laboratory learning environment. Students' perceptions and behaviours in laboratories are influenced by teachers, assessment practices and the materials available in the laboratory. Shah (2004) has argued that laboratory work offers an important link between theory and observation. However, the word 'theory' needs clarification. The word can mean almost anything from vague asserted opinion across almost to the formal hypotheses of scientific enquiry. Shah was using the word to describe the formal teaching of the classroom or lecture hall. The laboratory can perhaps make this real to the student. But there are some factors that inhibit learning in school science laboratories. Al-Madani (2004) stated some of them in his research on the situation in Kingdom of Bahrain: there is lack of equipment and the time allowed for student is not sufficient

for the number of experiments set for the curriculum. Moreover, the time is quite inadequate to allow for group work or individual work in the laboratory.

Also, Hofstein and Lunette (2003) raised some factors: students fail to understand the relationship between the purpose of their investigation and the design of the experiment and many students think that "labs" means manipulating equipment but not manipulating ideas. This is a very important point and is often not grasped by laboratory course designers. Frequently, course aims are specified in terms if practical skills to be mastered and, sometimes, the assessment reflect this. Thus, for example, the assessment of laboratory work in the Standard Grade courses in biology, chemistry and physics in Scotland (two year courses for approximately ages 14-16 in Scotland) lays great emphasis on the correct conduct of procedures. As a result, teachers teach towards that aim and it is rare for any student to fail to achieve a high grade. Moreover, Jerry Wellington in his book (1998) stated an important factor: One of the fundamental assumptions of much practical work in schools is that observation and experiment can provide certain knowledge about the universe. But because knowledge is assumed to derive directly from observation, emphasis becomes concentrated on doing rather than on thinking, and little or no time is set aside for discussion, argument and negotiation of meaning (Wellington, 1998).

The Science Teachers Association of Pakistan (1990) suggested these developments to improve the learning of science:

i. a minimum of 40 percent of the science instruction time should be spent on laboratory related activities. This time includes pre-laboratory instruction in concepts relevant to the laboratory, hands on activities by the students and a post laboratory period involving communication and analysis, and teacher

demonstrations are valuable but should not be substitutions for laboratory activities.

ii. evaluation and assessment of student performance must reflect the laboratory experience.

iii. an adequate budget for facilities, equipment and proper waste management must be provided to support the laboratory experiences.

iv. equipment and facilities must be maintained and updated on a regular basis.

v. for some activities, funds for field experiences must also be included in the budget.

The number of students assigned to each laboratory class should not be exceeding 24 and the students should have immediate access to the teacher in order to provide a safe and effective learning (Shah, 2004). However, Shah (2004) cast considerable doubt if these highly desirable aims are being addressed, little less achieved in a Pakistan context. Nonetheless, such aims seem extremely important for all developing countries. The many difficulties inherent in hindering the effective use of the teaching laboratory in Integrated Science in developing countries like Ghana can be summarized:

i. students are not given sufficient time and opportunity for interaction and reflection.

ii. many school science courses offer a ‘cook-book’ approach for the student to do the experiment. Thus, most students follow the instructions to reach the results without understanding either the purpose or the sequence of ideas in the experiment.

iii. most teachers need more knowledge skills and resources in the laboratories.

iv. assessment of student's practical knowledge tends to be undervalued or focuses on aspects which are not the most important.

v. there is a limitation in sources and materials in the laboratory.

Another issue is raised by Bernard and Epp (1987) who noted that, the efficiency of performance in the laboratory depends largely on the preparation made before the experimental work begins. The entire experiment should be read before any measurements are made. It is also advisable for the student to review sections in the class textbook that deal with the principles under investigation. (Bernard & Epp, 1987). Those with any experience in running laboratories know that such an aim is unrealistic. Students simply tend not to read the manual before the laboratory session and will rarely consult a textbook on their own (Carnduff & Reid, 2003).

2.5 Importance of Practical work in Teaching and learning Integrated Science

Science is a practical subject and that students cannot gain the knowledge and skills they needed entirely from a text book. Theories describe a well - verified body of abstract knowledge that has a large number. By 'practical work' we mean tasks in which students observe or manipulate real objects or materials or they witness a teacher demonstration.

According to Ossei-Anto (1995), Practical work can result in the following:

i. teaching of laboratory skills .

ii. enhance the learning of scientific knowledge.

iii. give insight into scientific method and develop expertise in using it .

iv. develop scientific attitudes', such as open-mindedness and objectivity.

Ossei-Anto again, asserted that science teaching and learning will definitely be better done if the issue of inadequate supply of science equipment and materials is tackled with zeal. He further explained that, learning by doing is one of the cardinal principles of teaching science. Experimentation has put many theories on a sound footing and has also resulted in the rejection of many. History reveals that many beliefs and superstitions were trashed out from the minds of people as a result of experimentation.

Science practical work engages students in 'finding out' 'and learning how' through firsthand experience. It is an integral part of good science teaching, which involves students in the scientific enterprise questioning, observing, classifying, gathering data explaining, experimenting etc. this type of work permits students to plan and to participate in investigation or to take part in activities that will help them improve their manipulative skills (Collete & Chiappeta, 1989). Practical work would help improve students' manipulative skills.

Practical work including hands-on activities, scientific inquiries, or experiments, always cited as the most powerful approach to helping students understand scientific knowledge. At the same time, Hodson (1992) argued that the skills-based approach of practical work was philosophically unsound, educationally worthless, and pedagogically dangerous. A holistic view of assessment to promote valid process learning, especially emphasizing the role of creativity in the data analysis process is necessary (Yager & McCormack, 1989). Torance as cited in Penick (1996) described creativity as a process of becoming sensitive to problems, deficiencies, gabs in knowledge, missing elements, and disharmonies. Creativity identification of the problematic, the research solutions, the generation of guesses, or the formulation of hypotheses about the deficiencies; testing and retesting the hypothesis and the potential modification and retesting; and last the communication of the result. The

role of guessing as the basic element of creativity is stressed by science Technology and Society of the United States of America. When students are viewing natural phenomena, to stimulate their creativity and interpretation of results, they should be encouraged to present wild guesses to generate diverse perspectives (Yager & McCormack, 1989).

An effective teacher plans practical work with specific learning objectives in mind. By using different pedagogical approaches the same practical task can be used to achieve different learning outcomes (Hodson, 1990). According to him, for some practical tasks, the learning is about objects and observables. Students are expected to recall what they have observed. Other tasks involve making links between observables and scientific ideas. Students generally find the latter harder, as they involve thinking as well as seeing and doing. The task design needs to 'scaffold' students' efforts to make these links. Practical work to develop students' scientific knowledge is likely to be most effective when:

i. the learning objectives are clear, and relatively few in number for any given task;
ii. the task design highlights the main objectives and keeps 'noise' to the minimum;
iii. a strategy is used to stimulate the students' thinking beforehand, so that the practical task is answering a question the student is already thinking about.

2.6 Importance of Teaching and Learning Materials

Woolnough (1991) highlighted the importance of practical work in science and suggested that, science teaching and learning should be practical and must involved the use of scientific equipment or apparatus with learning ideally taking place in the laboratory. In his real opinion a room set aside solely for science teaching and learning could serve the purpose. If the analysis done by Woolnough is anything to go

by, then there is no proper teaching and learning in Integrated Science in the selected schools in the Afadjato District in the Volta Region.

Again, it is an undeniable fact that availability of teaching and learning materials for integrated science practical work plays a pivotal role in the learning of integrated science. Many scholars such as (Bajah, 1986; Akinwumiju & Orimoloye, 1987) contended that the availability of physical and material resources is very significant for the success of any worthwhile educational endeavors. These researchers agreed that, availability of teachers recommended textbooks, reference materials, adequate school buildings, number of classrooms blocks, chairs, desks, and well resourced laboratories for science teaching are important for the accomplishment of any educational objectives.

According to Adeyanju (1991), learning can be reinforced with learning aids of different variety because they stimulate, motivate as well as arrest learner's attention for a while during the instructional process. He added that learning aids are instructional materials and devices through which teaching and learning are done in schools.

In similar observations, some investigators claim that whenever they taught with some of the learning aids, their students get more stimulated because the learning aids help students to become more attentive. In addition, students' positive attitudes generate more interest for lessons, and as a result, students participate better in class activity.

Studies on teacher education and the use of instructional materials have been carried out and reported by several investigators including those of Agun and Okunrotifa (1977), Agun (1986), Akanbi and Imogie (1986; 1988 and 1999), and Agun (1986)

pointed out the for development of skills by teachers undergoing their training so that they could be able to use a wide variety of instructional materials sufficiently.

The various researchers found that teachers who are trained and untrained need some form of materials to teach their lessons effectively. They however, pointed out that the relevance of choice of instructional materials types that are used and the quality of the instructional material types that teachers use must be investigated.

Ogunniyi (1982) held a similar view that, Nigerian primary school teachers have to be retrained in the modern methods of instruction and on how to use appropriate learning materials and equipment to harness pupil's enthusiasm and maximize learning. Furthermore, instructional materials are considered to make the teachers work more effectively and to provide an enriched classroom atmosphere (Davis, 1972).

Ainley (1981) stated that the standard of equipment and materials should be of great importance in the teaching and learning process. According to him they help to foster science teaching activities which involve students in a variety of stimulating activities.

2.7 Methods and Strategies of Teaching Science

According to Oxford Learners Advanced Dictionary, strategy is defined as a method or plan chosen to bring about a desired future, such as achievement of a goal or solution to a problem or the art and science of planning and marshalling resources for their most efficient and effective use.

Strategy is the sequencing, or ordering of the techniques the teacher has selected to teach the lesson. Therefore strategy is techniques sequenced to achieve method. For example the order of techniques (strategies) might be (1) lecture, (2) grouping, and (3) Panel discussion. It is important on the part of the classroom teacher to adopt suitable strategies from time to time when teaching**.**

Nacino-Brown, Festus, and Desmond (1982) defined teaching as an attempt to help someone acquire, modify or change some skill, attitude, knowledge, ideal or appreciation. Science teachers have an exciting opportunity to teach kids, young adult, adult (students) about how science makes the world work. Teaching is an intentional act of offering valuable service that is believed to have the potential to bring about an improvement in the life situation of the taught. It is expected that such improvement would enable the taught become a more useful member of the community (Afful-Broni & Ziggab, 2007). The teachers' task is to create or influence desirable changes in behaviour or in tendencies towards behaviour in students or pupils.

Mitchel (1968) suggests the following sequence of activities as a framework to guide discussions of controversial issues:

i. state the issue.
ii. define terms.
iii. collect purported facts from varied sources.
iv. look for evidence of the facts that have survived the test of evidence.
v. attempt to reach a conclusion.
vi. test the conclusion by thinking through the consequences.

