UNIVERSITY OF EDUCATION, WINNEBA

SENIOR HIGH SCHOOL BIOLOGY TEACHERS' ATTITUDES, COMPETENCE LEVEL AND PRACTICES IN PRACTICAL WORK.

COMFORT OFORI-APPIAH

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UNIVERSITY OF EDUCATION, WINNEBA

DEPARTMENT OF SCIENCE EDUCATION

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THESIS IN THE DEPARTMENT OF SCIENCE EDUCATION, FACULTY OF SCIENCE EDUCATION, SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES, UNIVERSITY OF EDUCATION, WINNEBA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR AWARD OF MASTER OF PHILOSOPHY (SCIENCE EDUCATION) DEGREE.

2015

DECLARATION

STUDENT'S DECLARATION

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

SIGNATURE… …….

DATE **……**

SUPERVISOR'S DECLARATION

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

NAME OF SUPERIVSOR: DR ERNEST NGMAN-WARA

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SUPERVISOR'S DECLARATION

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

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DEDICATION

This thesis is dedicated to the Almighty God who has made it possible for me to complete this work. To my mother Mrs. Faustina Prempeh Adjei, to my sons and daughter whose unconditional love, care, prayer support and wishes made my dream possible.

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ABBREVIATIONS

A' level: Advance Level Certificate.

B. Sc: Bachelor of Science.

CRDD: Curriculum Research and Development Division.

GAST: Ghana Association of Science Teachers.

GES: Ghana Education Service.

GNAT: Ghana National Association of Teachers.

NAGRAT: National Association of Graduate Teachers.

O' level: Ordinary Level Certificate.

SHS: Senior High School.

SSS: Senior Secondary School.

STME: Science Technology and Mathematics Education.

WAEC: West Africa Examination Council.

WASSCE: West Africa Senior Secondary Certificate Examination.

ABSTRACT

This study investigated the attitudes, competence, and practices of biology teachers during practical lessons. The study employed a descriptive survey research design. Stratified random sampling was used to select 80 biology teachers who had taught elective biology for three years and above at the SHS level in the Eastern Region of Ghana. Combination of quantitative and qualitative data gathering instruments consisting of questionnaire, observation checklist, interview and document analysis were used to collect data for the study. Collecting the data, there was an uncertainty of whether what respondents answer actually reflects their fundamental attitudes, competence and their practices. In order to address this, triangulation was used. Findings of the pilot test revealed that the Cornbach Alpha value of the questionnaire instrument was between 0.626 and 0.703 indicating a high level of reliability. The data analysis involved the use of multiple statistical procedures: simple percentages, means, standard deviation and independent sample 2-tailed t-test of significance. The results indicated that there is a perfect relationship between biology teacher competence, attitude and their practices during practical lesson (r=1). The results also showed that 83% of the respondents are not competent in making botanical garden which is a curriculum requirement. The study recommended that in order to boost biology teachers' attitude towards practical work there must be regular in-service training for all biology teacher. Also biology teachers as much as possible should make botanical garden in their various schools to enhance teaching and learning of biology.

CHAPTER ONE

INTRODUCTION

Overview

This study is necessitated by the fact that, practical work in science is a powerful tool in enhancing classroom instruction and students' performance. Teacher competence and positive attitudes towards science practical work are crucial for effective organization of practical lessons in Senior High Schools (SHS).

This chapter discusses the background to the study, statement of the problem, purpose of the study, objectives and significance of the study. It also states the research questions that guide the study, delimitation and limitations of the study. The chapter ends with the organization of the study.

Background to the Study

The teaching and learning of biology is very important because the knowledge of biology helps in improving the quality of life of people and helps in solving many societal problems relating to health, food storage, crop production and environmental conservation. In Ghana the importance accorded biology, in the school curriculum from the basic level to the senior high level reflects accurately the vital role it plays in contemporary society.

The rationale for teaching elective biology at the SHS level include the fact that, the survival of humans and the development of nations would ever depend more and more on science and technology. Biology however, as a branch of natural science is devoted to the study of life and activities of all living things from bacteria to high plants and animals. The survival of humans nevertheless depends greatly on the knowledge and understanding of the structure and functions of organisms and how

they interact with one another and the environment. Therefore, the need to teach biology ultimately is to explain the living world in terms of scientific principles although appreciating that, organisms behave in ways which often seem beyond the capabilities of their component parts. It is also to guide and inculcate in the learner, skills in observing and measuring, formulating hypothesis, predicating and designing, investigating, recording data and interpreting results, drawing conclusions and communicating the results.

The knowledge, skills and attitudes acquired through the study of biology is to provide the learner with the necessary basic tools for further studies. It further equips the learner for research in pure and applied science and technology that are vital areas for the advancement of society. Teaching elective biology in totality should guide the learner and make him/her capable of critical thinking, making meaningful decisions and solving problems. These cannot be achieved without practical activities. Practical work in science is defined to be any science teaching and learning activity which involves students, working individually or in small groups, manipulating and/or observing real objects and materials, as opposed to the virtual world (Science Community Representing Education (SCORE), 2008).

Biology also serves as a prerequisite subject for many professions and fields of learning which have contributed immensely to the advancement of the nation such as Agricultural engineer, biology teacher, nutritionist, nurse, surgeon, crime scene investigator and zoologist. As stated in Aniodoh (as cited in Yeboah, 2010), a sound theoretical and practical knowledge of biology is needed for the management of our natural resources, provision of good health facilities, adequate food supply and favourable environment. To achieve this, the main objectives of biology education in

Ghana are that, students acquire the skills to apply scientific knowledge to issues and problems. Through acquisition of capacity for experimental skills, drawing, identification and classification, analysis of some processes and interpretation of biological data that are needed for scientific problem solving.

Practical activities in biology however, provide opportunities for students to actually do science as opposed to learning about science. Nzewi (as cited in Na'Omi, 2013) asserted that practical activities can be regarded as a strategy that could be adopted to make the task of a teacher real.

However, as in many developing countries, effective implementation of practical activities is a general problem as there are so many constraints (Allsop, as cited in Cossa & Uamusse, 2015). For instance, lack of laboratories and equipment for teaching practical science, poor preparation of teachers, teacher attitude and competence, poor implementation of procedures such as designing and planning investigation, observing, measuring and overwhelming number of activities demanded by the curricula. As a result of these constraints, most science teachers either neglect or place less emphasis on the practical skills development aspects of learning biology.

Whatever views are expressed about the purpose of practical work in the teaching of biology, and in spite of different opinions about its role, practical work offers an essential opportunity for students to link first-hand experience with (scientific) concepts and ideas (Cossa, 2007). Perhaps it is in line with this thinking that the examination and science teaching syllabuses for Senior High Schools (SHS) produced by the West African Examinations Council (WAEC) and Curriculum Research and Development Division (CRDD) of the Ministry of Education (MOE) respectively placed emphasis on the value of practical work and students' familiarity

with experimental methods. In line with the above, WAEC releases the Chief Examiners' reports on practical examination each year stressing the strengths and weaknesses of candidates.

The Ghana Association of Science Teachers (GAST) organises annual conferences and workshops at regional and national levels where issues bordering on teaching and learning of science are discussed. Subject-based panel discussions are often held during these conferences and workshops hence biology teachers who attend have access to current information on issues which they can adopt in their classroom practices.

Science Resource Centres under Ghana Education Service has been organising training on investigative science teaching which is purposely designed for science teachers and laboratory technicians/assistants in SHS. Last year's training took place in May 2014 at Opoku Ware Senior High School and Prempeh College. The programme was a trainer of trainees' programme where participants were trained to train others. This training occurs whenever new science equipment are supplied to the schools.

In Ghana, the teaching of biology in the SHS is to guide and inculcate in the learner skills of observation, measurement, formulation hypothesis, predication, designing, investigation, recording and interpretation of data, drawing conclusions and communicating them (CRDD, 2011). It also emphasised that the teaching of biology should be student-centred and activity oriented where the teacher acts as a facilitator. It further suggested that well trained laboratory technicians be made available to play complementary role to the teacher. But factors such as (lack of) funds, poorly equipped science laboratory and teacher factors such as qualification, in-service training, attitude, subject specialization and competence are some of the

factors that influence successful implementation of science practical work in SHS. According to Katane and Selvi (as cited in Copriady, 2014), competency is a set of knowledge, skills and proficiency in creating a meaningful experience when organising an activity. Whiles Baysal, (as cited in Kasapoglu, 2010) defines the attitude as a cognitive, affective and behavioural response which is organised on the basis of experience and knowledge, to the individual himself/herself or any object or event around his/her environment. The teacher is responsible for translation and implementation of educational policies, curriculum and instructional materials package (Kasapoglu 2010). No educational system could be better than the teacher within and that there is high correlation between teacher factor and pupils learning. [Nwankwo (as cited in Bello, 2015)]. According to Tsui (1998), what the teacher knows and can do is the most important influence on what student learned.

Adodo (2007) argued that one key overriding factor for the success of students' academic achievement is the teacher. Ibukun (as cited in Gbore and Garamola, 2013) also asserted that no education system can rise above the quality of its teachers. Considering the assertions of Adodo (2007), and Ibukun (as cited in Gbore and Garamola, 2013), it implies that teachers' competence and attitudes towards organisation of successful practical activities cannot be undermined.

This implies that, well-funded science programme, well-resourced and equipped laboratory without a competent teacher will not promote practical work. The teacher is therefore one of the most crucial variables in the teaching-learning process, the teacher is meant to help a child acquire new knowledge, attitudes, values and materials (Labo-Popoolo, 2004). Nwoke (as cited in Bello, 2015) pointed out that the quality of education available in any given society cannot be better than its teachers.

This implies that no matter how well planned curriculum is, its success or effectiveness depends on how prepared the teachers are in both ability and willingness to have students experienced all the activities enshrined in the curriculum. This implies that biology teachers need competence and positive attitudes for successful organization of practical work.

Ghana is said to be the first independent sub-Saharan African country to embark on a comprehensive drive to promote science education and the application of science in industrial and social development Anamuah-Mensah (1999). A number of things have been done to support these policies. Science resource centres and scholarships for science students have been instituted. Also, the Ghana National Association of Teachers (GNAT) has instituted scholarships for female science teachers to study abroad for one year. In spite of the numerous policy provisions and other efforts by the government of Ghana on science education as the engine of national development, its advancement has not yet been up to expectation.

The biology curriculum expects students to acquire scientific process skills through practice.

These skills, according to Harlen (2000) are one of the sets of ingredients that constitute scientific literacy. The focus of the new form of teaching and learning as indicated in this syllabus, is to move teaching and learning of biology from the didactic acquisition of knowledge and rote memorization to a new position where students will be able to apply their knowledge, develop analytical thinking skills, develop plans, generate new and creative ideas and solutions and use their knowledge in a variety of ways to solve problems.

Chief Examiners' Reports (WAEC 2011; 2012) on biology practical stated that candidates neglected biological conventions, and failed to use observable structures as basis for differences and similarities among other things there by leading to huge loss of marks.

The chief Examiners' reports (2012) suggested a number of remedies to improve students' performance. Some of such remedies are that there should be practical classes for students throughout the duration of the course and teachers should emphasize the use of biological conventions to their students during lessons. The researcher through her experience as a teacher and her participation in Ghana Association of Science Teachers (GAST) conferences and subject based panel discussions noted that the implementers of Biology curriculum do not give much attention to practical activities in spite of the emphasis WAEC and CRDD place on practical work. The emphasis placed on science practical work cannot be accomplished without considering competence and attitudes of teachers and the practices they employ during biology lessons and learning of biology. A teachers' competency in teaching and learning determines the success of a teaching session.

Effective science teaching requires that teachers have the knowledge, skills, attitudes and ability to apply science in the laboratory in better way Copriady (2015). This view supports the fact that teachers should have the scientific competence (cognitive) and manipulative skills associated with psychomotor (Aktamis & Acar, 2010). Effective teaching happens if teachers have the knowledge and skill because the concept of competence in the form of laboratory activity is rooted in the ability to handle equipment and materials correctly, storing equipment and materials properly and safely, cleaning the scientific equipment in the right way, handling specimen

correctly and carefully and drawing specimens, science equipments and materials accurately. Biology teachers' competencies in organizing practical work are seen as scientific experimentation in the laboratory. An attitude may be defined as a predisposition to respond in a favourable or unfavourable manner with respect to a given attitude object (Oskamp & Schultz, 2005). According to De Bueger-Vander Borght, (as cited in Naumescu, 2008) competence refers to a state of being well-qualified to perform an activity, a task or job function whiles attitudes are generally considered within the scope of competency. Therefore successful implementation of biology practical lessons depends largely on the competence and the attitude of teachers towards practical work. Thus, biology teachers need to be confident in organising effective practical work in their classrooms.

The study sought to find out teachers' competence level and attitudes towards practical work and their practices. This is because teachers' attitude and competence level in teaching and learning of biology are important factors in determining the success of biology lessons.

Statement of the Problem

The examination and science teaching syllabuses for Senior High Schools (SHS) placed emphasis on the value of practical work. WAEC Chief Examiner's Report (2011 and 2012) on weaknesses of candidates also stated that candidates attempted questions from the theoretical point. These recur almost every year because students or candidates repeat similar mistakes (weaknesses) in the final examination. The main purpose of the Chief Examiners' report is to inform teachers about the strengths and weaknesses of candidates and also suggest remedies for teachers to emphasise in the course of their teaching. Recurrence of the weaknesses may be

primarily due to teachers' lack of knowledge about the Chief Examiners' report, the fact that practical activities were not organized very regularly for students (Ampiah, 2004), lack of well equipped laboratory for practical work, or teachers' lack of competence and negative attitude towards practical work. A teacher who has positive attitude towards his/her work would like to have more information to improve upon his work.