Mitchel (1968) recommends that teaching should be stimulated through questions in the following order proposed by Taba and Walker (1971):

i. the first questions in a discussion should be open questions
ii. the first questions should also be formulated to lead discussion toward the unit's objective
iii. follow-up questions should encourage pupils to generalize
iv. the preponderance of questions should be high level.

According to Gall (1970), one way in which teachers can reduce their use of factual or low-level questions is to use categories of the taxonomy of educational objectives as a guide to selecting high level questions.

Some teachers are now using techniques such as peer learning, role playing, and incorporating current event in science lesson plans. These techniques help engage students and help them understand the importance of science. They also make it fun to teach scientific concepts and help students understand common topics in the scientific world. As an educator, we cannot speak of teaching having taken place if no adequate understanding also occurred. To ensure understanding of the learners, the topic of the lesson should be within the understanding of the learners and at the age level or psychological group of the students.

Bruner (1973) contends that any subjects matter can be taught to any child at any level. Traditionally teachers used the lectures format to teach children about science. One of the drawbacks to the lecturer format is that it does not engage students in their learning. These teaching techniques encourage rote memorization and note taking instead of excitement about the world of science. Peer to peer teaching is when the students actually get involved in teaching each other about science. This is an active learning method that encourages students to discuss scientific topics, develop questions about the materials and work in teams to learn new information. For solutions and critics groups, the teacher assigns one group of students to gather information and give a presentation. A second group of student acts as a critics group by evaluating the presentation. All these technique help students develop research and presentation skills that will help in the study of science as well other areas of life.

For teaching to be effective, teachers ought to start from the following:

i. simple to the complex

ii. known to the unknown

iii. concrete to the Abstract

iv. specific to the General

v. easy to the Difficult

vi. near to the far.

In order for students to develop scientific literacy gain knowledge of scientific habits of mind, there is a need for teachers to link the following strategies seated above.

Von Secker and Lissitz (1999) found that "Teachers – Centered instruction is negatively associated with achievement on the other hand, mean science achievement is expected to increase with the amount of emphasis on laboratory inquiry" (p.1194).

According to Farrant (1986), the best method of teaching science is the enquiry method. Here the students are involved in activities to find solutions to problems themselves. These enable students to find out facts, and establish relationship and infer from these facts and relationships.

He who sees science as a method of enquiry would not presents his or her students with facts as a body of knowledge, but will provide the opportunity for them to find out by doing. Thus in teaching science, it is better the concepts at stake, for the understanding principles of the concepts to be seen and understood. Students must therefore be actively involved in the lessons as they learn best through their involvement, remember easily and apply the knowledge gained in other situations. For effective science lessons, teachers should make use of a lot of activities including the use of Teaching and Learning Materials (TLMs), and also ensure that all students are actively involved in the lessons. Reasoning is definitely of importance in the study or learning of scientific concepts and reasoning is generated as a result of doing.

Carvin (1985) also argued that science as a special discipline cannot be taught or studied verbally or theoretically for the learners to grasp the various scientific concepts effectively. Utilizing the appropriate methods of teaching would allow for a better understanding thereby improving student's performance.

Science as a discipline is taught using varied teaching methods which makes use of relevant and appropriate TLMs to appeal to learner's senses so as to improve their performance and to achieve aims and objective of the subject. Balugun (1984) is of opinion that science teaching should therefore be backed by intensive practical activities to expose learners to acquired varied experiences. "Science is experiment and experiment is science" Balugun explained.

In practical, students are made to put into practice the theory learnt, practical activity according to Tillery (1991); make the students acquire skills and mastery in his field of study. He continued that practical lessons are efficient and beneficial to students when the class is under supervision of their teacher with specific instructions. Tillery continued that research has shown that students are enthusiastic about practical work as it provides opportunities for the decision making discovery.

Practical activities serve two main purposes in teaching and learning of science. These are :

i. they allow the observation of new facts.
ii. they determine whether a working hypothesis fits the world of observed facts. The connotation about the above statement is that students should be made to handle and use science apparatus and equipment during science lessons which will help equip them with the requisite skills needed to discover new scientific facts taught or learnt.

2.8 Time and Period Allocated for Teaching Integrated Science Practical

Time and tide wait for no man as the adage goes. Most Integrated Science teachers over look the practical aspect of the subject perhaps because of time allocated for the teaching and learning of the Integrated Science and the number of the topics to be covered. Pratt (1980) is of the view that the greatest amount of time that is used in schools is that spent by pupil's time that is committed not by their own consent but the order of their elders. Mathew (1989) is of the opinion that a pupil`s level of attainment is directly related to the period of time actively spent on learning. This opinion also holds for Integrated Science practical lessons and again supported by the International Assessment of Education Progress (IAEP) project in 1991/92. The Integrated Science curriculum for Senior High Schools advocated for seven periods a week for first year, five periods a week for second year and three periods a week for third week. However, each period last for forty (40) minutes. Out of the periods allocated, the first years are to utilize three (3) periods, second years two (2) periods and third years one (1) period for practical activities respectively. This inadequacy of lesson time for Integrated Science perhaps has forced tutors to ignore the practical work when teaching in order to be able to complete the syllabus.

Fisher and Fraser (1990) gave two ways by which time for subject can be allotted in the curriculum. The two ways were time allotment in periods and allotment of time to the subjects, taking into consideration the number of activities involved in the teaching and learning of the subjects. This to them will give adequate time for practical lesson. The instructional time has the same scientific status the concept of homeostasis in Integrated Science, reinforcement in psychology, or gravity in physics. That is for more admired concepts, adequate instructional time allows for

understanding prediction, and control, thus making a concept worthy for a great deal more attention than it is usually given in education and educational research (Berliner, 1990).

Berliner gave different dimensions as follows:

i. Allocated time is usually defined as the time that the state, districts, schools, or teacher provides for the instruction of the students

ii. Engage time is usually defined as the time that students appear to be paying attention to materials or presentations that have instructional goals.

iii. Time- on- task is usually defined as engage time on particular learning tasks. The engagement must be on a particular learning tasks but not just general tasks.

iv. Academic learning time is usually defined as that part of allocated time, in subject – matter area (Science) in which a student is engaged successfully in the activities or with the materials to which he or she exposed, and which are related to educational outcomes that are valued.

v. Transition time is usually defined as the non instructional time before and after some instructional activities.

vi. Perseverance is usually defined as the amount of time a student is willing to spend on learning a task or a unit of instruction.

vii. Pace is usually defined as the amount of content covered during some time period.

Kaft (1994) in his view sees the amount of time spent on a basis of language and mathematics as a critical factor in the achievement level of students in Integrated Science. Kafts study which was focused on primary education gives insight into time allocation and use in our schools.

Stingler, Lee and Stevenson (1987) and Lynn (1989) found that Japanese and Chinese children spent much time on learning than American children. According to Kaft (1984), while the length of primary school year in Ghana was 800hours per year, it was 1080hours, 1290hours and 1128hours per year in, Benin, Burkina Faso and Nigeria respectively. In the view of Kaft, not only do Ghanaian children spend less time in school than many others, but that the actual academic learning time is less by two to three hours a day.

This means that the utilization or mismanagement of instructional time will result in a limited coverage of the design curricula, which will finally have negative on the student's performance. It is perhaps for this reason that Hurd (2002) suggests increasing the amount of time allocated for active experiment in life science (Integrated Science) as a way of increasing participation by students who are poorly motivated. He noted that often teachers use – centered instructional techniques and assign seat work to unmotivated students while more motivated students perform laboratory activities and are given assessment involving problem solving.

As indicated by Sheppard and Robbin (2002), there has been very little discussion about the time allocation for science in US High Schools. The committee recommended that 25 % of curricula time in each year of High Schools be devoted to science. Currently, students spend 15% of curricular time on science. This estimate is based on six periods a week out of 40 periods per week.

Time allocation in Ghana is somewhat smaller considering that other countries allow their students to enroll in more than one science course per year, thus leading to greater time allocation.

Additionally, more time should be devoted to Integrated Science in the classroom because of the experimental nature of the subject. Curricular time in Integrated Science in Ghana, like many other countries has not matched the significance increase in the number of Integrated Science topics to be taught at the Senior High Schools level.

CHAPTER THREE

METHODOLOGY

3.1 Overview

This chapter discusses the research design that was used for the study. It also gives an insight into the following: population, sample and sampling techniques, instrumentation, validity and reliability of the instruments used for the study. This is followed by the data collection procedure and data analysis.

3.2 Research Design

Research design, according to Worgu (1991), is a plan outlining how information is to be gathered for an assessment or evaluation that includes identifying the data gathering method(s), the instruments to be used, how the instruments will be administered, and how the information will be organized and analyzed. Research design provides the glue that holds the research project together (Trochim, 2006).The research design that was adopted for the study was the descriptive survey design to describe what existed with respect to how integrated science practical work was done in Senior High Schools within the Afadjato South District.

According to Gay (1987), the descriptive survey design involves collecting data in order to test hypothesis or to answer questions concerning the current status of the subject of the study. The descriptive survey design has also been recommended by Babbie (2001) for the purpose of generalizing from a sample of a population so that references can be made about some characteristics, attributes or behaviour of the population. Since the purpose of this research was to survey how Integrated Science

practical lesson is conducted in the schools within the Afadjato South District in the Volta Region of Ghana the descriptive survey design was appropriate for the study.

3.3 Population

Monatte and Anderson (1994), suggests that population is all possible cases of what we are interested in studying. A target population will be all possible cases of whatever a unit of analysis is (Kish, 1985). The target population consists of all the six Senior High Schools in the Afadjato South District. However, the accessible population comprises three selected Senior High Schools from which (6) six teachers and (90) ninety students were sampled for the study.

Table 1: Population of Selected Teachers and Students in the three Selected Schools

Schools	Number of Teachers	Number of Students		
		Male	Female	Total
JIBMASS	2	18	12	30
VE SHS	2	14	16	30
LEKLEBI SHS	2	13	17	30
TOTAL	6	45	45	90

Reasons for which the various schools were selected/ chosen

i. Because they are of the same level (Grade C schools)
ii. They are closer to each other and also not far from the researcher
iii. They have almost the same type of facilities

3.4 Sample and Sampling Techniques

A sample size of 90 students and 6 teachers out of 800 and 15 respectively were selected from the three Senior High Schools. Two (2) of the Integrated Science teachers in each of the three schools were purposively sampled for the study. For the students, a quota of 90 was determined using the quota system to give an equal number to the students from each of the Senior High School.

Simple random sampling technique in the form of the fishbowl method was then used to sample 30 students from each of the Senior High Schools. The method of selecting the students was such that they were asked to pick cards without their knowledge of what was written on them. Those students who had their cards with the inscription "chosen" were selected. The same method was used for selecting the teachers also.