Purpose of the Study

The purpose of this study was to investigate the competence level, attitudes and practices of SHS biology teachers in biology practical work. This study, therefore, explored biology teachers' competence level and attitude towards the organisation of biology practical work in SHS in the Eastern Region of Ghana and attitudes on their practices.

Research Questions

The study was guided by the following research questions:

1. What are SHS biology teachers' competencies in (organizing) practical work?
2. What are the attitudes of SHS biology teachers towards practical work?
3. How do SHS biology teachers carryout practical work?
4. What is the relationship between SHS biology teachers' background variables on their competency and attitudes towards biology practical work?

Null Hypothesis

A null hypothesis was formulated for testing:

H_0 There is no relationship between SHS biology teachers' competence and attitude towards biology practical on their practices.

Significance of the Study

The study could provide some information on SHS biology teachers' competency, attitudes and practices for improving students' performance in WAEC biology practical examinations. The information may be useful for in-service training programmes for biology teachers in the region.

The findings of this study may be useful for future policy formulation on practical work.

Delimitation

The study confined itself to some SHS offering elective biology in the Eastern Region of Ghana. Only teachers who have taught elective biology for three years and above were selected to participate in the study, since they might have covered the entire syllabus. The study focused on biology teachers attitudes and competence on practical lesson preparation, planning, presentation, comparison and abstraction. Therefore, the findings of this study may not be generalised.

Limitations

Delimiting the study to some SHS's in Eastern Region is likely to place limitations on the extent to which the findings of this study may be generalized to the whole region. Also the findings of this study may be influenced by lack of equipment, apparatus and materials in many laboratories. Again, the instruments had their own inherent problems, for instance, respondents' desire to improve their self-image leads

them to respond differently than they would usually do. The problem of participants' willingness to provide frank responses to the instrument may affect the reliability of the study. To limit this occurrence, triangulation was used whereby the researcher collected data from different approaches in order to challenge the findings of another approach. In this study, methodological triangulation was used to try to reduce bias and highlight areas that may have gone unnoticed in a single methodological approach. Respondents were also informed of the nature and purpose of the study. The questionnaires, observations with semi-structured interviews and document analysis were all administrated by the researcher in all the 38 schools, because of this, instrumentation threats were also reduced. Furthermore the participants were assured of confidentiality and anonymity.

Organisation of the Study

The research was organized into five chapters. Each chapter starts with a brief overview indicating what the chapter entails followed by the main content of the chapter. Chapter one being the introduction begins with the background of the study followed by the statement of the problem and the purpose of the study. It also includes the research questions for the study, the significance of the study, delimitation and limitation of the study. The chapter ends with organization of the study.

Chapter two deals with a review of literature. It covers the topical issues raised in the research questions and the purpose of the study. A summary of literature review ends the chapter. Chapter three deals with the methodology of the study, under this are the research design, population, sample and sample techniques, research instruments, pilot test, data collection procedure and finally, the data analysis plan.

Chapter four, deals with the result of the study and discussions. Chapter five presents the summary, conclusion and recommendations from the study.

CHAPTER TWO

LITERATURE REVIEW

Overview

In this chapter, a review of related literature to this study was presented: It included the works of recognized authorities and previous research works. The chapter highlighted the following: Conceptual Framework which provides the concept within which this study was undertaken. It included the Nature of Science as well as the History of Science Education in Ghana. It also discusses the Nature of SHS Biology Syllabus/Curriculum, Practical Method in the Teaching and Learning of Biology, Competency of SHS Biology Teachers towards Biology Practical Work, Practices Involved in the Teaching and Learning of Biology, Teachers' Classroom Activities on Practical Work, and finally the Attitudes of Biology Teachers towards Science Practical Work.

Conceptual Framework

According to Katane and Selvi (as cited in Copriady, 2014), competency is a set of knowledge, skills and proficiency in creating a meaningful experience when organizing an activity. "Competence is best described as a complex combination of knowledge, skills, understanding, values, attitudes and desire which lead to effective, embodied human action in the world, in a particular domain" (Deakin, 2008, pp. 31-55). Science teacher's competence to be a teacher should be confirmed by knowledge gained, developed abilities and formed value-based orientation. According to Lamanauskas and Vilkonienė (as cited in Khatoon, Alam, Bukhari & Mushqud, 2014), the ability to plan, organize and conduct various investigations involving students is certainly one of the most important competencies. Research also points to

the inseparable and mutual supporting relation between knowledge and competence (Sanchez, 2001). Biology teacher's competence is the knowledge put into action. A competent biology teacher will definitely understand how to guide students in performing experiments and practical implementation, Widyatiningtyas (as cited in Copriady, 2014). Effective science teaching requires that teachers have the knowledge, skills, attitudes and ability to apply science in the laboratory in better way Copriady (2015). This view supports the fact that teachers should have the scientific competence (cognitive) and manipulative skills associated with psychomotor (Aktamis and Acar, 2010). Effective teaching happens if teachers have the knowledge and skill because the concept of competence in the form of laboratory activity is rooted in the ability to handle equipment and materials correctly, storing equipment and materials properly and safely, cleaning the scientific equipment in the right way, handling specimen correctly and carefully and drawing specimens, science equipments and materials accurately. Biology teachers' competencies in organizing practical work are seen as scientific experimentation in the laboratory. To improve the quality and quantity of practical learning, biology teachers are required to master in the skills of competency, the skills to use the equipment in the laboratory and laboratory management skills and the spirit of strong will and motivation to apply practical methods in teaching and learning of biology (Copriady, 2015). Teachers ability and wisdom in handling learning activities will have a direct impact on students' active involvement in learning activities. A biology teacher must therefore have professional and educational competency to conduct practical activities.

Baysal (as cited in Kasapoglu, 2010) defines attitude as a cognitive, affective and behavioural response which is organized on the basis of experience and knowledge of the individual or event around the environment. According to Oskamp

and Scshultz (2005), an attitude may be defined as a predisposition to respond in a favourable or unfavourable manner with respect to a given attitude object. Abudu and Gbadamosi (2014) also viewed attitude as a hypothetical construct that indicates an individual like and dislike towards an item. It may be positive, negative or neutral. They further stated that attitude is an approach, temperament, sensation, situation, etc. with regard to a person or thing: inclination or course, especially of the mind. Likewise, "Attitude can also be defined as an acquired internal state that affects individuals' personal activity preferences towards a group of things, individuals, events and various situations" (Senemoglu, 2009, p. 419). Attitude as a factor could be viewed as the totality of an individual's inclination towards object, institution or idea (Gbore & Daramola, 2013).

It is expected to be higher relationship amongst teacher competencies and attitudes because both involves an individual to have knowledge, understanding and skills about teaching. Koksal (2014) confirmed this by stating that general competencies and attitudes are essential to enhance the quality of the teaching profession. He further indicated that, it is expected to be higher relationship amongst teacher competencies and attitudes because if individuals have knowledge, understanding and skills about teaching, they should have high attitudes about teaching profession.

Attitudes therefore are generally considered within the scope of competency and have a profound impact on teachers' practices. Competence has a strong association with attitude; if a teacher has competence in a subject, then the teacher has a positive attitude towards the subject. A knowledgeable teacher will have a positive attitude towards work. The teacher needs to be well-versed and knowledgeable of the experiment before the students can conduct their own experiments according to the

procedure. Having a positive attitude leads to effective classroom teaching. On the other hand, the teacher will be willing to teach the subject but when the teacher lacks the knowledge he will not be able to teach effectively.

In other words, with good knowledge and skills but without right attitude, a job or task could neither not be completed nor done unsatisfactorily as required. Teachers inevitably develop their own perceptions and attitudes towards practical work; those perceptions, in turn, might interact with curriculum demands. Such attitudes are likely to be reflected in their discourse and actions and may have influence on the activities they provide for students, how they organise and manage their classroom, what role they adopt, the way they use equipment and materials, and the criteria they use in assessing the success of practical work (Abrahams & Saglem, 2010).

The Nature of Science and Practical Work in Biology

The Nature of science consists of seldom taught but very important features of working science, for example, its realm and limit, its level of uncertainty, its biases, its social aspects, and the reason for its reliability (Kilbourne, 2013). Popular ignorance of these features of science has led to many misuses, misinterpretation and abuses of science. Science is a self-correcting process that produces reliable, objective public knowledge. The processes of science help in arriving at the product of science which in turn may lead to the process of science. Laws, principles, theories are products of science and observation, measurement, prediction, estimation, communication are the processes of science. Renner (as cited in Ofori-Amanfo, 2001) asserts that science at its roots is an active process, not facts or products, but the process of problem identification, experimentation, data interpretation, hypothesizing

and testing. It is, therefore, necessary to array the individual students with comprehensive scientific concepts, ideas, thoughts patterns and processes to enable them to become scientific liberates.

Knowledge of the nature of science can enable individuals to make more informed decisions with respect to scientifically based issues; promote students' in-depth understanding of "traditional" science subject matter; and help them distinguish science from other ways of knowing. Describing the nature of science, means considering the special characteristics, values, and assumptions that scientific knowledge is based on and how scientific knowledge is developed.

Akerson, Cullen and Hanson (2009), provide some thinking and research about the nature of science and state that:

- scientific knowledge is both reliable (one can have confidence in scientific knowledge) and tentative (subject to change in light of new evidence or reconceptualisation of prior evidence)
- no single scientific method exists, but there are shared characteristics of scientific approaches (e.g. scientific explanations are supported by, testable and against, empirical observations of the natural world)
- creativity plays a role in the development of scientific knowledge although science strives for objectivity, there is always an element of subjectivity (i.e. it is theory laden) in the development of scientific knowledge and
- cultural and social context play a role in the development of scientific knowledge.

Dreckermeyer (1994) further expands the view of the nature of science to include the idea that science, in general, "entails a body of knowledge (content) regarding reality

and a process of acquiring this knowledge (p. 11)." This vast body of knowledge is continually expanded and adapted in the scientists' never-ending quest for knowledge. Lawson (2010) suggests that teaching of science should start with questions about the nature of science, engage students actively, concentrate on the collection and use of evidence, not separating knowing from finding out and de-emphasize the memorization of technical vocabulary.

Research clearly shows most students and teachers do not adequately understand the nature of science. For example, most teachers and students believe that all scientific investigations adhere to an identical set of steps known as the scientific method, and that theories are simply immature laws. Even when teachers understand and support the need to include the nature of science in their instruction, they do not always do so. Instead they may rely upon the false assumption that doing inquiry leads to understanding of science. Explicit instruction is needed both to prepare teachers and to lead students to understand the nature of science (NSTA, 2003, p. 16)

McLelland (2006) summarised the nature of science as:

1. Science is a way of studying our natural environment, using a repeatable, methodical approach.
2. Science relies on evidence from the natural world, and this evidence is examined and interpreted through logic.
3. Science cannot be used, by definition, to study events or phenomena that cannot be perceived by natural or empirical senses and do not follow any natural rules or regularities.
4. Science is a human endeavour; it is based on observations, experimentation, and testing. It allows us to connect the past with the present.

5. Science provides us with a way to present ideas that can be tested, repeated, and verified.
6. Scientific claims are based on testing explanations against observations of the natural world and rejecting the ones that fail the test.
7. Scientists gather evidence (as opposed to "proof) to support or falsify hypotheses. Hypotheses and theories may be well supported by evidence but never proven.
8. A scientific theory is a well-substantiated explanation for a set of natural phenomena that has been tested and verified but is still subject to falsification. Theories are supported, modified, or replaced as new evidence appears and are central to scientific thinking.
9. There is no such thing as "*THE* Scientific Method." Scientists in different fields often approach their scientific testing in different ways.
10. Science is non-dogmatic. Science never requires ideas to be accepted on belief or faith alone.
11. "Explanations on how the natural world changes based on myths, personal beliefs, religious values, mystical inspiration, superstition, or authority may be personally useful and socially relevant, but they are not science." (NSES, 1996, p. 201)
12. The nature of science "is regarded in contemporary documents as a fundamental attribute of science literacy and a defence against unquestioning acceptance of pseudoscience and of reported research." (NSTA, 2003. p. 16).
13. Science does not prove nor disprove religious or spiritual beliefs, nor does it replace either. Science provides a method of understanding the *natural* world only.
14. Science cannot make moral or aesthetic judgments. Understanding how to clone a cat does not indicate whether cloning is an acceptable endeavour by humans.

Understanding what makes eyes blue or green does not indicate which is more beautiful.

History of Science Education in Ghana

Over the centuries Education has had different goals from spreading the Gospel to creating an elite group to run the colony. The Basel Mission society of Switzerland in 1828 played an important role in establishing an education net-work in Ghana. Besides reading, writing and arithmetic workshops were organised for pupils to acquire practical skills.

Since 1961, practical science has been progressively introduced. In-service training courses in science for teachers in middle schools were subsequently run by the Ministry of Education. Between 1962 and 1965, a four- year science scheme was developed jointly by science personnel of the Ministry of Education and teachers of science in middle schools. During the same period, five 'science centres ' were built, one in each regional capital and equipped with apparatus and materials for the teaching of science to middle schools pupils , who came to the centres from schools in the area (Haggis, 1969).

In 1966, an Education Review Committee recommended that certain areas of study namely English, Science and Mathematics should be compulsory for all secondary school students and should be studied throughout the course. The committee also recommended the inclusion of science among primary school subjects which should be thought to reflect the changing scientific, technological and cultural needs of Ghana. Similarly, it endorsed the inclusion of science as a compulsory subject in the teacher training college curriculum in order to equip prospective primary school teachers to teach science.

During 1965 and 1966, Ghana participated in a regional workshop for English speaking countries in Africa organized by the African Primary Science Programme of the Educational Development Centre, USAID. In 1967, Ghana acted as host to the regional workshop of this programme, and the tools, equipment and materials which were left in Ghana after the workshop provided the nucleus for permanent teachers (Haggis, 1969). Science centre in Accra where in – service training courses for both primary and middle school teachers were organised. The approach to science both in the primary and middle schools was environmental with an emphasis on practical activities to be carried out by the pupils themselves. The science course aimed at arousing the pupils' curiosity and to foster an inquiring attitude to the natural world.

Until 1963, science in the Primary Teacher Training colleges was largely theoretical, owing to lack of laboratories and equipment, and in many colleges little science was taught. Thus, primary school teachers in training were ill-equipped to teach science. In 1963, a practical science course for science tutors in training colleges was held (KNUST) at Kumasi and run jointly by the Ministry of Education, the British Council and the Ghana Association of Science Teachers (GAST). They subsequently formed a permanent committee concerned with the improvement of science teaching in training colleges. In 1964, a similar course was run at the University of Ghana under the same auspices, at which a four-year syllabus for science and training colleges was drawn up. At this course, strong representations were made by participants to the Ministry of Education to improve science facilities in training colleges so that practical science course could be run. Subsequently, GAST drew up a teachers' guide consisting largely of suggestions for practical work to accompany the four-year syllabus.

Science was a compulsory subject in all secondary schools for the five years of schooling. It was necessary to keep under constant review the content of the syllabuses and the methods of teaching in order to ensure that what was taught was related to the environment of the pupils, was firmly based upon experiments and was taught in a manner which would promote the development of an understanding of the methods of science and the spirit of inquiry.

In 1963, an introductory General Science course of an integrated nature was developed by Ghana Association of Science Teachers for use in the first two years of secondary education. It aimed to promote the approach to science teaching recommended by the Education Review Committee. During the third, fourth, and fifth years of schooling, varying practices were adopted. Some schools followed the practices recommended by the Education Review Committee and promoted a balanced course in physical and biological science for all pupils leading to the General Science and the Additional General Science examinations in school certificates. In others, the sciences: Physics, Chemistry and Biology, were taught as separate entities, often with little attempt to emphasize the inter-relationship among them.

A comparative survey made in 1963 as indicated in Haggis (1969) showed that over 30% of the secondary schools in the country were satisfactorily equipped or had only minor difficulties with apparatus, and only one school in the sample had no apparatus at all. There was rapid increase in enrolment of students following science courses in the Sixth Forms as indicated in the Advance Level Examination results between 1963 and 1967. Most of the preliminary work for the Physics, Chemistry and Biology syllabus was carried out by the Ghana Association of Science Teachers which had also organised in-service training courses for Sixth Form teachers of

science. The separate subject Botany and Zoology was replaced with Biology. A national science museum, which was established in Accra in 1965, organised out of school science activities which were well attended by school children and others in the Accra area. The activities included regular showings of scientific films, exhibitions and science fairs.

In 1974, there was a reform of the Educational system in Ghana, which resulted in Junior Secondary School education on an experimental basis. The Dzobo Review Committee introduced the concept of "comprehensive" practical skills to all pupils. The nationwide implementation of the Junior Secondary School began in 1987 with Integrated Science as one of the subjects.

Under the 1987 educational reform, science among other subject was in co-operated into the revised national curriculum of schools. At the Primary school level six periods a week were allocated to the teaching of science.

The teaching and learning of Science was given a boost by making science and some other subject compulsory at both Junior Secondary and Senior Secondary levels. Four periods a week were given to the teaching of science and the integrated approach recommended. At the secondary school level, initially the Integrated Science consisted of concepts from Physics, Chemistry, and Biology while Agriculture was a separate subject. CRDD (1998) fused certain aspects of Agriculture into Integrated Science. Government through the Ghana Education Service built new science oriented secondary schools in very deprived areas and science courses were also introduced into schools that were non-science schools. A total of six periods a week, each consisting of forty minutes, were allocated to teaching of Integrated Science, Biology, Physics and Chemistry.

Four-year Teacher Training Colleges were replaced with Three year Post Secondary Teacher Training Colleges and some training colleges were designated science based colleges (Fosu, Akropong, Komenda and St. Francis Training Colleges).These colleges were equipped to train teachers who were based on science and technical skills.

There were also the diploma awarding and specialist institutions which produced science teachers among others. Some selected initial training colleges were also accredited to run specialist courses in science. This move, though short lived was meant to support teaching and learning of science at the primary level. Further innovations of science education characterised the 2007 educational reform. Natural science was introduced at the primary level (p-3). The rationale for teaching Natural science at the primary level was to equip the young person with the necessary process skills and attitude that will provide a strong foundation for further studies in Science. Basic electronics was also introduced at the upper primary. Where emphasise was place largely on practical activities.

Science Technology Mathematics Education (STME) clinic for girls was instituted in 1987 to promote the interest of girls in science. The STME also enables the girls to interact with women scientist and technologist. The clinics initially focused on girls but for the past four years boys have been included. The STME started as an International clinics, later became regional but now decentralized to the districts. Girls' Education Unit of the Ministry of Education and Sport was created. The unit was charged with coordinating the organization of science clinics in the regions and zones particularly for girls, which has now been extended to boys. This

primarily equips students on hands on activities at all levels of pre-university education.

In 1995, the Ghana Government set up Science Resource Centres at all the then 110 districts to supplement teaching and learning of science at the secondary level. The centre schools had satellite schools that visited at regular intervals for science lessons. Science resource buses were provided to the centre schools to convey satellite students to the centres and for field trips. Also, the Resource centres were used to train centre and satellite school teachers as well as Junior Secondary School teachers. Furthermore, the centres also served occasionally as workshop centres for Ghana Association of Science Teachers annual district/municipal Science Technology and Mathematics Education clinics, science workshops organized by Ghana Education Service (GES) etc.

The Nature of SHS Biology Syllabus/Curriculum

The content of the syllabus has been designed in such a way as to provide students with basic knowledge in Biology for students to understand themselves and other organisms, which will enable them to make very informed choices as they interact with nature. The scope of the content of the syllabus has also been designed to enable the learner to pursue specialised careers relating to Biology and fully prepares the students who wish to continue the study of Biology at the tertiary level.

In view of the importance of the skills to the biologist, this syllabus has a unit in almost each section dubbed scientific enquiry skills to help the teacher consciously teach and facilitate certain activities to help the students develop these skills. Practical Skills involve the demonstration of manipulative skills using tools, machines and

equipment for practical problem solving. The CRDD advocates that teaching of practical skills should involve projects, case studies and field studies where students will be intensively involved in practical work and in search for practical solutions to problems and tasks. Experimental Skills involve the demonstration of the inquiry processes in science and refer to skills in planning and designing of experiments, observation, manipulation, classification, drawing, measurement, interpretation, recording, reporting and conduct in the laboratory/field. The teacher must ensure that students acquire a high level of proficiency in the use of tools and equipment for scientific work.

Practical Method in the Teaching and Learning of Biology

One important aspect in the study of the sciences and Biology is the method used during impactation of knowledge to the students. During practical examinations, students show that they cannot make accurate observation and record their findings or use even rulers accurately for measurements. There is the claim that teaching of science in Ghana has become more theoretical than practical. There is, therefore, the need to search for more effective strategies that are likely to improve achievement in senior high school Biology.

Research efforts have been directed at discovering more effective and learner-centred teaching methods and strategies that would ensure greater students' achievement in biology. Several science education research reports indicates innovative teaching methods and instructional strategies which could enhance students' achievement and acquisition of science process skills, foster student's interest and promote the development of positive attitude towards the learning of science. Some of the innovative teaching methods and instructional strategies

include: Co-operative Learning, Concept Mapping, Peer Tutoring, Computer Assisted Instruction, Blended Learning and Investigative Laboratory Approach. These innovative teaching methods and strategies can also be applied to biology instruction (Njuko & Okoli, 2012). Research reports also indicate that innovative teaching methods are effective in improving students learning outcomes in biology.

In Ghana the biology curriculum indicates that the teaching of biology should be student-centred and activity oriented. This supports SCORE (2008) definition of practical work as any science teaching and learning activity which involves students, working individually or in small groups, manipulating and/or observing real objects and materials, as opposed to the virtual world. Where the teacher acts as a facilitator. For effective teaching and learning in biology course. Scientific Inquiry Skills (SIS) as was stipulated in the biology syllabus are combination of practical and experimental skills that needs to be develop in students to become a good biologist. In view of the importance of the skills to the biologist, the biology syllabus has a unit in almost every section dubbed scientific enquiry skills to help the teacher consciously teach and facilitate certain activities to help the student develop these skills. These practical skills development involve the demonstration of manipulative skills using tools, machines and equipment for practical problem solving. The syllabus emphasise that, teaching of practical skills should involve projects, case studies and field studies where students will be intensively involved in practical work and in search for practical solutions to problems and task. Experimental skills involving demonstration of the inquiry processes in science and refer to skills in planning and designing of experiments, observation, manipulation, classification, drawing, measurement, interpretation, recording, reporting and conducts in the laboratory/field. Practical and

experimentation skills refer to the psychomotor domain which every student must achieve.

The teacher therefore must ensure that students acquire a high level of proficiency in their use of tools and equipment for scientific work. Proper equipment handling and use of tools and equipment for practical and experimental work. Development of hypotheses, planning and designing of experiments, persistence in the execution of experimental activities, modification of experimental activities where necessary, in order to reach conclusion. In view of the practical oriented nature of biology syllabus CRDD (2010) allocated three periods of 40 minute each to practical lessons every week .The classroom, laboratory and the school environment can be made conducive to the teaching and learning of biology if the following issues are considered;

- The capability of the teachers to improvise by preparing simple models where teaching models are not available, using demonstration and activity kits, introducing new ideas and technologies (computers and internet) where available in teaching
- Over viewing misconceptions and inhibitions on the part of students (mindset) that certain subjects or areas are too difficult or irrelevant, while some topics are considered not relevant to the topics to be studied.
- Adequate knowledge of the syllabus to reduce the conflicting demands and contradictions of the West African Examinations Council (WAEC) and Ghana Education Service (GES) syllabus which calls for comprehensive lesson plans across board, whereby fundamental principles are taught first;

- Provision of logistics and other resources to support teaching, such as computers, projectors etc; Arrangement for distinguished scientists to talk to the students on debatable issues on science and society or science in action;
- Experimentation with demonstration must be taken more seriously and handled with vigour and not as mere activities or games as pertains in GAST textbooks. Adepoju (1991) described the approach used by many teachers as one which does not give room for students to develop their intuition, imagination and creative abilities. The minds of the students must be disabused of looking for quick fix approaches to pass their examinations instead of going through the practical approach.

According to Young (as cited in Sharpe, 2012), science is a doing subject. He also stated that science is the system of knowing about the universe through data collection by observation and controlled experiment. Students must observe and experience biology in action in the schools which will set the stage for career selection. Therefore, educational visits to some industries such as Uniliver, Cocoa processing company etc, to observe and study processes and products and the development of the technologies utilized in industry.

Competency of SHS biology Teachers on biology Practical Work

Teachers' competency in teaching and learning is an important factor in determining the success of a teaching session. According to Lamanauskas and Vilkoniene (as cited in Khatoon, et. al., 2014) acquiring appropriate competencies in high school science teachers is a guarantee for successful lesson delivery, but achieving competencies is not a final process as it longs last. In this regard, teachers would have to develop not only their teaching skills related to lesson delivery but also

skills related to organising different activities inside and outside of class. As stated by Ajaja (2009), the practiced competencies of science teachers can be derived from what they actually do in schools and particularly in the science classrooms. In Ghana, teaching elective Biology in totality guides the learner and makes them capable of critical thinking, making meaningful decisions and solving problems.

Research indicates that teacher competency especially competency in successful lesson delivery is the required competencies for producing problem solving ability in students. Bryan (2003) revealed that teachers who are competent in ensuring students to conduct the necessary experiment steps without mistakes will make practical effective. Bibi (2005) mentioned that exemplification, questioning, relate lesson to daily life and proper use of teaching aids were essential skills for successful delivery of lesson. In another study by Halim, Osman, Subahan and Meerah (2006), Biology teachers must have skills of planning and developing science instruction. Hamza and Griffith (as cited in Khatoon et al., 2014) recommend safe class environment for producing problem solving ability in the students. Eze and Onyegegbu (2006) found that effective use of new technical devices had engaged students in practical activities enhanced students' problem solving ability. Suryawati, Osman, and Mohd (2010) pointed out that problem solving, arranging group discussion, and provision of opportunities of learning from environment and daily life were essential teaching competencies for producing problem solving abilities in students. Veselinovska, Gudeva and Djorkie (2011) conclude that creating active classrooms and laboratories, daily life experiences and safe class environment prepare students for future challenges.

For teachers to be competent, they need to be efficient in designing, planning and implementing the lesson since science subjects require practical training as well

as theoretical studies. Also, as stated by (Khatoon, et al., 2014) teachers need to have a high capability and competencies in developing laboratory instructions, lesson planning, preparing and documenting laboratory equipment, implementing and translating the process in the form of continuous assessment throughout the teaching practice in the laboratory.

A part from that, teachers need to access the practical training and laboratory experiment. The nations need more scientific-minded people to accomplish the national mission of science education for development.