3.5 Instrumentation

Questionnaire was used as the main instrument for data collection. This was supplemented with interview and observation. In agreement with Barnes (1985), the Researcher undertook unscheduled observations of some Integrated Science lessons. An unsystematic instrument was used. As reported by Johnson (1978) and Smith (1982), this method does not require the use of check list; instead a free- form procedure of recording data is used. The recording procedure enabled the Researcher to capture as closely as possible, the total picture of what happened during the observed lessons. A thorough examination of some documents related to the study was also done. The documents analyzed included Integrated Science curriculum and materials used such as text books and syllabuses.

Two sets of questionnaire were used for the data collection; one for the teachers and the other for the students. Both sets of questionnaires were designed in such a way

that they contained open ended and closed ended type of questions. For the close ended type of question, options were given and the respondents were asked to tick the answer which was applicable. With the open ended type of questionnaires, respondents were asked to express their own kind of responses in the space provided on the questionnaire.

3.6 Observation

To have firsthand experience to confirm the responses given by the respondents from the sampled schools (to see if the responses are the true reflection of information and data collected).

3.7 Validity

According to Jappe (2000), validity determines whether the research instrument truly measures that which it was intended to measure. To ensure the validity of the questionnaire it was given to my supervisor who painstakingly went through and offered the necessary suggestion and correction to ensure content and face validity.

3.8 Reliability

To check the reliability of the research instruments, a pilot test was carried out on 20 SHS students offering Integrated Science in Kpeve Senior High in the Volta region of Ghana. These students used for the pilot test did not form part of the sample for the study. Cronbach's alpha was determined on the data gathered using statistical package for social sciences (SPSS) software version sixteen (16). The output gave alpha

coeffient of reliability of .816, which according to Bryman and Crammer (2001) is acceptable at 0.8 and as such, highly reliable.

3.9 Pilot Test

The instrument was pre-tested in a pilot study carried out at Kpeve Senior High School in the Volta Region of Ghana. The school was selected because it shares similar characteristics and also near the Senior High School in the Afadjato South District of the Volta Region. The pilot test was done to determine the workability of the instruments. It also enabled the researcher to restructure the questionnaire to help elicit the right responses.

3.10 Data Collection Procedure

Before data was collected, the researcher used Five days to visit each of the selected schools to sought permission from the head teachers to conduct the study and also seek their views and opinions about the study. The visit was to enable the researcher establish good rapport with all the respondents. The researcher explained the purpose of the study to the teachers and an arranged date was set for the researcher to present the questionnaire to the teachers and the students.

The researcher visited the selected schools and administered the questionnaires personally. This enabled the researcher to ensure that the questionnaire got to the respondents directly. Also a research assistant was created in each school. Their role was to collect and keep completed questionnaires from respondents. The researcher later collected these completed questionnaires from the research assistant. After the questionnaires were issued out to the respondents, a time frame of two hours was allowed so that respondents could respond to them appropriately and at their own

convenience. This was repeated in all the three schools. It took the researcher four weeks to collect the data.

Additional data for the study was obtained through interview. This was done through an examination of the various curriculum materials, official gazettes relevant to Integrated Science and WASSCE Chief Examiners' Report (1998-2012).

3.11 Data Analysis

Coding schemes was developed to organize the data into meaningful and manageable categories. The categorized data was converted into frequency counts and simple percentages using the SPSS (Statistical Package for Social Sciences) to answer the research questions addressed in the study.

CHAPTER FOUR

RESULTS AND DISCUSSION

Overview

This chapter presents the results gathered from the respondents and the discussion of the results. The chapter begins with the analysis of the responses given by both the students and teachers from the selected S.H.S in the Afadjato South District.

4.0 Analysis and Interpretation of Research Questions

4.1 Research Question 1

What is the state of laboratories for Integrated Science practical lesson among the selected schools?

This research question sought to found out the state of the laboratories for teaching and learning of Integrated Science practical lessons. The Researcher then used item 5 of the students' and teachers' questionnaire respectively. Table 1 represents the responses of students and teachers in line with the research question.

Table 1: School laboratories equipped with materials necessary for practical work

Response	**SHS**			
	Students		**Teachers**	
	Frequency	Percentages%	Frequency	Percentages%
Very adequate	0	0	0	0
Adequate	12	13.3	2	33.3
Inadequate	78	86.7	4	66.7
Total	90	100 %	6	100%

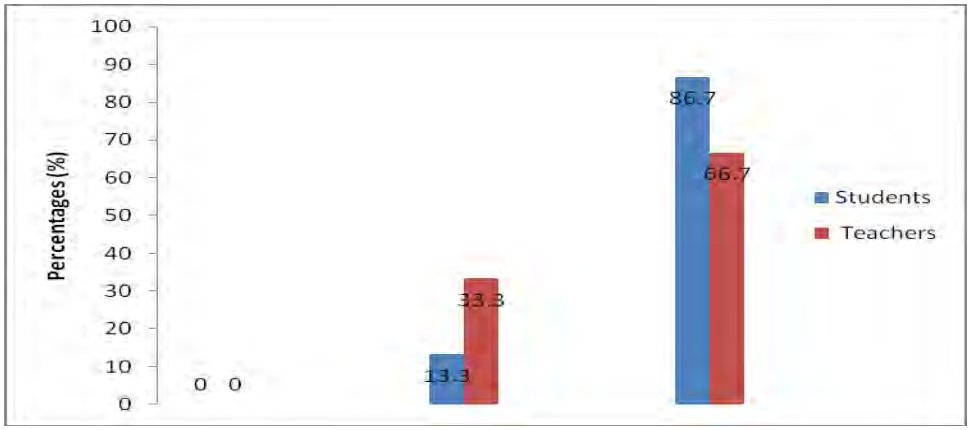
This research question sought to find out from both students and teachers the availability of equipment, apparatus and materials in their various school laboratories for Integrated Science practical lessons.

To the surprise of the researcher none of the respondents from the selected schools indicated on the questionnaire that they have very adequate science materials for Integrated Science practical work, however, 13.3% of the students and 33.3% of teachers confirming that they have a laboratory equipped with materials necessary for practical work. Surprisingly, an appreciable proportion of 86.7% of students and 66.7% of teachers are also saying that the laboratory materials provided to them for learning and teaching is inadequate. Despite the fact that some students and teachers say they have laboratory equipped with materials necessary for practical work as stated above, not all the laboratory equipment and materials are in good state for use.

This is an indication that there is the need to supply more laboratory equipment for practical work in the various schools within the District to enhance smooth running of Integrated Science practical work.

Figure 4.1: Respondents' view on the state of the laboratory

The Graph below lends credence to the above information given:



The researcher in answering these questions used items 17 of the student's questionnaire and items 7 of teacher's questionnaire.

The question sought to find out whether the science laboratories are resourced or equipped with science materials in the selected schools in the Afadjato South District. However, a questionnaire was disseminated to gather information from both students and teachers. Multiple responses were given by both teachers and students on the above question. The responses provided were coded under the following: Agree (AGR); Disagree (DIS); Strongly agree (STRA); Strongly disagree (STROD). Below is the result as shown in table 2 below:

Table 2: Adequacy of equipment for all students during practical work

Responses	**SHS Students**		**Teachers**	
	Frequency	Percentages%	Frequency	Percentages%
AGR	2	2.2	1	16.7
DIS	8	9.8	0	0
STRA	0	0	0	0
STROD	80	88	5	83.3
Total	90	100%	6	100%

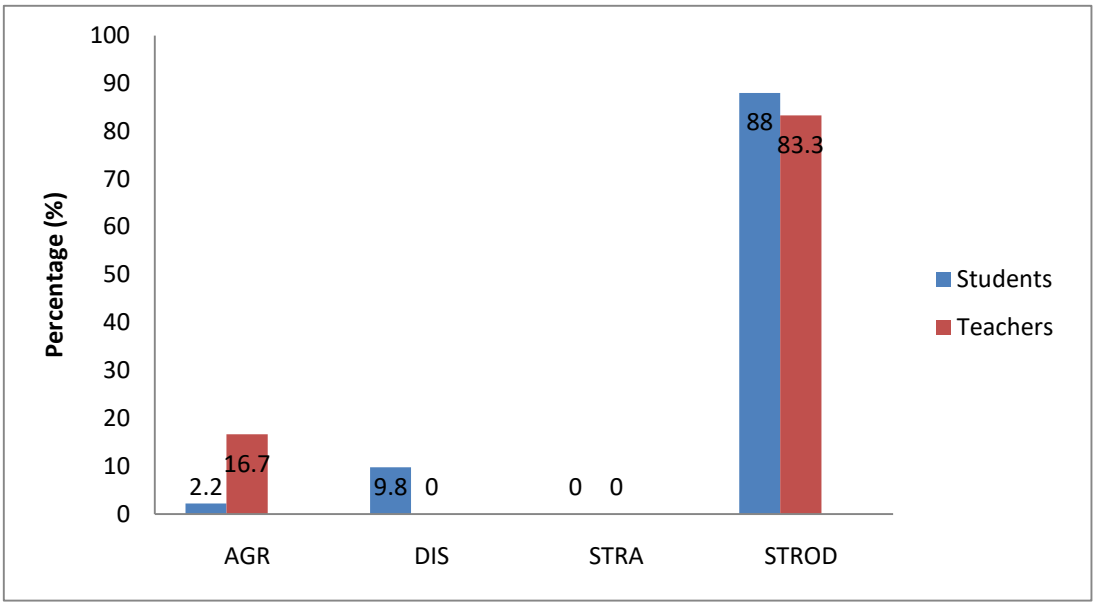
This question investigates if there are enough equipment and apparatus to go round all students during practical work. When students and teachers were interrogated through the use of questionnaire whether there were sufficient equipment, apparatus and materials for the organization of Integrated Science practical lesson in their various schools, according to Table 2, 2.2% of students representing the frequency of 2 and 16.7% of teachers representing the frequency of 1 agreed (AGR) there were equipment and apparatus adequate to go round all students during practical work in

their various schools. However, 9.8% of students disagree (DIS) that there was not adequate equipment to go round all the students during practical work. In addition, 88% of students representing a frequency of 80 and 83.3% of teachers representing a frequency of 5 also responded in strong disagreement (STROD) that there were not adequate science equipment and apparatus to go round all students during practical work. From item 18 of students' questionnaire, 86.7% representing a frequency of 78 students said that the practical normally do not come on whereas item 8 of teachers' questionnaire indicated that 16.7% representing a frequency of 1 teacher said he improvised to enable the students understand sometimes and 83.3% representing a frequency of 5 says they call off the practical work due to the inadequate apparatus as compared to the class size.

These responses from both students and teachers showed clearly that most of the students might not get access to the materials and equipment since they are not sufficient in the science laboratories. This will eventually lead to poor academic performance of students in WAEC examination in the District.