Attitudes of Biology Teachers towards Science Practical Work

The term attitude can be defined as what people think, feel, and do. According to social psychologists, attitudes consist of three dimensions: (1) cognitive, (2) affective and (3) behavioural [van der Zander, (cited in Kasapoglu, 2010)]. Attitude is a hypothetical construct that indicates an individual's like and dislike towards an item. Attitude is also regarded as an approach, temperament, sensation, situation, etc. with regard to a person or thing: inclination or course, especially of the mind (Abudu & Gbadamosi, 2014)

Attitude means the individual's prevailing tendency to respond favourably or unfavourably to an *object* (a person or group of people, institutions or events). Attitudes can be positive (values), negative (prejudice) or neutral. The phrase "attitude towards Biology practical" is therefore used to indicate all that an individual feels and thinks about Biology practical work as a result of interacting directly or indirectly with various aspects of Biology practical activities and which exert a direct influence on their behaviour towards biology practical work. The concept of attitude, like many abstract concepts, is a construct. It is an instrument

that serves the human need to see order and consistency in what people say, think or do. However, according to Abdalla, (as cited in Ampiah, 2004) it is not something that can be examined, or measured in the same way one can examine the cells of a person's skin.

Also, a common hypothesis with respect to teacher's attitude and student's achievement is that students taught using the right approach or attitude achieve at a higher level because their teachers have displayed the right attitude and acquired classroom management skills to deal with different types of classroom problems (Gibbons, Kimmel, & O'Shea, 1997). Most teachers teach science in a way that merely requires the students to listen, write, read and regurgitate. This depicts negative attitude to teaching. Several research findings have confirmed the hypothesis that teacher's attitude either towards science or towards science teaching affects their students' achievement and attitude towards science (Abudu & Gbadamosi 2014).

Okpala (as cited in Butt & Shams 2013) found that the effect of teacher's attitude towards assessment practices on student's achievement and their attitude towards physics was positive. In another study, Onocha (as cited in Butts & Shams, 2013) reported that teacher's attitude towards science is a significant predictor of learner's achievement as well as their attitude. This supports Gbore and Damamola, (2013) assertion that teachers' attitude towards science is a potent predictor of students' academic achievement in science and attitude towards science learning. Also Igwe (as cited in Abudu & Gbadamosi, 2014) showed that the effect of teachers' attitude to chemistry was stronger on the student's chemistry achievement than on their attitudes. Also according to Abimbande (1999), teachers are said to be effective when their teaching can lead to students learning. Since learning is a change in behaviour, until the teacher succeeds in causing a change in behaviour in the learner

nothing has been taught and nothing has been learnt. The development of scientific literacy among students requires their positive attitudes toward science (Linn, 1992). Teachers are therefore supposed to be a role model to the students, if biology teachers' attitude towards studying biology is positive, such teacher(s) should device all methods to entice students to develop positive attitudes to learning the subject. . Literature has indicated that teachers' attitude exerted some influence on the academic achievement of students. For instance, Yara (2009) reported that teacher's attitude towards science has a strong relationship with students science achievement as well as the students' attitude towards science. Onocha and Ogunwuyi (as cited in Bello, 2015) on teachers' attitude towards practical work indicated that biology teachers had poor attitude to cleaning and arrangement of laboratory equipment after the conduct of practical work, while teachers with 5 years experience and above had good attitude to taking safety measures during the conduct of laboratory practical work, other teachers with less than 5 years experience had poor attitude using safety measures during laboratory practical work. The study further stated that factors that influence biology teachers' attitudes towards practical work include teaching experience, motivation, workload, availability of well equipped laboratory. It is, therefore, important that the teacher must see teaching as an attempt on his part to transfer what he has learnt to his students using the right approach and attitudes.

Teachers' Classroom Activities on Practical Work

Fairbanks et al. (2010) study explored why some teachers are more adaptive than others in practical work. They found out that knowledge alone does not lead to the kind of thoughtful teaching everyone strives to maintain. According to the study, teachers with similar professional knowledge and qualifications were found to have

differences in their teaching practices. Nonetheless improving the quality of education depends on the improvement of the quality of classroom practices. The distinction between teachers' Practices and Conceptions, as Dancy and Henderson (2007) suggest, is valid and useful, because a teacher might hold very progressive views about education, but in practice use conservative teaching methods. Such a situation could be a result of various factors such as a teacher's lack of content or pedagogical knowledge, difficulties in adapting to change, or pressure at school (Dancy & Henderson 2007)

According to (Ommundsen, 2001) Educational activities should reflect what real people actually do, as biologically literate citizens. Biology teachers must ensure that little of their students time is spent watching lectures, rather they should be involved in application of information, decision-making, problem-solving, investigation, policy analysis, debate, critical thinking, creative thinking, and information retrieval. These are the activities that should be occurring in the classrooms, field, and laboratory. These are the kinds of activities that create an exhilarating learning environment.

Research shows that student's achievement can be enhanced by use of (a) case examples meaningful to the learner, (b) active learning rather than passive listening (*experience* is always the greatest teacher), (c) *concrete application* of core concepts in many contexts, (d) practice and repetition, (e) feedback, and (f) emotional content (Ommundsen, 2001).

Akinfe, Olofinniyi and Fashiku (2012) indicated that when teaching method are effectively utilized, students academic performance will increase tremendously and that teachers experience is an added advantage in preparing students for both

internal and external examination. It was also established that the quality of teachers to a large extent determine students achievement because a professional teacher will make the best of every unpleasant situation; however, an enabling environment must be created in terms of instructional aid amongst other variables for the teachers' potentials to be utilized maximally. Practical studies in science lessons have an important place among instructional methods for a meaningful learning. It is generally believed that science is better learnt in an applied manner by way of doing laboratory studies (Ozcan, 2003). For example Akçay (as cited in Ozcan, 2003) compared the effect of different teaching methods on achievement of students on cell concept. He found significant superiority of experimental teaching over lecturing and questioning. The student by doing experiments constructs the base for learning, because by using more senses they provide retention in their learning. Use of demonstrative materials also strengthens the instruction in biology lessons.

Penick (1995) mentioned that in the classrooms where the students are encouraged to ask questions there are successful students. In these classes teachers also ask questions. The more questions they ask the more likely they are to be involved to learn and know what is happening. Penick (1995) also stated not only that the best teachers' classes are laboratory-centred and student active but also that the most effective teachers do some kind of hands-on activity.

The teacher is a vicarious learning, model. Students' perception of the credibility of the teacher may strongly influence their reaction to the course content. The teacher is more likely to inspire students if he prepares thoroughly, well-rehearsed, well-organized, enthusiastic, and entertaining. Teachers encourage students and provide as much feedback as possible to individuals. Classroom morale does

affect student's achievement (Ommundsen, 2001). Ommundsen (2001) further stated that educational activities should reflect what real people actually do, as biologically literate citizens. Biology teachers must ensure that little of their students time is spent watching lectures, rather they should be involved in *application* of information -- decision-making, problem-solving, investigation, policy analysis, debate, critical thinking, creative thinking, and information retrieval. These are the activities that should be occurring in the classrooms, field, and laboratory. These are the kinds of activities that create an exhilarating learning environment.

Teachers have a responsibility of select learning issues that are meaningful to their learners. Learning should be fun and exciting. This is because students can become engrossed in learning activities that are pertinent to their needs and interests

Practical Work in Biology Teaching

Practical work under the guidance of competent teachers with scientific equipment and procedures are vital aspects of scientific training. Hodson (as cited in Millar, 2004) found that practical work help students of biology to experience an increase in motivation and teachers also will have the opportunity to evaluate the knowledge of their students and determine the practice connection at the highest level. This will also stress the impression that practical work is core domain of science. In this thesis, by 'practical work' the researcher means any teaching and learning activity that engages teachers and students in observing or manipulating concrete objects and materials (Millar, 2004)

The benefits of practical work are many. Practical work turns abstract concepts into concrete experiences. It engenders not only skills which are appropriate for scientific inquiry, but it also inculcates attitudes and conceptual perspectives which are necessary for skilled scientific inquiry. The Society of Biology (2010) also

believes that it is important to support and promote practical work in science because it:

- stimulates creativity, curiosity and critical thinking.
- underpins and illustrates concepts, knowledge and principles.
- promotes student engagement with the scientific method.
- encourages active learning and problem-solving.
- allows collaborative working.
- provides opportunities to collect and analyse data and apply mathematical skills.

Ausubel (as cited in Ango, 2002) supports the view that practical work is extremely valuable in promoting the development of meaning and understanding. He maintains that practical work enhances the quality of a student's learning. In Ausubel's words, practical work creates a "discovery-reception continuum," as opposed to a "meaningful rote learning "experience. He argues that process skills, such as measuring, observing, classifying and predicting, are crucial for the development of a fruitful understanding of scientific concepts and propositions and for a meaningful use of scientific procedures for problem solving and for applying scientific understanding to one's own life.

It is appropriate to conceive of teaching as not only giving guidance and providing counselling, but also as a skill fully constructing situations in which students may engage in guided study with a view to achieving intended learning outcomes. To this end, Ango and Gyuse (as cited in Ango 2002) have suggested that teachers should "not do all the telling, discussing and doing" in science classrooms. They advocate that school teachers not only initiate action and demonstrate skills, but also provide appropriate practical work and experiences for their students.

Aniodoh (as cited in Yeboah, 2010) observes that effective teaching and learning require accurate and exact observations, carefulness and thoroughness of technique and logical interpretation of data. He emphasized that practical work is the part of the study of biology and should go hand in hand with theory. Aniodoh (as cited in Yeboah, 2010) further noted that a sound theoretical and practical knowledge of biology is needed for the management of our natural resources, provision of good health facilities, adequate food supply and favourable life environment.

The importance of practical work in school science is widely accepted, but it is important to ensure that such practical work genuinely supports learning and teaching, and that the teacher is allowed to do this in relation to their pupils' needs and the courses they are studying.

Summary

The success of any educational system depends on the teachers' preparation and practice. Successful implementation of any curriculum depends largely on the implements. Implementing curriculum in science successfully depends on trained and competent teacher, adequate supply of relevant equipment/materials, positive attitude to practical work and good practices employ by the biology teachers. In order to play this role successfully, the teacher must have competence in organising practical work. The teacher must have abilities such as handling of science equipment, supervision, providing guidance, the ability to set up laboratory, provision of materials etc. Biology teachers' attitude towards science process skills development is another factor that determines successful implementation of the science curriculum. Teachers with positive attitude towards science process skill development will use a variety of teaching strategies innovative learning activities, student-centred instructional strategies to impart scientific skills in their students. Such teachers adequately prepare

for students by supporting their active participation in class, guiding them individually or collectively so as to follow the scientific procedure in the development of a particular skill and also encourage them to use acquired knowledge or skill.

Innovation teaching methods and instructional strategies are effective in improving students' acquisition of science process skills. Since it foster students interest and promote the development of positive attitude towards the learning of science. Review of related literature on biology teachers' competent, attitude and practices indicated that these factors are crucial in the successful implementation of the biology curriculum.

CHAPTER THREE

METHODOLOGY

Overview

This chapter deals with the method used for the study. It describes the method and procedures followed in collecting data for the study. The chapter comprises research design, population, sample and sampling techniques, and instrumentation for data collection, pilot-testing, description of data collection procedure. This chapter ends with data analysis.

Research Design

The research design for this study was descriptive survey research design with mixed methods sequential explanatory design. By definition, mixed methods is a procedure for collecting, analysing, and "mixing" or integrating both quantitative and qualitative data at some stage of the research process within a single study for the purpose of gaining better understanding of the research problem (Tashakkori & Teddlie 2003; Creswell 2005). The rationale for mixing both kinds of data within one study is grounded in the fact that neither quantitative nor qualitative methods are sufficient by themselves to capture trends and details of a situation. When used in combination, quantitative and qualitative complement each other and allow for a more robust analysis, taking advantage of the strength of each (Tashakkori & Teddlie, 1998). Mixed methods design requires certain methodological issues such as priority or weight given to the quantitative and qualitative data collections and analysis of the study, sequence of the data collection and analysis, and the stage/stages in the research process at which the quantitative and qualitative phases are connected and the results are integrated Morgan and Creswell et al. (as cited in Ivankova, Creswell & Stick, 2006). The mixed methods sequential explanatory design occurs in two distinct

interactive phases: quantitative followed by qualitative phase (Creswell, Plano Clark, Gutmann, & Hanson, 2003). According to Greene and Caracell, (as cited in Kellner, 2012) mixed method design can yield richer, more valid and more reliable finding more than 62 evaluations based on either the qualitative or quantitative methodologies alone. Furthermore, a sequential explanatory mixed-methods design was chosen because multiple methods work to provide a complete understanding of the research problem (Creswell, 2007). According to Gay (1987), descriptive survey involves collecting data in order to test hypotheses or to answer research questions concerning the current object of study. The descriptive survey has also been recommended by Babbie (2001) for the purposes of generalizing from a sample of a population so that references can be made about some characteristics, attributes or behaviour of the population. In this study, both quantitative and qualitative data were gathered sequentially.

With the sequential explanatory design, the researcher first collected and analysed quantitative data using frequencies and percentages (descriptive statistics) in the first phase. In the second phase of the study, the researcher connected the quantitative and qualitative phases by purposively selecting one participant from each stratum based on typical responses. This was used to develop interview questions and observation checklist for more intense study. The researcher also analysed related documents through inspection of students' practical notebooks, biology syllabus and WAEC Chief Examiner's report. These helped to explain, elaborate on, the quantitative results obtained in the first phase. The purpose of this form of research is that both quantitative and qualitative research in combination will provide a better understanding of the research problem. The qualitative data and their analysis refine

and explain those statistical results by exploring participants' views in more depth (Creswell, 2003).

The qualitative data (semi-structured interview, observation and document analysis) were analysed by coding the responses into themes. Quantitative and qualitative results were integrated whiles discussing the outcomes of the whole study. Such mixing of the quantitative and qualitative methods results in higher quality of inferences (Tashakkori & Teddlie, 2003) and underscores the elaborating purpose of the mixed methods sequential explanatory design.