Figure 4. 2: Availability of science materials

Below is the Graph illustrating the information stated above:



4.2 Research Question 2

What strategies do teachers and students adopt in the teaching and learning of Integrated Science practical lesson?

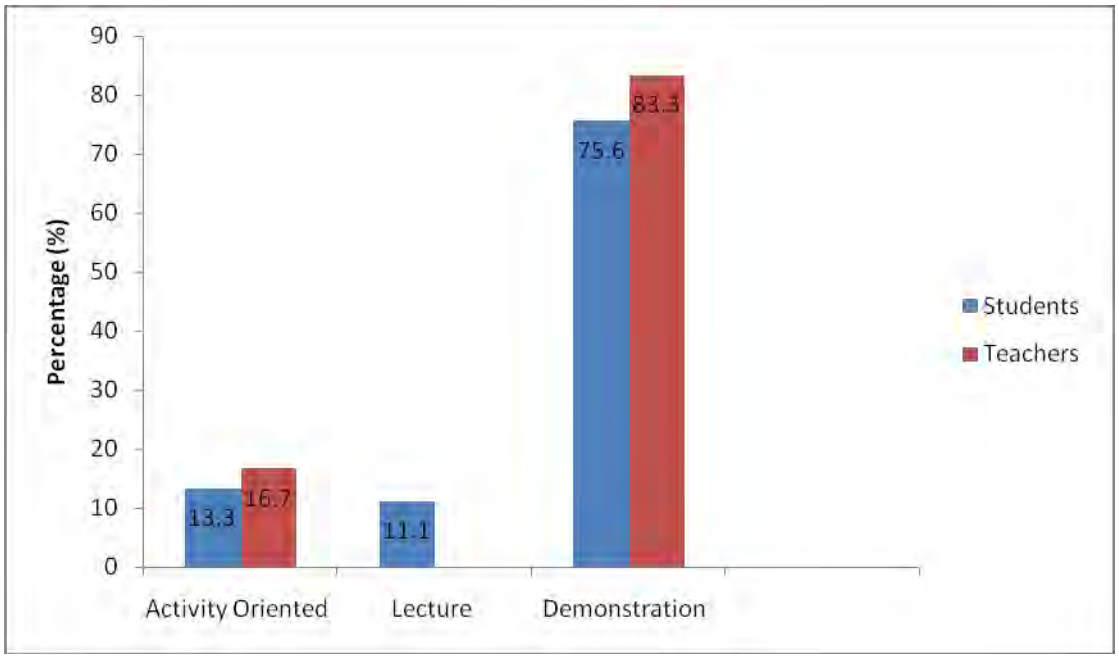
The question sought to determine the strategies used by teachers in the Afadjato South District in teaching of Integrated Science practical lesson. To answers this question, a questionnaire was used in other to get accurate and firsthand information from both students and teachers. The table 3 below presents the breakdown of the result in frequencies and percentages using SPSS analysis:

Table 3: Method (s) teachers use during Integrated Science practical Lessons.

Teaching Strategies	**SHS Students**		**Teachers**	
	Frequency	Percentage %	Frequency	Percentage %
Activity Oriented	12	13.3	1	16.7
Lecture	10	11.1	0	0
Demonstration	68	75.6	5	83.3
Total	90	100.0	6	100

The findings of the study revealed that, some teaching methods used in the delivery of Integrated Science practical lessons as indicated in Table 3, using students and teachers' questionnaire of items 7 and 9 respectively, 12 students representing 13.3% said their teacher organizes practical work for them using activity oriented method. This is also affirmed by 1 teacher representing 16.7% also using activity oriented method. Furthermore, 10 students representing 11.1% said the only means by which they were taught Integrated Science practical lesson was through the use of lecture method. No teacher affirmed or agreed on this lecture method being used. However, a frequency of 68 students representing 75.6% affirmed that their teachers used demonstration method and this is equally confirmed by teachers themselves with 83.3%. In an interview with the teachers on why most of them prefer demonstration method as against activity oriented method their feedback was that there was not enough time provided on the schools time table to teach the Integrated Science practical and the lack of adequate apparatus and laboratory materials.

Figure 4. 3: Teaching strategy



This question sought to investigate the best method(s) used for teaching and learning of Integrated Science practical. The summary of result of the analysis are presented are in Table 4 below:

Table 4: Students and Teachers Response on the best method(s) for effective teaching and learning of Integrated Science practical.

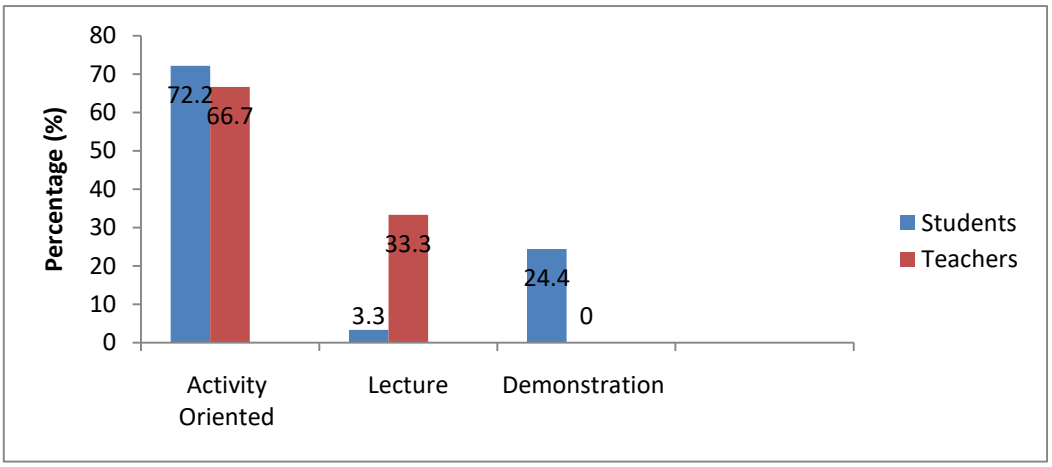
Strategies	**SHS Students**		**Teachers**	
	Frequency	Percentage %	Frequency	Percentage %
Activity Oriented	65	72.2	4	66.7
Lecture	3	3.3	2	33.3
Demonstration	22	24.4	0	0
Total	90	100.0	6	100

This research question sought to determine the strategies used by the Integrated Science teachers during practical lessons. When students and teachers were asked to indicate the method they preferred best the following responses were provided.

From the Table 4, 72.2 % of the students and 66.7 % of the teachers respectively preferred activity oriented method of teaching as the best method of teaching Integrated Science practical. However, 3.3 % of students said they prefer lecture method as against 33.3% of teachers in affirmative of it. In the case of demonstration method, 24.4 % of students as against none of the teachers were in favour of that method. In conclusion, both students and teachers said they consider activity oriented methods as the best way of teaching Integrated Science practical lessons.

The result of the research implies that the students whose teachers used lecture methods of teaching might not have enough opportunity to handle equipment, apparatus and materials during Integrated Science practical lessons. This in the long run might affect students' performance in their Integrated Science examination.

Figure 4. 4: Most Preferred Teaching Strategy



4.3 Research Question 3

What are students' perceptions towards Integrated Science practical lesson among the selected schools?

The aim of this research question in the questionnaire was to investigate students and

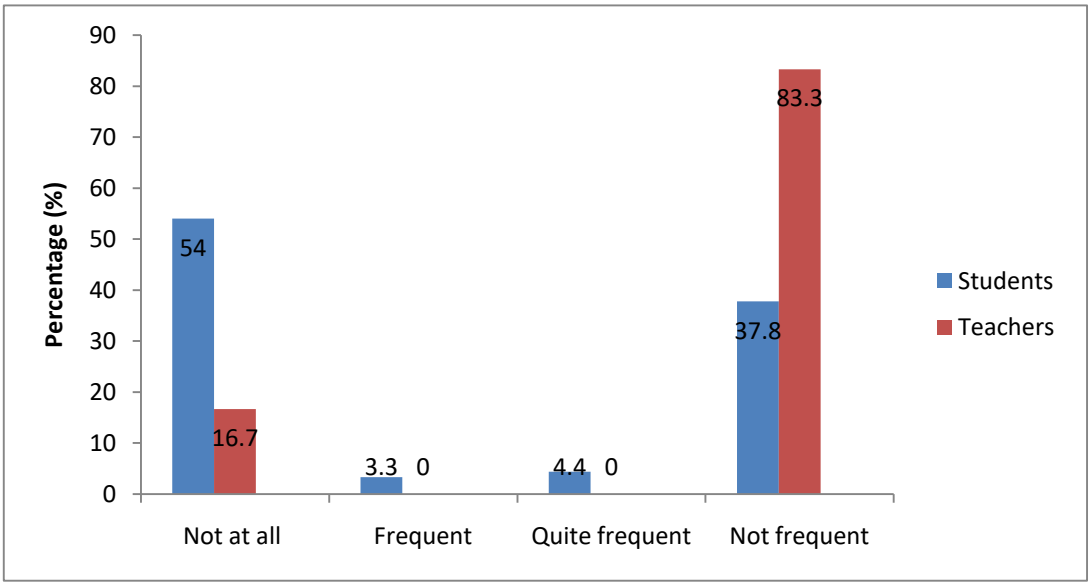
teachers opinions towards the conduct of practical lessons in the selected schools in Afadjato South District. To answer this question, item 9 of students' and 11 for teachers' questionnaire were used to summarize the result below in Table 5:

Table 5: Students and Teachers Response on the conduct of Integrated Science practical lesson in the laboratory.

Responses	**SHS Students**		**Teachers**	
	Frequency	Percentage %	Frequency	Percentage %
Not at all	49	54	1	16.7
Frequent	3	3.3	0	0
Quite frequent	4	4.4	0	0
Not frequent	34	37.8	5	83.3
Total	90	100	6	100.0

It is clear that only few students hold positive views towards the conduct of Integrated Science laboratory work in their schools. According to Table 5, for instance, 54% of the students confirmed that no Integrated Science practical work is carried out in their respective schools as against 16.7% of the teachers who also attested to the same view. However, 3.3% of the students confirmed that practical work is conducted and carried out in their various schools frequently. Nevertheless, 4.4% of the student sample said the conduct of experiment is done quite frequent and 37.8% also said it was done not frequent whilst 83.3 % of the teachers also said that practical work was not done frequently in their schools.