Population

A research population is a well-defined group of individuals and entities having similar characteristics (Castillo, 2009). The targeted schools were all the 78 public SHS in the Eastern Region of Ghana. Forty of the schools are sited in the district capitals whiles 38 are sited outside district capitals. The study targeted all biology teachers who have taught biology for three years and above since they might have covered the entire syllabus. Observation by the researcher indicated that each school has an average of three teachers who have taught biology for three years and above. Accessible population was all biology teachers who have taught biology for three years and above in the 38 selected schools.

Sampling Technique

A sample is a small part of anything which is intended to represent the whole (Wellington, 2003). To ensure proportionality the study employed stratified simple random sampling method. According to Gupta (as cited in Yeboah, 2010), random sampling is one where each item in the universe has an equal or known opportunity of being selected. All SHS in the Eastern Region were categorized into two that is,

schools in district capitals and schools outside district capitals. A random list of the schools was generated using Microsoft Excel, 20 schools from district capitals and 18 schools from outside district capitals. The biology teachers in the selected schools formed the study sample. The sample consists of fifty seven males and twenty three females. Forty eight percent of the schools in the Eastern Region were randomly selected since Patton (2002) argues that 30% of the target population is enough in a descriptive survey study.

Priority

Priority refers to which approach, quantitative or qualitative, (or both), a researcher gives more weight or attention throughout the data collection and analysis process in the study (Morgan 1998; Creswell et al. 2003). As reported by (Creswell et al., 2003), it is a difficult issue to make a decision about and might depend on the interest of a researcher, the audience for the study, and/or what a researcher seeks to emphasise in the study(Creswell, 2003). In the sequential explanatory design, priority, typically, is given to the quantitative approach because the quantitative data collection comes first in the sequence and often represents the major aspect of the mixed methods data collection process (Creswell et al., 2006)

Instruments

The instruments used to collect data for the study were: closed ended questionnaire, observation, semi-structured interview and document analysis. The closed ended questionnaire was used during the first phase of the study to collect quantitative data. Observations of practical lessons followed by semi-structured interviews and document analysis were used in the second phase to collect qualitative data.

Questionnaire

A questionnaire is a written document in survey research that has a set of questions given to respondents or used by an interviewer to ask questions and record the answers (Neuman, 2003). The questionnaire items can be:

- closed-ended in which the questions permit only certain responses such as 'yes' or 'no' or the respondent chooses from answers provided in the questionnaire.
- Open-ended, in which individuals can make any responses they wish in their own words. (Acheampong, 2013).

The main advantage of the questionnaire is that it can be mailed or given to a large number of people at the same time (Jack & Norman, 2003).

Close-ended questionnaire was used for the study (Appendix B). The questionnaire was in two sections, A and B. Section A was made up of eight items which was used to collect demographic data of the respondents, including gender, age, years of teaching experience, academic qualification, professional qualification, subject area of specialization and in-service training in biology teaching.

Section B consisted of 40 items which were adapted from an instruments developed by Ampiah (2004) and Khatoon et al. (2014). The original instruments consisted of 43 and 40 items respectively. Twenty seven of the items were selected from Ampiah's (2004) instruments, thirteen from the instrument of Khatoon et al. (2014). The items were grouped into three constructs namely biology teachers' attitude towards biology practical work (10 items), teachers' competence in organising practical work (13 items) and practices (17 items).

The attitude construct focused on biology teachers' attitude towards practical work while the competence construct sought to determine biology teachers'

competence in organising practical work. The practices construct was also meant to find out teachers' practices during biology practical. All the items under the three constructs were close-ended and of the five-point Likert type scale. Robson (2002) intimates that Likert-scale looks interesting to respondents and people enjoy completing a scale of this kind. Neuman (2000) on the other hand, considers the simplicity and ease of use of the Likert scale as its real strength. Five-point Likert scale was adapted because studies on the use of Likert scale indicated that reliability increases up to 5 categories, beyond which no further substantial gains are made (Jenkins & Taber; Lissitz & Green, as cited in Preston & Colman, 1999). Also the scale was selected because it is commonly used and familiar to respondents. Again, five-point scale was chosen because according to LaMarca (2011), respondents usually avoid choosing the "extremes" options on the scale, because of the negative implications involved with "extremists", even if an extreme choice would be the most accurate. Meaning if there are seven scale responses, the instrument actually has only five –point. This is due to the fact that it is highly unlikely for respondents to answer the most extreme scale (1or 7).

The respondents were asked to indicate the intensity of their responses to each of the items on the five-point Likert scale. Statement that indicated positive attitudes (e.g. I like Biology practical) were scored as follows: strongly agree (5), agree (4), neutral (3), disagree (2) and strongly disagree (1). However, statements that reflected or indicated negative attitudes (e.g. biology practical is boring) were scored as follows: strongly agree (1), agree (2), neutral (3), disagree (4) and strongly disagree (5). Reverse order of scoring was important for reducing respondents' bias. So it was to counteract the tendency for respondents who without much thought, would give the same answer to all questions (Gay, 1987).

Observation

An observation protocol was used to collect data on how practical was being carried out at the SHS level. Creswell (2002) recommended the use of observational protocol as a method of recording notes. This enabled the researcher to know exactly what went on in the laboratory during practical lesson. It was also used to determine whether the respondents expressed views in the questionnaire were consistent with their practices. The instrument was in a form of a checklist (Appendix C) which contained ten items. The items addressed

- Setting up practical for students (items 1),
- Supervision of practical work (items 7, 8, 13)
- Provision of material and equipment(items 4,9,10,12) and
- Procedure (item 3, 5)

Semi-structured interview

A semi-structured interview schedule was used to gather qualitative data from the respondents. The interview schedule consisted of 10 items the content of which was grounded in the quantitative results, outcome of observed practical lessons and the purpose of the study. It was used to examine any inconsistencies between the teachers' responses to the questionnaire items and their practices observed during practical lessons. In other words, the interviews were used for the purpose of data triangulation. Since triangulation is concerned with "the correctness of the insight and legitimacy of the interpretation" (Newby, 2010, p. 128) and using a variety of methodological approaches can increase the "credibility" of the study (Lichtman, 2010, p. 229).

Probes were used to provide a better understanding and to obtain deeper information. The probing questions were not written in the interview schedule but asked when needed. The probing were used to ensure that interviewee understood the question in a correct way (Ozcan, 2003). Example of a probe is as follows:

12. Question: Do you organized practical for all the classes you teach i.e. 1,2 and 3?

If answer: Yes, ASK; Why?

If answer: No, ASK: why not?

Document analysis

This involved thorough examination of documents related to the study. The documents included students practical note books, biology syllabus, WAEC Chief Examiners' report. The students practical note books were examined to find out the type of practical activities students had undertaken their frequency, and their relationship to the biology syllabus, and how biology teachers made use of WAEC Chief Examiners' report. For example, every year WAEC Chief Examiners' Report contains the strengths and weaknesses of students to be addressed by teachers in their teaching. This should be reflected in the practical work books of students.

Pilot Test

The questionnaire instruments were pilot tested in the Greater Accra Region of Ghana. The Region was selected because SHS share similar characteristics to that of the accessible population. Cargan (2007) explains that a pilot study is a good means of ensuring that the questionnaires would provide data that is accurate and is standardised as well as guaranteeing successful administration in the main study. The instruments were tested to establish the internal consistency, reliability and validity of

the instruments. It was also (to ask teachers for feedback) to identify ambiguous and difficult questions based on the analysis of data from the pilot test, some modifications were made in the questionnaires. For example "The equipment/materials students need for practical are readily available in our school laboratory" was modified to read "I provide the appropriate equipment/materials students need for biology practical". Also items 1, 8, 13 and 14 of the attitude construct which did not survive item analysis were removed to improve the reliability of the instrument. The final questionnaire instrument comprised 40 items categorized under three constructs as indicated in Table 3.1.

Table 3.1 Construct and number of items

Constructs	**No. of items**
Biology teachers' attitudes towards practical work	10
Biology teachers' competence in organizing practical work	13
Biology teachers' practices during practical lessons	17
Total	**40**

Validity of the Instruments

The quality of a research instrument or a scientific measurement is determined by both its validity and reliability (Kimberlin and Winterstein 2008). An instrument is considered valid when there is confidence that it measures what it is intended to measure in a given situation (Punch, 1998). In determining the validity of the instruments, questionnaire, lesson observation and interview schedule were given to senior lecturers in the Department of Science Education, University of Education, Winneba, to determine their content validity and also identify any ambiguities in the items. This was to ensure that the items reflected the intent of the research.

Face validity pertains to whether the test "looks valid" to the examinees who take it, the administrative personnel who decided on its use and other technically untrained observers (Anastasi, 1988). Thus face validity refers to the "obviousness" of a test, the degree to which the purpose of the test apparent to those taking it. The face validity of the questionnaire and the lesson observation protocol was also established with the help of Science Education experts in the University of Education, Winneba. The questionnaire items, lesson observation and interview schedule were modified based on the feedback from the senior lecturers. Their comments led to correction of typographical errors and clarification of some of the items of the instruments.

Reliability

Bell, (as cited in Sharpe, 2012) refers to reliability as "the extent to which a test or procedure produces similar results under a constant condition on all occasions. A factual question which may produce one type of answer on one occasion but a different answer on another is… unreliable." (pp. 50-51). Reliability indicates the accuracy or precision of the measuring instrument (Norland, as cited in Al-Mashaqbeh, 2012). The questionnaires were administered to 10 biology teachers in SHS in the Greater Accra Region of Ghana. Pilot testing of the instruments reduced ambiguity of items and therefore enhances their reliability (Meriwether, 2001). These teachers used for the pilot test were not part of the study.

Internal consistency (Cronbach Alpha) approach was employed to establish the reliability of the questionnaire. The Cronbach coefficient alpha (Appendix E) which measures reliability was used. The Alpha value spanned between 0.626 and 0.703 as indicated in Table 3.2. According to Leech, Barrette and Morgan (2005) alpha value of 0.70 and above indicates a reasonable internal consistency and that alpha value between 0.60 and 0.69 indicate minimal adequate reliability. According to

Ary, Jacobs and Razavieh (2002), where results are used to make decisions about a group, reliability coefficient of 0.50 to 0.60 are accepted. The questionnaire items were therefore accepted as reliable by the researcher based on the purpose and objective of this research study.

Table 3.2 Reliability Coefficient of the questionnaire.

Constructs	No. of items	Alpha Coefficient
Biology teachers attitude towards practical	10	0.652
Biology teachers competence in organizing practical work	13	0.703
Biology teachers' practices during practical lesson.	17	0.626

The lesson observation protocol was also piloted with the same teachers used in pilot testing of the questionnaire. The inter-rater percentage reliability of the lesson observation protocol was then assessed. Samples of the lesson observation protocol were used to observe lessons by different experts to determine the inter-rater percentage reliability of the schedule. Three biology teachers were trained by an expert in research data coding to code the set of responses from the observation checklist and interview. They independently examined the responses and proposed a set of themes. The raters met to compare proposed themes and to agree on an initial master list of codes that operationalize these themes, paying close attention to (1) how relevant the codes were to the study objectives and (2) whether the codes actually emerge from the text. For each code, the raters derived a set of rules by which they decided whether a specific unit of text is or is not an instance of that code. (Once

given the responses, the raters independently code them according to instructions given to them) The raters met again to discuss problems with applying codes, code definitions, and inclusion/exclusion criteria and to evaluate interrater percentage reliability. The interrater percentage reliability value was found to be 77% after analysing the data obtained by the experts. This suggested that the lesson observation schedule could be used to undertake the study.

Data Collection Procedure

Letter of introduction (Appendix A) obtained from the Head of Science Department at the University of Education, Winneba was used to obtain permission from the heads of the Senior High Schools to carry out the study. The Headmasters in turn informed the biology teachers about the plan to involve them in the study. Before the data collection began, the researcher visited the schools selected to meet the teachers. The first visit was meant to enable the researcher establish rapport with the respondents. It was also to enable the researcher explain the purpose of the study to the respondents and to elicit their maximum cooperation so that the objective of the study could be achieved. A date was set with the respondents for the administration of the questionnaire. The second visit was used to administer the questionnaire on the agreed dates. The researcher personally administered the questionnaire. This enabled the researcher to ensure that the questionnaires got to the respondents directly. It also enabled the researcher to explain further the intention of the study and any part of the questionnaire that might posed a problem to the respondents. All the respondents were assured that any data collected from them would be held in confidence. They were informed that any identification written on the questionnaires would not be used in the text and data would be put away in a secured private place.

Each respondent was given adequate time to complete the questionnaire. The questionnaire was completed and collected the same day and 100% return rate was achieved. A sub-sample of two teachers was purposively selected one from the District capital and the other from out of District capital for classroom observation and interview. The purpose of selecting two teachers was that the analysis of the quantitative data revealed similar responses by teachers. Indicating possible common behaviour during practical lesson. The teachers were given codes. The teacher from District capital was labelled DCT (where DCT stands for District capital teacher) and outside District capital, ODCT (where ODCT stands for out of District capital). One practical lesson each was observed using the observation checklist. The observation was to cross check and identify discrepancies between respondents' competence, attitudes and practices based on the quantitative data gathered during the first phase.

During the practical lesson, every observable behaviour (verbal and non-verbal) of the teachers were ticked (√). The researcher was a non-participant observer. Notes were also taken during the lesson to take care of relevant issues not covered by the observation schedule, such as the topic and objectives for the lesson, list of materials and equipment used in each observed lesson. Notes were taken on the nature of laboratory activities and the involvement of students in these activities. The Practical lesson observations lasted for 80 minutes.