Figure 4.5: Students's and Teachers' opinion towards practical lessons



The aim of this question was to find out if there is a problem(s) both students and teachers encounter in Integrated Science practical lesson. Items 39 and 30 of both students and teachers questionnaire respectively was used to analysed the following below in Table 6:

Table 6: Perception of Students' and teachers' on Integrated Science practical lesson

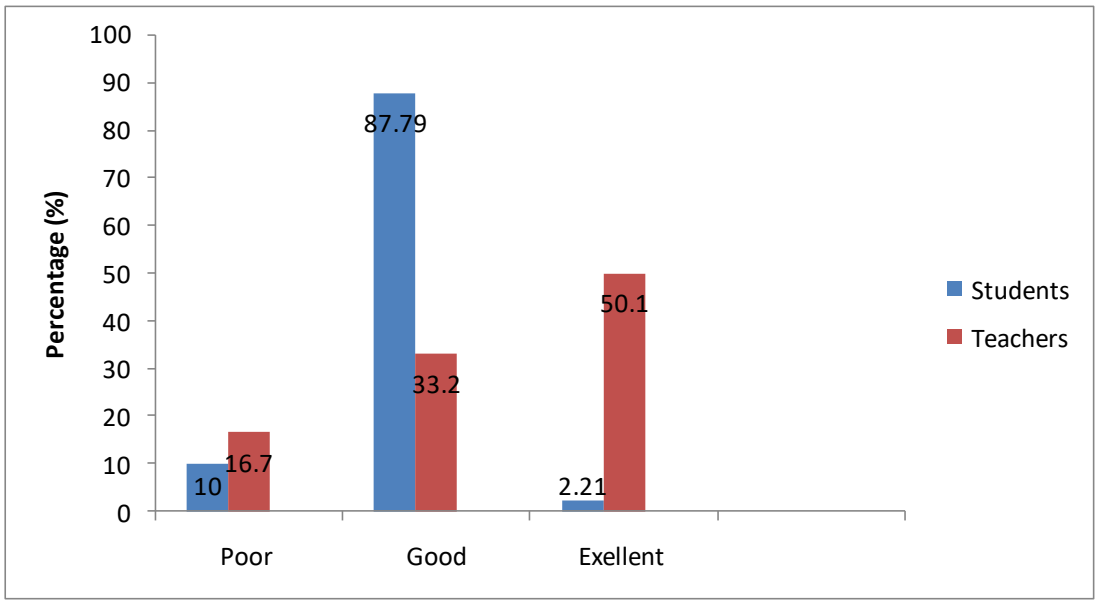
Response	**SHS Students**		**Teachers**	
	Frequency	Percentage %	Frequency	Percentage %
Poor	9	10.0	1	16.7
Good	79	87.79	2	33.2
Excellent	2	2.21	3	50.1
Total	90	100.0	6	100

Items 39 and 30 of both students and teachers questionnaire respectively were used to determine the perceptions and attitudes of students' and teachers' towards Integrated Science practical lesson.

It was gathered that some of the participant had poor perceptions and attitudes towards the teaching and learning of Integrated Science practical lessons.

As shown in the table 6, 10% and 16.7% of students and teachers respectively have poor perception about Integrated Science practical lesson and for that matter seeing it as a waste of time however, 87.79% and 33.2% of students and teachers respectively agreed that Integrated Science practical lesson is good and hence the good perception about it. Finally, 2.21% and 50.1% of both students and teachers see it and confirmed that the studying of Integrated Science practical is excellent and not waste of time as perceived by others. However, few gave some reasons upon interview why they think the studying of Integrated Science practical work is waste of time. Although none of the teachers mentioned it explicitly, but a look at their timetables, shows that the driving force for their decision was the fear of being tasked to carry extra teaching load. Some students also had the notion that Integrated Science practical is difficult and also perceive it as time wasting and boring. Students notion have to be corrected about how they perceive Integrated Science practical lesson.

Figure 4. 6: Perception towards Integrated Science practical lesson



4.4 Research Question 4

What are some other factors that influence the teaching and learning of Integrated Science practical lesson?

The rationale of this question was to find out if there is a need for other facilities and equipment that both students and teachers think should be added to what already exist in their school laboratories. Item 36 and 16 of both teachers and students were used respectively to answer the above question. Multiple responses were given by both teachers and students on the above question. The responses provided were coded under the following: Agree (AGR); Disagree (DIS); Strongly agree (STRA); Strongly disagree (STROD). These are represented in the Table 7 below:

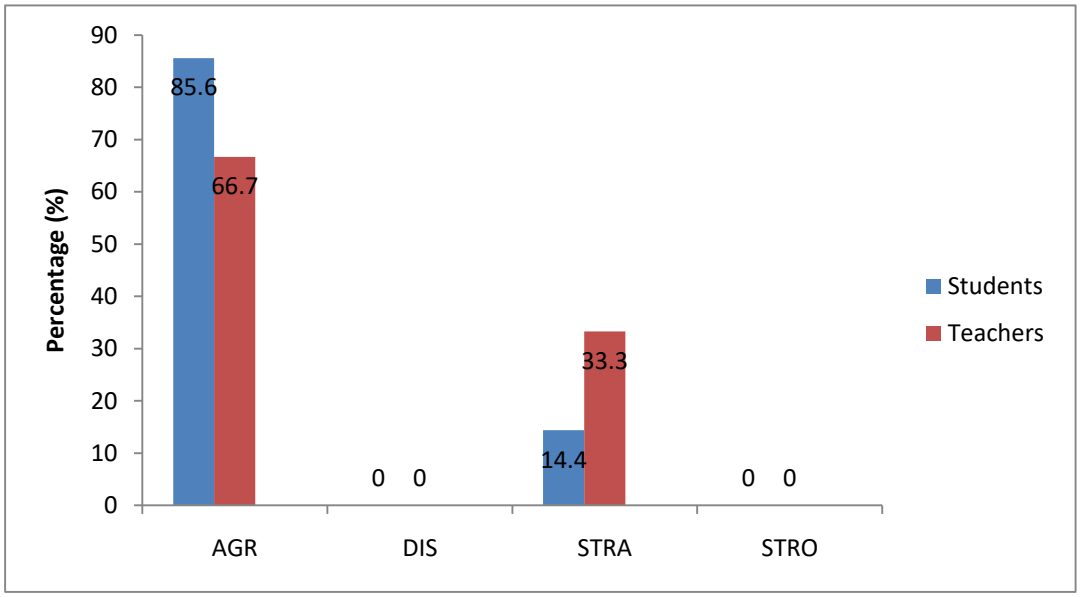
Table 7: The need for additional facilities and equipment

Response	**SHS Students**		**Teachers**	
	Frequency	Percentage %	Frequency	Percentage %
AGR	77	85.6	4	66.7
DIS	0	0	0	0
STRA	13	14.4	2	33.3
STROD	0	0	0	0
Total	90	100.0	6	100

As observed in the Table 7, 85.6 % of the students agreed (AGR) on the need for more equipment and laboratory apparatus to be supplied as against 66.7% of teachers who equally hold the same view. Surprisingly, the researcher found out that neither of the respondent disagreed with the idea that more science resources are needed. This is an indication that there is still the need of additional facilities and equipment to beef-up the already existing once. However, 14.4% of the students and 33.3% of teachers within the District strongly agreed (STRA) that there is a need of supply of lab equipment and apparatus to the schools since there is not enough. Again none of the respondents goes for strongly disagree (STROD).

In both the students and the teachers' survey, space was left for open responses. Item 36 and 37 of both teachers and students questionnaires respectively were used to ask the respondents to express their answers candidly. Therefore, students and teachers suggested the following laboratory equipment and apparatus such as pipette, burette, and retort stand, Bunsen burner, conical flask, round bottom flask, chemicals, reagents for food test, measuring cylinders, digital balances, microscopes, etc be supplied.

Figure 4.7: Respondents' view towards their practical needs



The aim of this question was to find out if there is a peculiar problem(s) both students and teachers encounter in Integrated Science practical lesson. However, Item 40 of students and 28 teachers were used to answer the above question. Multiple responses were provided by both teachers and students on the above question. The responses provided were coded under the following: lack of standard laboratory (LSL); lack of laboratory technicians (LLT); inadequacy of practical equipment and material (IPM); large class size (LCS); insufficient time for practical work (ITP). These are represented in the Table 8 below:

Table 8: Problems students and teacher encounter in Integrated Science Practical Lesson.

Strategies	**SHS Students**		**Teachers**	
	Frequency	Percentage %	Frequency	Percentage %
LSL	24	26.7	1	16.7
LLT	42	46.6	1	16.7
IPM	17	18.9	2	33.2
LCS	6	6.7	1	16.7
ITP	1	1.1	1	16.7
Total	90	100	6	100

As observed in the Table 8, 26.7% of the students and 16.7 % of the teachers affirm that one of the major problems they encounter is the lack of standard laboratory (LSL) for practical work in Integrated Science.

With respect to the lack of laboratory technicians (LLT), 46.6% of the students and 16.7% of the teachers responded in affirmative, which in the opinion of the researcher was not encouraging as the value of those laboratory assistant can never be underestimated.

When it came to the problem of inadequacy of practical equipment and material (IPM), 18.9 % of the students as against 33.2 % of the teachers responded positively and strongly to the need for additional practical equipment and material such as pipette, burette, retort stand, Bunsen burner, conical flask, round bottom flask, chemicals, reagents for food test, measuring cylinders, digital balances, microscopes, etc.

On the contrary, 6.7% of the students as against 16.7 % of the teachers indicated large class size (LCS) as the problem they have been encountering during Integrated Science practical lesson.

In terms of insufficient time for practical work (ITP), 1.1 % of students and 16.7 % of teachers responded positively.

To address the question on things to do solve the identified problems, the Researcher used items 40 and 28 of both the students' and teachers' questionnaire respectively.

The responses given by both participants were categorized into the following:

Provision of necessary equipment and materials by stakeholders (PEM); Employing of well educated laboratory technician/ assistant (ELT); Adjustment in time allocated for practical work (ATW); provision of proper equipped laboratory (PPL); and others.