The teachers were interviewed immediately after the lesson observation to clarify issues that bothers on their competence, attitude and practices during the observation and also certain aspect of the quantitative data. In this study, the researcher employed one-on-one semi-structured interview to collect qualitative data from the respondents because it allows new ideas to be brought out during the interview as a result of what the interviewee says. The teachers were interviewed

based on the issues that emerged during the practical lesson observation and issues from the quantitative data. Each interview session lasted for twenty minutes. The interview was audio-tape recorded. The audio-tape recording of each interview was transcribed verbatim on the same day the interview was conducted. This was to ensure credibility and accuracy of the transcription since relevant issues would be fresh on the researcher's mind.

Additional data for the study were obtained through document analysis. Various curriculum materials and students practical note books and WAEC Chief Examiners' report were examined. These helped to explain some of the information collected through observation and interview. This was also to enable the researcher to ascertain whether respondents paid attention to the WAEC Chief Examiners' reports on biology practical work.

Data Analysis

Data analysis is the ordering and breaking down of data into constituent parts and performing statistical calculations on the raw data to provide answers to the questions guiding the research (Osuala, 1993). There are four main sources of data within this study: (1) questionnaire data from teachers, (2) audio-recording from semi-structured interviews, (3) observation using observation checklist and (4) document analysis. Quantitative and qualitative data were analysed separately given the different nature of the data.

Quantitative Data Analysis

Descriptive statistics were used to organise the data collected from questionnaire into frequencies, percentages, means and standard deviation. The categories were re-categorised into agree, neutral and disagree to ease interpretation

of the results. Strongly agree' and agree were categorized as 'agree' whiles 'strongly disagree' and 'disagree' were categorized as ' disagree'. A mean score above or below 3 was considered competent and incompetent respectively, while 3 was considered as neutral. The mean score and standard deviation were used to describe the respondents' competence and attitude towards lesson in practical while frequency counts and percentages were used to describe their practices. Inferential statistics such as bivariate correlation was used to determine the relationship between biology teachers' competence, their attitude towards practical work, practices and the background variables such as age, sex, years of teaching experience etc. The statistical significance was based on a p-value< 0.05. The results of the correlation was used to test the null hypothesis formulated for the study (Appendix F).

Qualitative Data Analysis

Qualitative analysis was performed on the data gathered through the semi-structured interviews, the lesson observations and document analysis. The audio-recordings from semi-structured interviews were transcribed verbatim. After preparing the transcripts, the researcher sent them to the participants for member check for accuracy as Banu (2011) did in her study. Any corrections to the transcripts were then made and the corrected transcripts were sent again to the participants for validation.

The recorded interviews were analyzed individually using the comparative method of analysis, the researcher read through the transcripts several times for each interview to get a sense of the uniqueness of that data. Each transcript was reviewed, sentence by sentence, and the responses categorized into themes. In order to generate common themes, the researcher repeatedly read the interview transcripts. However, data collected through observation schedule were analysed using frequency count and

percentages (Appendix G). Data which were collected on school documents were analysed descriptively to answer the research questions.

Like Bryan (2003), the researcher triangulated these data sources in order to code the data, which were categorised on the basis of emergent ideas and themes. From each category, more than one subtheme emerged and the researcher gave each subtheme a title. After repeatedly reading all the subthemes, main themes that showed the findings of the study began to emerge. Thus, this extensive and in-depth analysis of data disclosed teachers' competence, attitudes and practices during the teaching and learning of biology practical.

Ethical Issues

In research, ethical matters are the principles of right and wrong, accepted by a particular group at a particular time (Bogdan & Biklen, 2007). According to Cassell and Jacobs (as cited in Banu, 2011), ethical codes represent desire and efforts to show respect to others' rights, execute responsibilities, avoid harm, and supplement benefits to the subjects. To ensure participation of the selected respondents and their respective institutions, the researcher ensured confidentiality of their information and anonymity. This was done by informing respondents not to write their names nor indicate their schools in connection with their responses. This was done to avoid respondents presenting artificial behaviours that would not have been displayed in a normal situation. Headmasters and heads of department were aware of the research being totally anonymous and they were clear of the details of the study. The questionnaires, observations, interview and document analyses were completed during school time and in the normal school environment under the direction and authority of the Headmaster who had willingly agreed for their schools and teachers to participate in the study.

CHAPTER FOUR

RESULTS AND DISCUSSION

Overview

This study investigated SHS biology teachers' competence, their attitudes towards practical activities and practices they employed during practical lessons in the Eastern Region of Ghana. This chapter provides information on biology teachers' competence, attitude towards practical work and their practices. Data collection involved two phases. In the first phase the researcher used closed ended questionnaires to collect quantitative data from 80 respondents. In the second phase qualitative data were collected using observation, semi-structured interview and document analysis. Data collected were analysed to answer the specific research questions and hypothesis in this study. The presentation of the results was done in the order in which research questions were presented in Chapter one.

The first section dealt with the respondents' demographic data while the second section presented the data collected to answer the study research questions.

This chapter also discusses the findings of the study. The pieces of evidence from the literature were used to support the arguments. It was also based on the research question and hypothesis formulated.

Background Information on the Respondents

The data on gender of the study is presented in Fig.4.1.

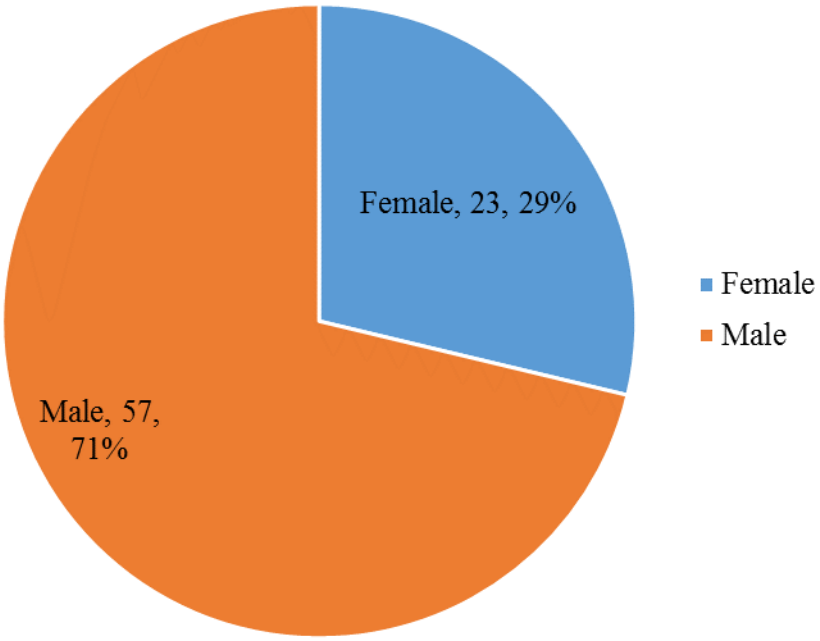

Fig. 4.6 Gender Distribution of Teacher Respondents

Out of the 80 teachers involved in the study, 29% (23) of them were females with the majority being males 71% (57). The female biology teachers involved in the study were less than their male counterparts because there are relatively fewer number of female biology teachers in most SHS in the Eastern Region of Ghana.

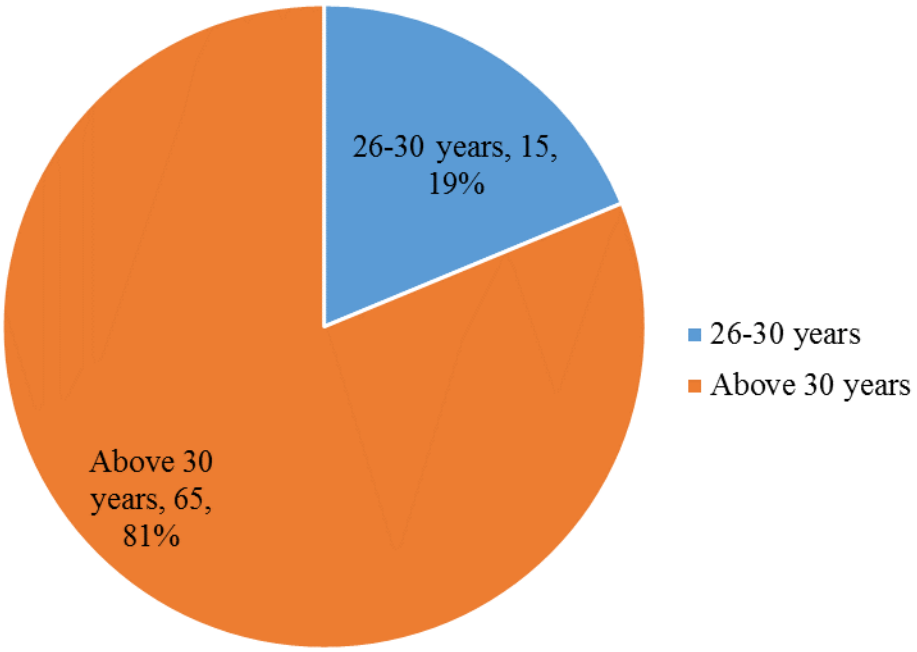

Fig 4.7 Age Distribution of Respondents

The age group of the respondents varied between 26 and 30 years and above. Majority of the respondents 65 representing 81% were above 30 years of age. Only 19% (15) of the respondents were within 26-30 years (Fig.4. 2)

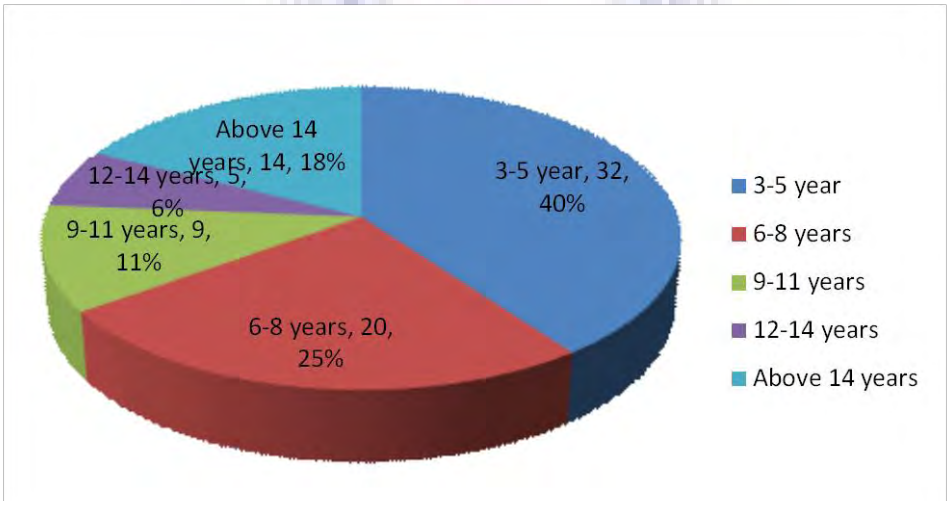

Fig 4.8 Years of Teaching Experience of Teachers

The SHS biology teachers had varied years of teaching experiences. The years of teaching experience ranged from three to 14 years and above with majority of the respondents (40%) with between 3 to 5 years of teaching experience and 6% of them had between 12- 14 years. Further details are provided in Fig.4.3.

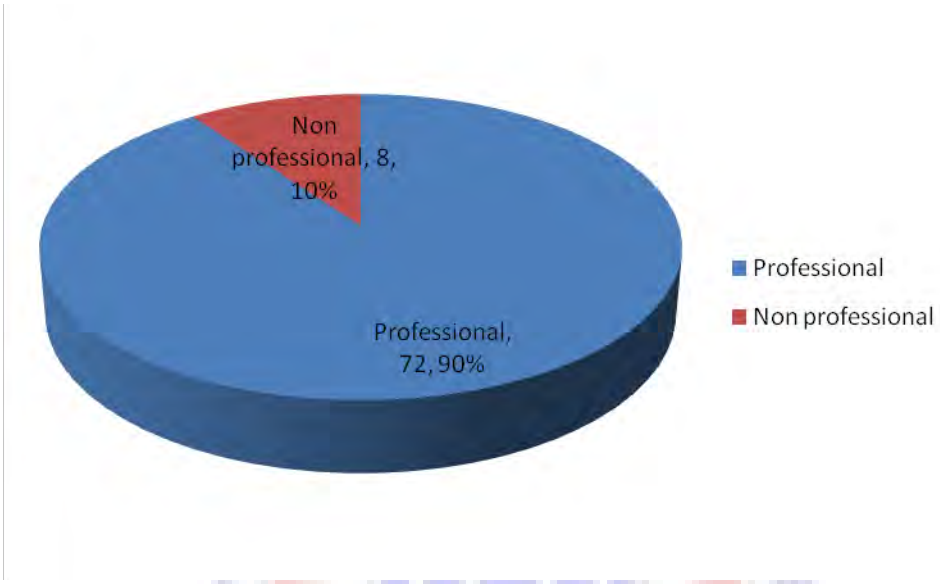

Fig. 4.9 Respondents' Professional Qualification

Out of the 80 SHS biology teachers involved in the study, 90% (72) of them had professional qualification in teaching and only 10% (8) were non-professional teachers (Fig. 4.4). The non-professional teachers involved in the study were fewer than the professional teachers because there are more professional teachers teaching biology in the Eastern Region. Fig. 4.4 is a graphical presentation of the fraction of the non-professionals teachers among the study subjects.