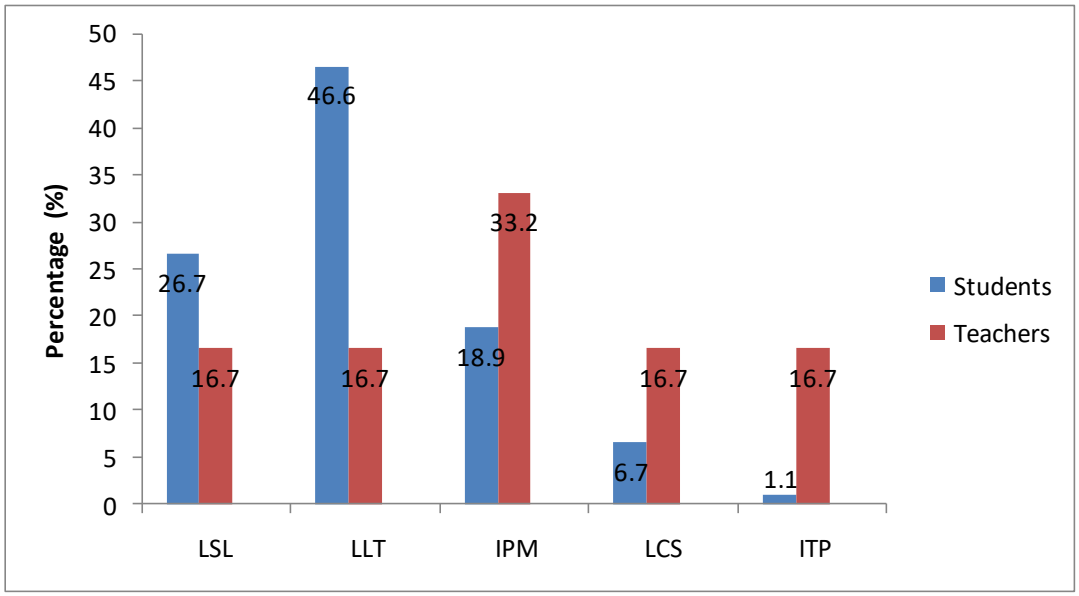


Figure 4.8: Some problems

The researcher in answering this question used items 40 of the students' questionnaire and 28 of the questionnaire of teachers. The responses provided were coded under following: provision of necessary equipment and materials (PEM); employing of well educated laboratory technician (ELT); adjustment in time allocated to practical work (ATW); provision of proper and well-equipped laboratory (PPL).The summary of students' and teachers' response with respect to the solution is presented in the Table 9 below :

Table 9: Solution to the identified problems.

Solutions	**SHS Students**		**Teachers**	
	Frequency	Percentage %	Frequency	Percentage %
PEM	77	85.5	1	16.7
ELT	4	4.4	1	16.7
ATW	8	8.9	2	33.3
PPL	1	1.1	2	33.3

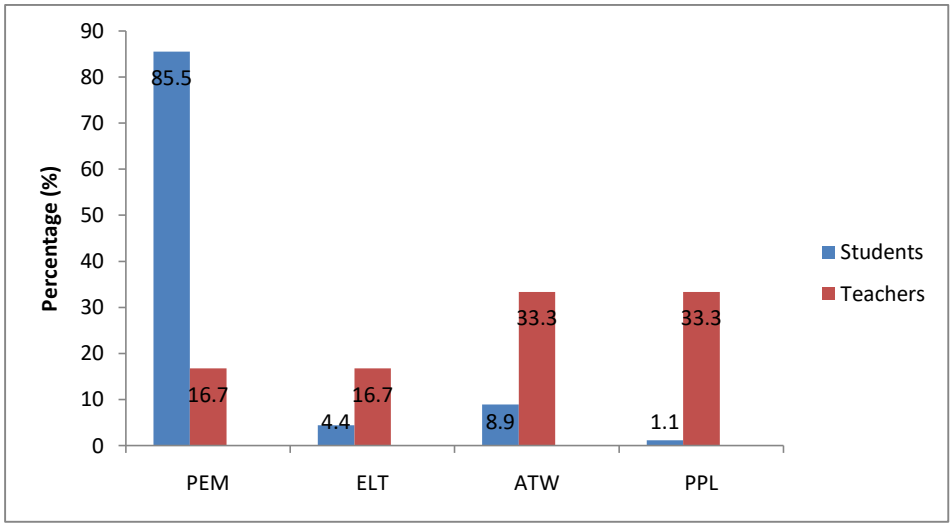
In the Table 9, 85% of the students as against 16.7% of the teachers identified the need for the provision of necessary equipment and materials (PEM) by all the stakeholders in education to better their lot with respect to Integrated Science practical work.

In terms of the employing of well educated laboratory technician (ELT) to help both students and teachers in their practical work, 4.4% of the students as against 16.7 % of the teachers supported the idea or were in favour of it.

However, a population of 8.9% of the students as against 33.3 % of the teachers agreed and suggested adjustment in time allocated to practical work (ATW) to enhance students' understanding of scientific concepts.

Only 1.1% of the student as against 33.3% of teachers indicated the provision of proper and well-equipped laboratory (PPL) as a key areas in solving the identified problems.

Figure 4.9: Solution to the identified problems



CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER STUDIES

5.1 Overview

This chapter contains summary of findings, conclusion, recommendations and suggestions for further studies to improve the teaching, learning and organization of Integrated Science practical lessons in the Afadjato South District.

5.2 Summary of the Study

This research was carried out to find out some factors influencing teaching and learning of Integrated Science practical lessons in the Afadjato South District. This is because most of the WASSCE candidates who graduate from the various SHS in the District could not gain access to Tertiary education because they do not pass the four core subjects particular Integrated Science. Questionnaire and interviews were the main instruments used to collect data for this research.

The data was collected from ninety (90) students and six (6) teachers respectively from the selected Senior High Schools. In all thirty (30) students and two (2) teachers were randomly selected from each of the schools to answer the questionnaire.

An interview was conducted using five students selected at random from each school. It was followed by an interview granted to one Integrated Science teacher from each of the selected schools.

5.3 Summary of the Main Finding of the Study

From the analysis gathered from the study, the following were the major findings:

i. Both students and teachers in Afadjato South consider the demonstration and activity oriented methods as the best and most effective methods of teaching and learning of Integrated Science practical lessons.

ii. The study revealed that school laboratories in Afadjato South were not adequately furnished with equipment, apparatus and materials for Integrated Science practical lessons.

iii. Students and teachers in the study indicated inadequacy of equipment, apparatus and learning materials in the schools. As such students are not given the opportunity to handle materials individually.

iv. The study also confirmed other problems in the District such as the lack of laboratory assistants, insufficient equipment, apparatus and teaching materials for practical lessons as well as the lack of protective wear during practical lessons.

v. The study again revealed that most of the students consider Integrated Science as a difficult and time consuming subject. Therefore, the students perceive it to be boring, and so had a negative attitude towards it.

vi. The selected schools in the District were found to have too large class sizes. Some school Heads perceived the provision of materials and equipment as waste of money, and did not take Integrated Science serious because it involves money.

5.4 Conclusions

Questionnaire and the interview guide were analyzed using simple frequency and percentages. The following conclusions were drawn from the research:

Majority of the teachers use demonstration method to teach without involving the students in the lessons to practice as a result of inadequate equipment and apparatus in the schools. Students have negative attitudes towards Integrated Science because they think that Integrated Science is a difficult and time consuming subject. Hence, they do not take their studies serious.

It also appears that some school authorities do not have interest in the provision of science materials and equipment for the subject. The excuses they gave were that there were no funds for such purchases.

More so, the large class sizes of Integrated Science in the Senior High Schools visited had been a major drawback towards the effective use of practical activities in the teaching and learning of Integrated Science. This therefore has become a major cause for concern, which must seriously be looked at by all stakeholders in education. Much success could be attained if such large classes are split into more manageable units.

In the researchers' opinion, students should be counsel in other to discard the notion they have about Integrated Science as being difficult and time consuming. Again, all stakeholders of education need to put in the needed efforts in providing well – equipped laboratories for all the Senior High Schools. This will enable the teachers and students to use practical work effectively in the teaching and learning of Integrated Science practical lessons.

5.4 Recommendations

Based on the findings of the study, the following recommendations are proposed:

i. Science teachers at Afadjato South should be given incentives such as risk allowances, and regular provision of funds for the purchase of essential materials without going through the usual bureaucratic process of applying for funds.

ii. Headmasters and educational authorities in the Afadjato South District should be provide adequate and relevant teaching and learning materials in the science laboratories for students and teachers to use during practical lessons.

iii. The class size of 55 students per class for Integrated Science practical lesson should be reduced to small manageable units for an effective practical work.

iv. Regular or periodic in- service training should be organized by the District education directorate of Afadjato South to help the teachers to upgrade their methods of teaching particularly how to teach science using the learner-centered approach.

v. Selected Senior High Schools in the Afadjato South Distrct with inadequate materials for teaching and learning are advised to make good use of the various science resources centre nearby for practical activities.

5.5 Suggestions for Further Studies

The following suggestions have been made for further studies:

i. This study could be replicated in other Districts in the country to find out more about the factors influencing the teaching and learning of Integrated Science practical lessons.

ii. Science normally goes with the teaching and learning of Mathematics, therefore, a further research should be carried out in the Afadjato South District about the teaching and learning of mathematics at the Senior High School level.

iii. A study needs to be done to find out whether the lack of in – service training workshops for teachers has any influence on the teaching and learning of Integrated Science at the Senior High School level.

REFERENCES

Adedapo, K. (1976).The effect of experimental approach to teaching science on academic performance. *Journal of Science Teachers of Nigeria,* 57-64.

Adeyanju, J. L. (1991). Production of cheap instructional materials for the 6-3-3 system of education with emphasis on the first six years. *Trends and research in educational technology*, 45-53.

Adjetey-Adjei, A. (2009). *The attitude of senior high schools students towards science, as a factor of their preference in integrated science*. M. Phil thesis presented to the School of Research and Graduate Studies. U.E.W., Winneba.

Afful-Broni, A., & Ziggah, R. S. (2007). *Introduction to curriculum Development in Ghana*. Accra, Ghana: Yamens Press Limited.

Agboala, J. A. (1984). *Activities for develop critical thinking skills*. Unpublished Ph.D Thesis presented to the Department of Education, Ahmadu Bello University, Nigeria.

Agun, I. (1986). *Institutional Support for Education Technology, the case of college of education: A paper presentation at the national symposium on status and trends in educational technology*. Nigeria Technology Centre Kaduna. 16-21, November.

Agun, I., & Okunrotifa, P. O. A. (1977). *Educational technology in Nigeria teacher education. Education for Development: International Perspective on Expanding Role of Teachers Education*. (ICET),75.

Ainley, J. (1981). The importance of facilities in science education. *European journal of science education*. 127-138.

Akanbi, K., & Imogie, I. (1988). *Selection, utilization and evaluation of instruction*. Ibadan; Y-Books, 91-92.

Akinmade, C. T. O. (1992). Attitude to Science as a school subject . In O.E. Akpan *Towards creative science teaching and learning in West African schools*, 75-83. Cape Coast: Catholic Mission Press.

Akinwumiju, J .A., & Oriwoloye, P. S. (1987). *Accountability in public examinations.* In A. Dada (Ed.), Mass failure in public examination: causes and problems. Ibadan: Heinemann Educational Books Ltd.

Al-Madani, K. (2004). *Student and teacher attitudes towards laboratory work in chemistry in Bahrain*, University of Glasgow, Glasgow, UK.

Anamuah-Mensah, J. (1989). A perspective on science education in Ghana. *Journal of Ghana Association of science Teachers*, 14-15.

Antwi, M. K. (1992). *Education, Society and Development in Ghana*. Accra, Ghana: Unimax Publishers Ltd.

Asiedu, P., & Amoako, C. (2010). *Teaching Syllabus for Integrated Science for Senior High Schools.* Ministry of Education, Ghana.