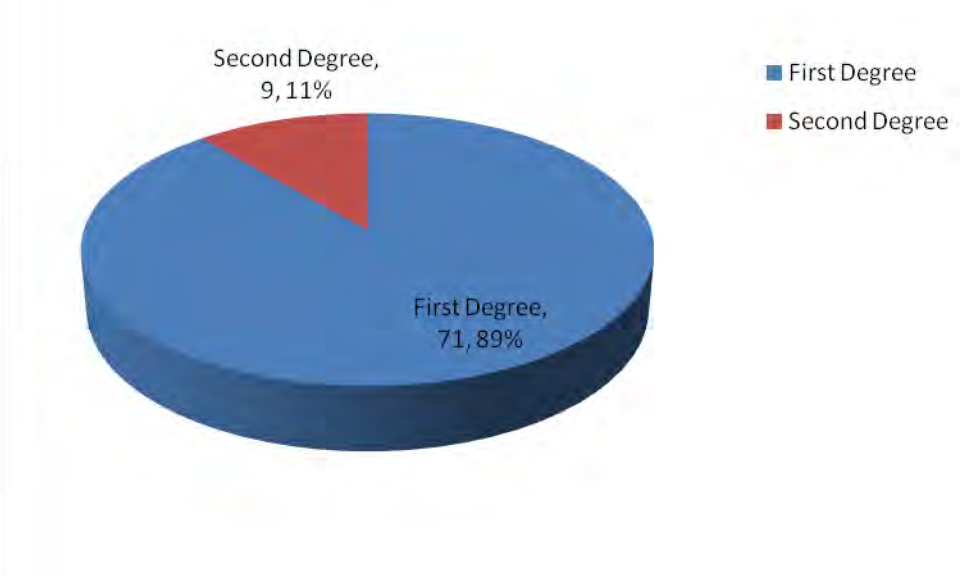

Fig. 4.10 Academic Qualification of Teachers

Out of the 80 SHS biology teachers involved in the study, 89% (71) had first degree in biology and other subjects as their academic qualification whiles only 11% (9) were second degree holder as indicated in Fig. 4.5. The results implies that all the respondents had the required academic qualification which is first degree approved by GES for teaching in the SHS.

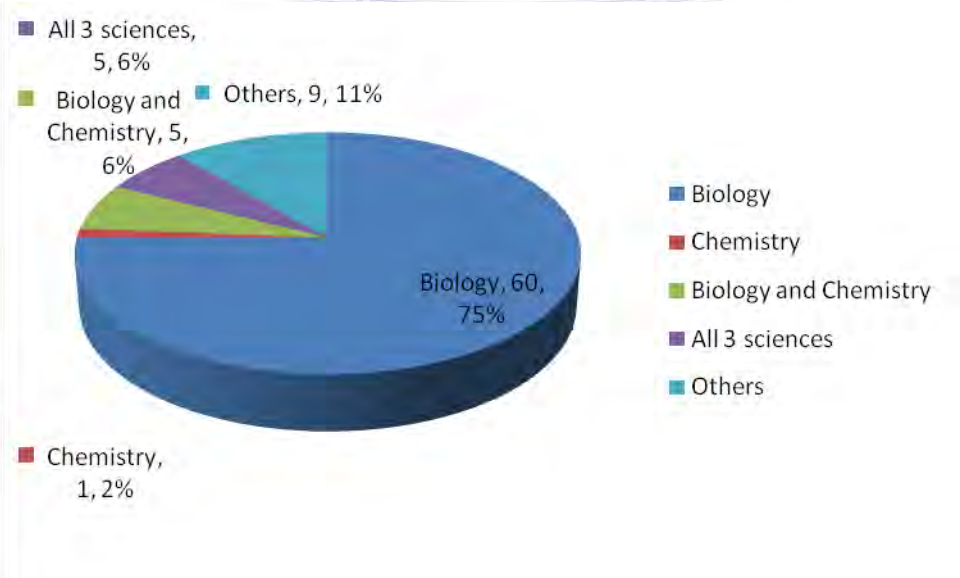

Fig. 4.11 Respondents' Area of Specialisation

The SHS biology teachers had varied areas of specialisation. As shown in Fig. 4.6, the dominant area of specialisation was biology 75 % (60) whiles 1% (1) had specialisation in Chemistry. A few specialised in two disciplines. About 6% (5) had specialised in Biology and Chemistry, while 1% (1) claimed had specialised in all the three science subjects. Another 11% (9) specialised in subjects other than science namely Health Physical Education Recreation and Sports, Environmental Studies, Agriculture and Social Studies. The data revealed that 19% (15) of the respondents had not specialised in biology. This is because those with Biology and Chemistry had Biology as their minor. Further details are provided in Fig. 4.6.

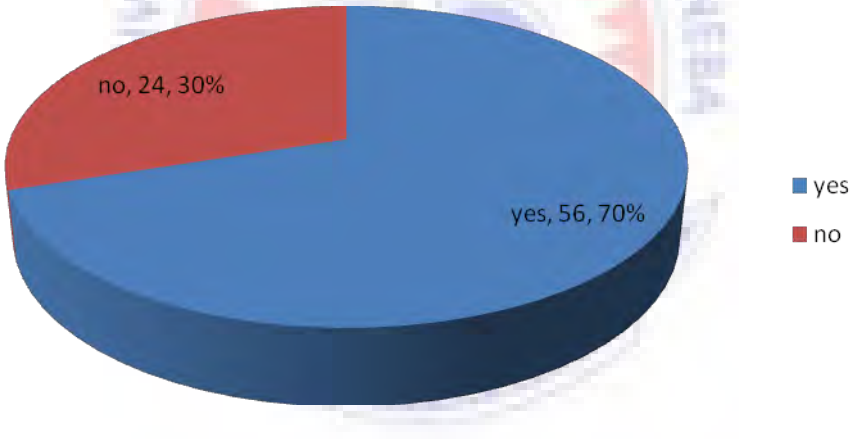

Fig. 4.7 In-service Status of Respondents

The researcher further enquired from the respondents whether they had in-service training programmes. The in-service training programmes were organised by Ghana Association of Teachers (GNAT), Ghana Education Service. General observation from fig.4.7 was that majority of the respondents 70% had in-service training while 30% had no in-service training. The fact that 30% (24) of the

respondents had no in-service training is quiet unfortunate since in the implementation of any curriculum professional development programmes are crucial.

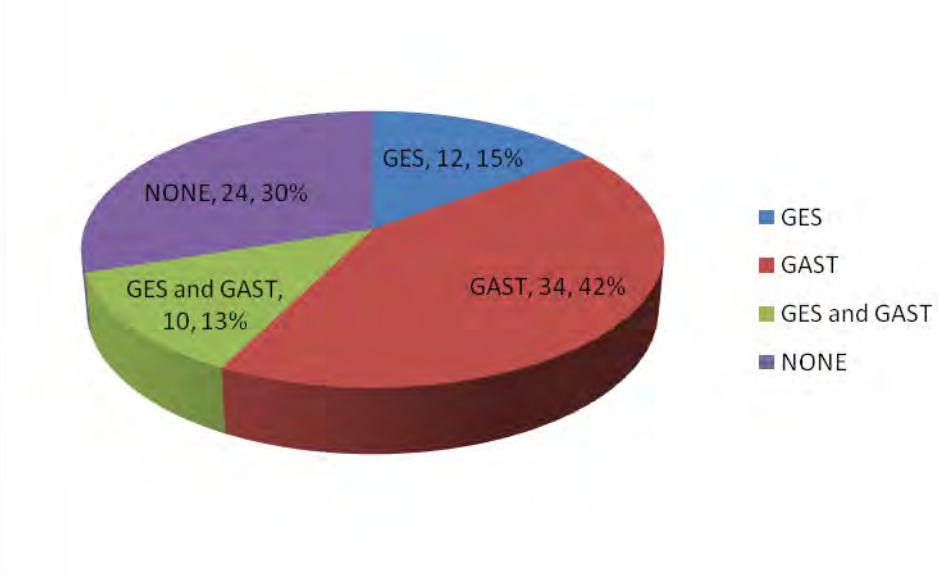

Fig. 4.8 Organisers of In-service Training

The in-service training for the SHS biology teachers was organised by the Ghana Association of Science Teachers (GAST), Ghana Education Service (GES) and others. Out of the 55% (61) respondents who had had in-service training, majority of the teachers (42%, 34) were trained by GAST, 15% (12) GES alone, while GES in conjunction with GAST trained 13 % (10) as indicated in Fig. 4.8.

Research Question One: What are SHS Biology teachers' competencies in organising practical work?

The research question sought to determine the competencies of SHS Biology teachers in organizing practical work. Descriptive statistics were used to determine mean scores, standard deviations, frequencies and percentages on the samples responses on the questionnaire In the analysis, 'strongly agree' and agree were categorized as 'agree' whiles 'strongly disagree' and 'disagree' were categorized as '

disagree'. A mean score above or below 3 was considered competent and incompetent respectively, while 3 was considered as neutral. The results of the analysis are presented in Table 4.1.

Table 4.1: Distribution of percentage frequencies, mean score and standard deviation of Senior High School Biology teachers' responses on their competence in organizing practical work.

Items	Responses				
	A	N	D	MS	DS
1	100 %(80)	0.0%	0.0%	4.49	.50
2	87% (70)	8% (6)	5% (4)	4.14	.76
3	64 % (51)	25 %(20)	11% (9)	3.66	.90
4	91% (73)	9% (7)	0 .0%	4.49	.66
5	59 % (47)	32% (26)	9 %(7)	3.45	.86
6	37% (30)	39% (31)	24% (19)	3.24	1.05
7	17% (15)	41% (37)	42 %(38)	2.56	1.08
8	65% (52)	20% (16)	15% (12)	3.73	1.09
9	99% (79)	0 .0%	1% (1)	4.58	.57
10	95% (76)	2.5% (2)	2.5% (2)	4.45	.67
11	85% (68)	10% (8)	5% (4)	4.23	.87
12	98% (78)	1% (1)	1% (1)	4.50	.60
13	94% (75)	4% (3)	2.5% (2)	4.29	.66

*A= Agree, N=Neutral, D=Disagree

The minimum and maximum frequencies of the teachers' responses to the questionnaire were between 1 and 80 respectively, and the mean scores ranged from

3.24 (SD=1.05) to 4.58(SD= 0.57). Only one item 7 (I have competence in making a botanical garden in school for teaching) had a mean score of 2.56(SD= 1.08). Generally, the teachers had competence in organising practical work. The respondents' competencies in organising biology practical work as indicated in Table 4.1 shows that all the (100%, 80) respondents found themselves competent in giving clear explanation before students perform practical work. This implies that the teachers seem to be well-versed and knowledgeable of the experiments students performed during practical lesson. This was followed by teachers' competence in linking lesson with past experiences 99% (79) with only 1% (1) disagreeing whereas 98% (78) have competence in defining the problem in simple language. Majority of the respondents, 95% (76) indicated that they had competence in linking concrete and abstract experiences of students. Majority of the respondents 94% (75) were competent in handling equipment. Most of the responses on the use of the internet to gather information for students shows that 68 out of the 80 respondents had competence in that, 10% (8) were neutral while 5% (4) found themselves incompetent.

Responding to the use of interactive whiteboard in labelling diagrams, 65% (52) indicated that they were competent in doing so, 20% (16) showed neutrality, while 15% (12) appeared incompetent. On assessing teachers' competence in helping their students to write reports on experiments, 64% (51) indicated they were competent, 25% (20) were neutral while 11% (9) were incompetent. This implies respondents generally had competence in writing reports on experiments conducted at the laboratory. Fifty nine percent of the respondents (59%, 47) found themselves competent in helping their students in making science model, 32% (26) were neutral whiles 9% (7) were found incompetent. The fact that 33 teachers out of the 80

respondents were incompetent in making science model indicated that most teachers lack competence in that. Table 4.1 also indicates that only 37% (30) were competent in arranging field trips, majority 39% (31) were neutral, with 24% (19) being incompetent. This implies that generally respondents are incompetent in organising field trip which is curricula requirement. Only 17% (15) of the respondents were competent in making botanical garden, 41% (37) were neutral and majority of the respondent 42% (38) found themselves incompetent. This revealed that biology teachers are incompetence in making botanical garden. The above analysis indicated that majority of the respondents had competence in organising practical work.

Research Question Two: What are the attitudes of SHS Biology teachers towards practical work?

This question sought to determine the attitudes of biology teachers who participated in the study towards practical work. Questionnaire was used to gather information on the biology teachers' attitude towards practical work. Descriptive statistics were used to organise the teacher responses into frequencies, percentages, mean scores and standard deviation. The negative statements were reversed in scoring. For example strongly agree=1, agree=2, neutral=3, disagree=4 and strongly disagree=5. The results of the analysis are presented in Table 4.2

Table 4.2: Teachers' attitudes towards practical work

Item	Responses				
	A	N	D	MS	DS
1	100% (80)	0.0%	0.0%	4.53	.50
2	9% (7)	4% (3)	87 %(70)	1.91	.87
3	95% (76)	4% (3)	1% (1)	4.49	.64
4	0.0%	1% (1)	99 %(79)	4.58	.57
5	97.5% (78)	2.5% (2)	0.0%	4.38	.54
6	82% (66)	9% (7)	9% (7)	4.03	.94
7	99 %(79)	0.0%	1% (1)	4.69	.54
8	95% (76)	4% (3)	1% (1)	4.39	.63
9	99 %(79)	1% (1)	0.0%	4.66	.50
10	1 %(1)	3% (2)	96 %(77)	1.45	.61

*A= Agree, N=Neutral, D=Disagree

The minimum and maximum frequencies of the teachers' responses to the questionnaire were between 1 and 80 respectively, and the mean scores ranged from 4.03 (SD=.94) to 4.58(SD= 0.57). From the analysis, it was observed that Biology teachers had positive attitudes towards practical work. All the respondents (100%) were positive about biology practical work (item 1). All the teachers (100%) liked biology practical because it helped them to acquire scientific skills. Also, majority (99%, 79) of the respondents liked practical because it helped them appreciate biology better. Majority (96%) of the respondents disagreed with the statement that biology practical is boring (item 10). The respondents (82%) indicated that, they like working with science equipment (item 6). The responses on item 4 (I teach only theory in class) which 79 respondents disagreed indicated that respondents organise practical as part of their teaching practices. Item 10 (Biology practical is boring) 77 respondents strongly disagreed, revealed biology teachers positive attitude towards practical work.