Babbie, E. (2001). *The practice of social research*. Belmont, California: Wardworth Publishing Company.

Bajah, S. T. (1986). *Implementation of the new SSC Chemistry curriculum keynote Address presented at the STAN,* National Chemistry Workshop, Enugu. April 27-May 2.

Bajah, S. T. (1986). The challenges of science technology and teacher education in Nigeria beyond the year 2000. *African Journal of education*, 43-49.

Balugun, T. A. (1984). *Interest in science and technology education in Nigeria.* Paper presented at the 12th International Symposium on Interest in Science and Technology Education, Lagos-Nigeria.

Barnes, D. (1985). *Practical Curriculum Studies.* London: Routledge and Kegan Paul.

Berliner, D. C. (1990). *What's all the fuss about instructional time?* Arizona: Arizona State University.

Bernard, C. H., & Epp, C. D. (1987). *Laboratory experiments in college physics,* John Wiley &Sons.

Bishop, G. (1985). *Curriculum Development: A Test Book for students*. London: Macmilan Publishers.

Blough, O., & Schwartz, J. (1990). *Elementary School Science and how to Teach it.* University of the Michigan.

Brown-Acquaye, H. A. (2001). Each is necessary and none redundant. The need for science in developing countries. *Journal of Science Education*, 68-70.

Bruner, J. S. (1973). *The Relevance of Education*. New York: Norton.

Bruner, J. S. (1996). *The culture of education*. Cambridge, M. A.: Havard University Press.

Bryman, A., & Cramer, C. (2001). *Quality data analysis: A guide for social scientists.* Philadelphia: Tylor and Francis Inc.

Carnduff, J., & Reid, N. (2003), *Enhancing undergraduate chemistry laboratories: Pre-laboratory and Post-laboratory Exercises* . London*:* Burlington House.

Carvin, M. (1985). *The psychology of Optimal Experience.* New York: Harper and Row.

Chalmers, A. F. (1994). *What is this thing called science?,* London*:* Milton.

Collete, C., & Chiappera, E. L. (1989). *Practical approach to science teaching Senior High School.* London:Longman.

Davies, J. (1972). An assessment of changes in science instruction and science facilities initiated by NDEA. *Title funds use for high school science in Tennessee* between 1965- 1970. Unpublished Ph.D. thesis, University of Tennessee (University Microfilms, 73-2439).

Evans, S. R. (1991). *The Contribution of Japan's Education Economic Growth*. *In E.R. Beauchamp (Ed.)Windows on Japanese education*. New York: Greenwood.

Farrant, J. S. (1996). *Principles and Practice of education*. Hong Kong: Sheck Wah Tong Press Ltd.

Fisher, D. L., & Fraise, B. J. (1990). School Climate: Assessing and Improving School environments. *Journal of the NZCER,*14- 17.

Gall, M. (1970). *Educational research: An introduction.* New York: Longman.

Gay, L. R. (1987). *Educational Research Competence for analysis and application* (3rd ed). Columbia, Ohio: Merill Publication Company.

Hodson, D. (1990), *A critical look at practical work in school science*, School Science Review March, 33 – 40.

Hodson, D. (1990). Re-thinking Old Ways: Towards A More Critical Approach To Practical Work In School Science. *Study Science Education*, 85 – 142.

Hodson, G. (1992). *Practical work and teaching of science to schools,* NewYork. Mcmillan.

Hofstein, A., & Lunetta, V. (2003). *The laboratory in science education:* Foundations for the twenty-first century.London: Wiley.

Hurds, P. D. (2002). Modernizing Science Education. *Journal of Research in Science Teaching*, 3 – 7.

Johnson, B. (1978). *Beginning.* London: Croom Hall.

Joppe, M. (2000). *The research process.* London: David Fulton Publishers Ltd.

Kish, T. (1985). *Investigating New Forms of Students Assessment. In G. Grant's Review of Measurement in Education*. London: Lowe and Brydone Printers Ltd.

Kraft, R. (1994). *Teaching and Learning in Ghana.* Accra: Ghana.

Lee, S.Y., & Stevenson, H. W. (1987). Mathematics Classrooms in Japan, Taiwan and the United State. *Child Development*, *58* (12), 72-85.

Lynn, R. (1989). *Mathematics Teaching in Japan*. Wiltshire: Anthony Rowe Ltd.

Marson, R. (1998). *Model for effective Science Teaching*. Global Tops, Canada: Tops Learning system.

Mathew, J. (1989). *Curriculum exposed.* London: David Fulton Publishers Ltd.

McKinsey, G. (2013). *Disruptive technologies: Advances that will transform life, Business, and the global economy.* San Francisco:wiley.

Ministry of Education, (2010). *Integrated Science Teaching Syllabus for SSS*. Accra: Ghana.

Mitchell, P. (1968). *Acquiring a Conception of Mind: A Review of Psychological research and Theory.* Hove: Psychology Press.

Monatte, T., & Anderson, R. (1994). New York: Holt, Rinehart and Winston, Inc.

Nacino-Brown, R., Festus, O., & Desmond, P. (1982). *Curriculum and instruction: An introduction to methods of teaching*, New York: Macmillan.

Noye, D. A. (2001). A model for Integrating informal Science and technology into pre university level educational system. Winneba:UEW.

Ogunniyi, M. B. (1982). *Teaching and learning primary science*. 23rd Annual conference Proceedings of the Science Teachers Association of Nigeria, 33-37.

Ogunniyi, M. B. (1988). *Primary school science and methods*. Ibadan: Heinemann Education Books Ltd.

Ossei-Anto, T. A. (1995). Management and integration of science resource in Ghana's educational reform programme. *Journal of Educational Management*, 46-66.

Pratt, D. (1980). *Curriculum Design and Development.* New York: Harcourt Brace Javanouich publishers.

Quarm, J. A. (2001). *Science education for senior high school in Ghana*,Kumasi Redemption Press.

Raizen, S. (1994). International Assessment of Education Progress. Retrieved on 2nd August, 2014 (http://www.snap.edu/read.org.]

Ranis, G. (1990). *Science and Technology policy.* Boulder: West view.

Renner, J. W., & Strafford, D. G. (1972). *Teaching science in secondary schools*. New York: Harper and Row Publishers.

Robbin, J. (2002). *On restructuring teacher education through collaboration: The case of the urban teacher education program.* Paper presented at the 71st annual meeting of the Association of Teacher Educators, New Orleans, Louisiana.

Sekyere, E. A. (2013). *Teachers Guide*. Kumasi: Afosek educational consult.

Shah, I. (2004). *Making University Laboratory Work in Chemistry More Effective.* Glasgow:Macmillan.

Sheppard, K., & Robbins, D. M. (2002). Lessons from the committee of ten. *Physics Teachers*,426 – 432.

Smith, M. L. (1982). Benefits of Naturalistic methods in Research in Science Education, *Journal of Research in Science Teaching, 19* (8), 627-638.

Stigler, J. W., Lee, S.Y., & Stevenson, H. W. (1987). Mathematics Classrooms in Japan, Taiwan and the United State. *Child Development*, *58* (12), 72-85.

Taba, H., & Walker, D. F. (1971). *Curriculum Development: Theory and Practice.* New York, N Y: Harcourt, Brace & World.

The National Science Teachers Association of Pakistan (1990). *Evaluation of Pakistan Studies Text book for Secondary level. Islamabad:* National Book Foundation.

Tillery, A. (1991). *Construction of prototypical situations in teaching the concept of energy.* London: Falmer Press.

Tom Aquinas, S. (2013). *Scientific Literacy.* Retrieved on 4th May, 2015 *http://www.ghana.gov.gh/index.php/gov-t-projects/ministry-of-education*

Torrance, E. P. (1996). Guiding creative talent. Englewood cliffs: Prentice Hall

Trochim, W. M. K. (2006). *Research methods knowledge base*.Retrieved on 2nd August, 2015, http://www.socialresearchmethods.net/kb/design.php.

Von Secker, C. E., & Lissitz, R. W. (1999). Estimating the impact of instructional practices on students' achievement in science. *Journal of Research in science Teaching*, *36*(10), 1110-1226.

Wellington, J. (1998). *Practical work in school science.* London: Routledge.

West African Examination Council (1998). *Integrated Science Chief Examiners' Report*. Accra: WAEC Press.

West African Examination Council (1999). *Integrated Science Chief Examiners' Report*. Accra: WAEC Press .

West African Examination Council (2000). *Integrated Science Chief Examiners' Report*. Accra: WAEC Press.

West African Examination Council (2001). *Integrated Science Chief Examiners' Report*. Accra: WAEC Press.

West African Examination Council (2002). *Integrated Science Chief Examiners' Report*. Accra: WAEC Press.

West African Examination Council (2003). *Integrated Science Chief Examiners' Report*. Accra: WAEC Press.

West African Examination Council (2004). *Integrated Science Chief Examiners' Report*. Accra: WAEC Press.

West African Examination Council (2005). *Integrated Science Chief Examiners' Report*. Accra: WAEC Press.

West African Examination Council (2006). *Integrated Science Chief Examiners' Report*. Accra: WAEC Press.

West African Examination Council (2007). *Integrated Science Chief Examiners' Report*. Accra: WAEC Press.

West African Examination Council (2008). *Integrated Science Chief Examiners' Report*. WAEC Press, Accra: WAEC Press.

West African Examination Council (2009) . *Integrated Science Chief Examiners' Report*. Accra: Ghana.

West African Examination Council (2010). *Integrated Science Chief Examiners' Report*. Accra: WAEC Press .

West African Examination Council (2011). *Integrated Science Chief Examiners' Report*. WAEC Press, Accra: Ghana.

West African Examination Council (2012). *Integrated Science Chief Examiners' Report*. Accra: WAEC Press.

Woolnough, A. R. (1991). *Using Scientific Apparatus in Teaching.* Ibadan, Nigeria: Emeka and Co. company Ltd.

Worgu, B. A. (1991). *Educational Research Method*. Boston: Houghton Mcfflin Company.

Yager, E. R., & Mc Cormack, A. J. (1989). Assessing teaching and learning success in multiple domains of science and science education.

Yager, R. E. (1992). The search for excellence in science education London:Macmillan.

APPENDIX A

Questionnaires for Teachers only

TOPIC: **IMPROVING TEACHING AND LEARNING OF INTEGRATED SCIENCE PRACTICALS IN SELECTED SENIOR HIGH SCHOOLS.**

Dear Respondent

This study is purely meant for academic purposes. You will be contributing to its success if you answer the items as frankly and honestly as possible. Your responses will be kept confidential. Kindly read through each of the items carefully and indicate the opinion that is the nearest expression of your view on each of the issue raised.

General Instruction

Please tick [√] the appropriate bracket or column or fill in the blank spaces provided where applicable.

Section A

The state of laboratories for Integrated Science practical lesson

1. Do you have a laboratory in your school for Integrated Science practical work?

(a)Yes [ ] (b) No [ ]

2. If yes to (1), is the laboratory the same for the core and elective sciences?

(a) Yes [ ] (b) No [ ]

3. If No to (2) above, where do you normally have your Integrated Science practical lesson?

(a)Classroom [ ] (b) under a tree [ ] (c) In the open [ ] (d) Not at all [ ]

4. Is your school laboratory equipped with materials necessary for practical work?

(a) Yes [ ] (b) No [ ]

5. How is your school laboratory equipped?

(a) Very adequate [ ] (b) Adequate (c) Inadequate

6. Are these materials enough for teaching and learning during Integrated Science practical lessons? (a) Yes [ ] (b) No [ ]

7. Equipment and apparatus adequate to go round all students during practical work?

(a) Agree [ ] (b) Disagree [ ] (c)Strongly agree [ ] (d) Strongly disagree

8. If you say No to item (7) above, then what do you normally do in such situations?

……

……

Section B

Some strategies / techniques teachers and students adopt in the teaching and learning

9. What do you normally do as the Integrated Science tutor before having Integrated Science lessons? Provide your answer in the space provided below……
……..……
…….

10. Which of the method(s) would you consider effective for the teaching and learning of Integrated Science practical?

Tick as many as you have been using (a) Activity oriented [ ] (b) Lecture [ ]

(c)Demonstration [ ] (d) Specify other (if any)…….....

…….....

Section C

Some other factors that influences the teaching and learning of Integrated Science

11. How often is Integrated Science practical lessons conducted in your school laboratory?

(a) Not at all [ ] (b) Frequent [ ] (c) Quite frequent [ ] (d) Quite frequent [ ]

(e) Not frequent [ ]

any)……..

12. Who normally organizes such practical lessons? The……

(a) Integrated Science Teacher [ ] (b) Lab. Technician [ ] (c) Lab. Assistant [ ] (d) Class prefect [ ]

13. How are the available teaching materials used during Integrated Science practical lessons?

(a) Individually [ ] (b) In Groups [ ] (c) Whole class demonstration [ ]

14. Do students have access to practical equipment during their free time?

(a) Yes [ ] (b) No [ ]

15. If your answer to item (15) is No, give

reasons……

…….....

.....

16. Do you think there are other important equipment and facilities that should have been provided but are not available in the laboratory?

(a) Agree [ ] (b) Disagree [ ] (c) Strongly agree (d) Strongly disagree

17. If Agreed or strongly agreed to item (16) above, please list them……

……

18. How often do the Senior High School Authorities provide / supply the laboratory with materials?

(a) Very frequent [ ] (b) Frequent [ ] (c) Quite frequent [ ](d) Not Frequent [ ] (e) Not at all [ ]

19. Do the Senior High school authorities perceive the provision of equipment and material as waste of fund and resources? (a) Yes [ ] (b) No [ ]

20. What makes you think so? Give reason (s)……

……..

21. How many period (s) is / are allocated for Integrated Science practical work in your school per class?

SHS 1 0 [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ]

SHS 2 0[ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ]

SHS 3 0 [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ]

22. How do you perceive the time allocated for Integrated Science practical lesson in your school?

(a) Not sufficient [ ] (b) Sufficient [ ]

(c) Quite sufficient [ ] (d) Very sufficient [ ]

23. How many students do you have in your class? Provided your answer in the space provided……

24. Do you have laboratory assistant (s)/ technician (s) in your school to assist you during practical lessons? (a) Yes [ ] (b) No [ ]

25. If Yes to (25) is the laboratory technician or assistant for both core and elective sciences? (a) Yes [ ] (b) No [ ]

26. What type of Integrated Science practical work do you often perform in your school laboratory? You can tick as many as possible.

(a) Physics [ ] (b) Agriculture [ ]

(c) Chemistry [ ] (d) Biology [ ]

(e) Specify other (if any)…….....

27. Every human endeavor is bound to meet problems. What problem do you often encounter during Integrated Science practical lessons? Specify such problems provided in the space below…….....

……..

28. How do you think such problems could be solved to improve upon the learning teaching of Integrated Science in the Senior High Schools?

……

Section D

Students' perception/ attitude towards Integrated Science practical

29. Does the student in your class promote effective teaching and learning during Integrated Science practical lessons? (a) Yes [ ] (b) No [ ]

30. How do you perceive Integrated Science practical lesson? (a) Poor [ ] (b) Good [ ] (c) Excellent

APPENDIX B

Questionnaires for Students only

TOPIC: **IMPROVING TEACHING AND LEARNING OF INTEGRATED SCIENCE PRACTICALS IN SELECTED SENIOR HIGH SCHOOLS.**

Dear Respondent

This study is purely meant for academic purposes. You will be contributing to its success if you answer the items as frankly and honestly as possible. Your responses will be kept confidential. Kindly read through each of the items carefully and indicate the opinion that is the nearest expression of your view on each of the issue raised.

General Instruction

Please tick [√] the appropriate bracket or column or fill in the blank spaces provided where applicable.

Section A

The state of laboratories for Integrated Science practical lesson

1. Do you have a laboratory in your school for Integrated Science practical work?

(a)Yes [ ] (b) No [ ]

2. If Yes, is the laboratory the same for the core and elective / pure Sciences?

(a) Yes [ ] (b) No [ ]

3. If No, then where do you normally have your Integrated Science practical lesson?

Classroom [ ] (b) under a tree [ ] (c) In the open [ ] (d) Not at all [ ]

4. Is your school laboratory equipped with materials necessary for practical work?

(a) Yes [ ] (b) No [ ]

5. How is your school laboratory equipped? (a) Very adequate [ ] (b) Adequate [ ]

(c) Inadequate [ ]

6. Are the equipment and facilities in the laboratory appropriate for Integrated Science practical?

(a) Yes [ ] (b) No [ ]

Section B

Some strategies / techniques teachers and students adopt in the teaching and learning.

7. Which method(s) of teaching has / have your teacher(s) been using during Integrated Science practical lessons?

Tick as many as you have been using (a) Activity oriented [ ] (b) Lecture [ ]

(c)Demonstration [ ] (d) Specify other (if any)…….....

…….....

8. Which of the method(s) would you consider effective for the teaching and learning of Integrated Science practical?

Tick as many as you have been using (a) Activity oriented [ ] (b) Lecture [ ]

(c)Demonstration [ ] (d) Specify other (if any)…….....

……...

Section C

Some factors that influences the teaching and learning of Integrated Science in Afadjato South District?

9. How often is Integrated Science practical lessons organize in your school laboratory?

(a) Not at all [ ] (b) Frequent [ ] (c) Quite frequent [ ] (d) Quite frequent [ ]

(e) Not frequent [ ]

10. Who normally organizes such practical lessons? The……

(a) Integrated Science Teacher [] (b) Lab. Technician [] (c) Lab. Assistant []

(d) Class prefect [ ]

11. How many times in a week do you have Integrated Science practical lesson(s)?

(a) Once in a week [ ] (b) Twice in a week [ ] (c) Sometimes [ ]

(d) Specify others (if any)……

……

12. How many period(s) do you have for practical work in Integrated Science within a week?

(a) One [ ] (b) Two [ ] (c) Three [ ] (d) Four [ ] (e) Not at all [ ] (f) Others [ ]

13. How do you perceive the time allocated for Integrated Science practical lesson in your school?

(a) Not sufficient [ ] (b) Sufficient [ ]

(c) Quite sufficient [ ] (d) Very sufficient [ ]

14. How many are you in class? Provide your answer in the space provided……

15. Does the number of student in your class promote effective teaching and learning during Integrated Science practical lessons? (a) Yes [ ] (b) No [ ]

16. In a short sentence gives a reason for your answer……

……..

17. Equipment and apparatus enough to go round all students during Integrated Science practical lessons

(a) Agree [ ] (b) Disagree [ ] (c) Strongly Agree [ ] (d) Strongly disagree [ ]

18. If No then, what do you normally do in such situations?

……..

19. How are the available teaching materials used during Integrated Science practical lessons?

(a) Individually [ ] (b) In Groups [ ] (c) Whole class demonstration [ ]

20. Does / do your tutor(s) allow you to practice on your own laboratory?

(a) Yes [ ] (b) No [ ]

21. Do you have a laboratory assistant (s)/ technician (s) to assist you during Integrated Science practical lessons? (a) Yes [ ] (b) No [ ]

22. If Yes, is it the laboratory technician or assistant for both core and elective sciences? (a) Yes [ ] (b) No [ ]

23. Is / are your Integrated Science tutor(s) always present when having practical lessons? (a) Yes [ ] (b) No [ ]

24. If No, what do you do when you are in difficulty? ……

……

25. Do you have access to computers in the laboratory?

(a) Yes [ ] (b) No [ ]

26. How many computers are in the laboratory, if yes to (25)?

(a) One [ ] (b) Two [ ] (c) Three [ ] (d) Four [ ] (e) Five [ ] (g) Specify others (if any)……..

27. How often are computer used by teachers to teach at the laboratory?

(a) Very often [ ] (b) Often [ ] (c) Seldom [ ] (d) Not at all [ ]

28. Who operates the computer(s) for teaching (if any).....

……..

29. Do you go for field trips and excursions sometimes?

(a) Yes [ ] (b) No [ ].

30. Every human endeavor is bound to meet problems. What problem do you often encounter during Integrated Science practical lessons? Specify such problems provided in the space

below…….....

……..

Section D

Students' perception/ attitude towards Integrated Science practical lesson among the selected schools in Afadjato South District?

31. What do you normally do as the Integrated Science student before having Integrated Science lessons? Provide your answer in the space provided

below……

……..

32. What do you also do as a student before going for practical lesson in the laboratory?

…….....

…….....

33. Which of the following skills do you often learn during practical lesson?

Tick as many as you know of. (a) Observing [ ] (b) Drawing [ ]

(c) Analyzing [ ] (d) Interpreting [ ] (e) Recording [ ] (f) Inquiring [ ] (g) Manipulating [ ]

34. Do you like going to the laboratory for practical lessons in Integrated Science?

35. Give reason(s) for your answer in

(34)…….....

…….

36. Are there other facilities and equipment that you feel should be added to what already exist? (a)Agree [ ] (b) Disagree [ ] (c) Strongly agree (d) strongly disagree

37. If your answer to (36) is agreed or strongly agreed, what is / are its/ their name(s)? Specify…….

(a) Yes [ ] (b) No [ ]

38. Give reason(s) for your answer……..

39. How do you perceive Integrated Science practical lesson? (a) Poor [ ] (b) Good [ ] (c) Excellent

40. How do you think such problems could be solved to improve upon the learning and teaching of Integrated Science in the Senior High Schools?

……