Research question Three: How do SHS biology teachers carry out practical work?

The research question sought to find out the practices of biology teachers during practical lessons. Questionnaire was used to gather data on biology teachers' practices during practical work. Descriptive statistics were used to organize the data into frequencies and percentages. Table 4.3 provides detailed results of the analysis.

Table 4.3: Responses on how Biology teachers carry out practical work.

Responses	A	N	D
1	99% (79)	1% (1)	0.0%
2	94% (75)	5% (4)	1% (1)
3	95% (76)	4% (3)	1% (1)
4	91.5% (73)	6% (5)	2.5% (2)
5	9% (7)	5% (4)	86% (69)
6	73% (58)	11% (9)	26% (13)
7	1% (1)	0.0%	99% (79)
8	91% (73)	8% (6)	1% (1)
9	1% (1)	2.5% (2)	96.5% (77)
10	1% (1)	5% (4)	94% (75)
11	2.5% (2)	1% (1)	96.5% (77)
12	0.0%	1% (1)	99% (79)
13	14% (11)	24% (19)	62% (50)
14	65% (52)	21% (17)	14% (11)
15	88% (70)	6% (5)	6% (5)
16	50% (40)	26% (21)	24% (19)
17	84% (67)	15% (12)	1% (1)

*A= Agree, N=Neutral, D=Disagree

Form Table 4.3 it was evident that majority of the teachers 99% (79) supervised their students during practical (item 1). Item 2 of the questionnaire sought to find out whether teachers taught theory before students perform practical and 94% (75) of the respondents agreed to that. This implies the respondents teach theories

before student are allowed to perform practical on the topic. Also, 95% (76) allowed their students to work in groups during practical (item 3). Most of the respondents, 91% (73) gave immediate feedbacks to students when they need direction to precede (item 4).

Majority of the respondents (86%, 69) related theory students learn in biology to the practical they perform (item 5). This implies that students perform practical work based on the theory that they had been taught. Seventy three percent (58) of the respondents often organised group work because there wasn't enough equipment for practical work (item 6). Majority of the respondents (99%, 79) indicated that they supervised what students do during practical (item 7). Also, the researcher wanted to know whether appropriate equipment in the laboratory was used for biology practical. Ninety one percent (91%, 73) of the respondents provided appropriate equipment for Biology practical (item 8). With teacher guidance during practical, 96% (77) of the respondents' guided their students during practical (item 9). A negligible number of respondents (2.5%, 2) were neutral while 1% (1) agreed with the statement that students perform practical without guidance. Only one respondent indicated that there is no equipment in the school laboratory so he did not organise Biology practical while 94% (75) disagreed (item 10). This implies science laboratories at the SHS level are well equipped for biology teaching. On opportunity for students to handle equipment, 96.5% (77) of the respondents offered opportunity for their students to handle equipment (item 11). Almost all the respondents (99%, 79) of the respondents disagreed that equipment in the Biology laboratory gave inaccurate results (item 12).

About 14% (11) of the respondents agreed that they allowed their students to design their own experiment during practical work and 24% (19) were neutral whiles

62% (50) disagreed (item 13). The implication is that biology teachers teach for examination in an attempt to complete the overloaded biology curriculum which denies the students the opportunity to practice as scientist. Majority of the teachers (65%, 52) agreed that they allowed their students to perform experiment based on WAEC past questions, which only 14% (11) does not depend on WAEC past questions (item 14). Most of the respondents (88%, 70) selected practical tasks from GES approved textbooks (item 15). This implies that biology teachers allowed their students to perform practical based on both WAEC past questions and GES approved textbooks.

The researcher further assessed teacher preparation before practical. Fifty percent (50%, 40) had enough specimens for Biology practical as against 50% who did not have enough specimens (item 16). Again, 84% (67) of the respondents improvised materials for teaching where there are no Teaching and Learning Materials (item 17). The above analyses with further details provided in Table 8 indicate clearly that biology teachers employed good practices during practical lessons.

Research question Four: To What extents do biology teachers' competency and attitudes impact their practices during practical work?

A null hypothesis was formulated for testing.

Testing the research hypothesis

H_{01} There is no relationship between SHS biology teachers' competence and attitude towards biology practical on their practices.

The hypothesis was tested using bivariate Pearson correlation and the results of the analysis is presented below in Table 4.4.

Table 4.4. Correlation Matrix Involving Competence, Attitude and Practices

		practice scale	attitude scale	competence scale
practice scale	Pearson Correlation	1	.506**	.576**
	Sig. (2-tailed)		.000	.000
	N	80	80	80
attitude scale	Pearson Correlation	.506**	1	.468**
	Sig. (2-tailed)	.000		.000
	N	80	80	80
competence scale	Pearson Correlation	.576**	.468**	1
	Sig. (2-tailed)	.000	.000	
	N	80	80	80

**. Correlation is significant at the 0.01 level (2-tailed).

Form table 4.4, the diagonal from top left to bottom right consisted of 1.00 repeated three times. This implies the correlation of competence with itself, of attitude with itself and practices is a perfect relationship (r=1.00). Therefore the null hypothesis which states that there is no relationship between SHS biology teachers' competence and attitude towards biology practical on their practices is rejected.

Correlation of background variables against competence, attitudes and practice

The researcher performed bivariate Pearson correlation (Appendix F) on respondents background variables and the three constructs. The results indicated that:

1. There was no significant correlation between sex of respondents and their attitude towards biology practical work r was -.29 ($p<0.0005$)
2. There was a relationship between sex of respondents and the competence of respondents r was -.29 ($p<0.01$).
3. There was no relationship between sex of respondents and their practices r was -.11

4. The was no significant relationship between age of respondents and their practices r was 0.100.
5. There was no significant relationship between age of respondents and competence r was .18.
6. The was no significant relationship between age of respondents and their attitude r was 0.06.
7. There was significant relationship between teaching experience and attitude of respondents', r .was -.26. The significant level was $p<0.05$
8. There was no significant relationship between teaching experience and competence of respondents r was - 0.17.
9. There was no significant relationship between teaching experience and respondents' practices r was -.10.
10. There was no significant relationship between academic qualification and respondents' attitude r was -.100.
11. There was no significant relationship between academic qualification and competence of respondents r was .03.
12. There was no significant relationship between academic qualification of respondents and their practices, r was -.03.
13. There was no significant relationship between area of specialisation of respondents and their attitude, r was .01.
14. There was no significant relationship between area of specialisation of respondents and their competence, r was 0.19.
15. There was no significant relationship between area of specialisation of respondents and their practices, r was -.05.

16. There is no significant relationship between professional qualification of respondents and their attitude, r was -.10.
17. There was a significant relationship between respondents in-service training and their attitude towards practical work, r was -.31. The level was $p<0.01$.
18. There was no significant relationship between in-service training of biology teachers and their competence, r was -.16.
19. There was no significant relationship between in-service training of biology teachers and their practices, r was .177.

Analysis of Qualitative Data

Lesson Observation

A sub-sample of two teachers from the sample size were purposively selected to be observed. Each teacher was selected purposively from a district capital and out of district capital to represent each stratum. Each teacher was observed once. An observation checklist (Appendix C) was used to observe each lesson. The researcher ticked whenever a particular behaviour occurred. The observation checklist began with a description of the teacher followed by that of the laboratory environment. These were supported with notes taken during the observations on relevant issues that were not captured in the observation schedule, but which were deemed important by the researcher. Also included was the topic of the lesson and its objectives. The result of the observations is presented in the next section.

District Capital Teacher (DCT) in this study represents a non-professional graduate teacher who obtained a Bachelor of Science (B. Sc) Degree in Microbiology and graduated in 2007. She has been teaching biology at the SHS level throughout her eight years of teaching.

DCT was teaching 57 form one General science biology students (3 girls, 54 boys) at the time of the study. The laboratory had six long benches and 71 stools. Each bench was to accommodate four students however nine students shared a bench whereas individual used a stool each. The class was overcrowded. This situation inhibited effective supervision and interaction between students and their teacher. The GES directive on number of students per class is 35 and a number of students per teacher are 20. Biological charts were displayed on the wall. There were biology models in the laboratory. Students were not given workbooks to serve as a guide.

The lesson observed was on the preparation of temporary slides of plant cells. The main objectives for that lesson were for the students to:

1. Prepare temporary slides of plant cells.
2. Draw the cells under the microscope.

The entire class was engaged in one activity. The findings from the observation are presented in the Table 4.5.

Out of District Capital Teacher (ODCT)

ODCT is a professional graduate teacher, who graduated in 1988 and holds Bachelor of Science (B.Sc) Degree in Biological Science and Diploma in Education. He has been teaching biology for 28 years. ODCT was teaching 20 form 2 Home Economics students. All the students were girls. The lesson took place in the classroom because the school had no laboratory for practical lessons. Individual students had a table and chair and students worked individually because there were enough flowers for the lesson. There was adequate space in the classroom, which facilitated interaction between the teacher and his students. It also ensured effective supervision of students' activity. There were no biological charts on the walls. No

workbook was used to serve as a guide. The lesson observed was on the reproductive organ of a flowering plant. The main objectives of the practical work were for students to:

1. Identifying the flower parts
2. Describe the adaptation of the varieties of flowers (Flamboyant, Pride of Barbados, Rattle box)
3. State how the flowers are adapted for their function.

The findings from the two observations (DCT and ODCT) are presented in Table 4.5.

Table 4.5: Findings from the two observed lessons.

Activity	Observed		Not observed	
	DCT	ODCT	DCT	ODCT
Does the teacher set-up practical for students?	X	√	X	
Does the teacher give clear explanation before practical work	√	√	X	X
Teacher teaches theory before practical work		√		X
Teacher provides enough materials/Equipment during practical	√	√		
Lesson				
Students work in groups during practical lesson	X	X	X	X
Teacher marks students work and provide immediate feedback	X	√	X	
Teacher guides students during biology practical lesson	√	√		
Student follow rules in their drawing	√	X	X	X
Students are given enough time to complete the task	√	X	X	X
Student use the right equipment during practical	√	√		
Teacher links concrete and abstract experiences of students'	√	√		
Teacher collects animals and plants specimens for biology teaching	√	√		
Teacher supervises students while performing practical task	√	√		

DCT= District Capital Teacher ODCT = Out of District Capital Teacher √= observed **X**= not observed

From Table 4.5:

1. DCT set-up a practical activity for students during practical activities whiles ODCT allows students to set up their own practical activities. DCT had competence in setting up biology practical.
2. The teachers had competence in giving clear explanation to students before practical. This is because both of them gave a clear explanation before practical lesson.
3. DCT had competence in teaching theory before practical while ODCT mixed both theory and practical.
4. The observed teachers had competence in providing enough materials/equipment during practical lessons.
5. None of the observed teachers had competence in organising group work.
6. ODCT had competence in marking student exercises and provided immediate feedback so that they could proceed, however DCT could not do so.
7. DCT and ODCT guided their students and ensured that students used the right equipment. This implies they had competence in guiding their students.
8. DCT had competence in ensuring that students follow biological rules in their drawing but not ODCT.
9. ODCT gave students enough time to complete the task whiles DCT, the students were unable to complete the task due to limited time. This implies ODCT had competence in allocating time to practical lessons.
10. The observed teachers ensured the use of the right equipment, linked concrete and abstract experiences of students and also supervised students while they perform practical tasks

Analysis of Semi-Structured Interview.

The semi-structured interview protocol had 10 questions (Appendix D). The content of the interview were: 1) Why practical work in the teaching and learning of biology 2) What challenges do you face during biology practical work? 3) Do you use practical activities to help students understand the theory? and so on.

The purpose of the semi-structured interviews was to investigate discrepancies between the quantitative data and lesson observation data.

The findings from the semi-structured interview were put into emerging themes. The transcripts were read over and over again to identify the sections that fitted into the already emerge themes. The different ideas that emerged were: (1) setting of practical (2) supervision (3) provision of material and equipment and (4) The qualitative findings were presented with quotations extracted from the respondents' transcripts.

Biology teachers' competence

Teachers were interviewed about their organisation of practical work, the role of biology teachers in practical work, how practical work facilitates teaching and learning of biology in SHS. According to the respondents, they organised practical work for all the classes they taught, set-up laboratory and guided students during the practical lesson. On the role of teachers

Researcher: What role does practical work play in the teaching and learning of biology?

ODCT: The teacher has to organise the materials, at times you have to go for the materials and there are times too you have to ask the students to bring them. Teachers must prepare the laboratory where there is no laboratory

assistant, in fact, to find out whether the equipment is working. The teacher guides students as they do the practical work you go around and monitor what they are doing to ensure that they do the right thing they don't destroy things.

DCT: Well, I think teachers should supervise what the students are doing. If it is necessary the teacher demonstrates certain techniques the students find difficult to perform, for example sectioning an organism and also guides the students.

From the responses, respondents design (writes up) practical for students, set-up the laboratory for practical lessons, guides students and ensure students use the right equipment during practical lessons.

Attitude of biology teachers towards practical work

On teachers' attitudes respondents were interviewed on practical lesson and the attitude of students. The respondents indicated that practical work helps the students to understand what they are taught. After the theory lesson, students need related practical for better appreciation and understanding of the concept. It also caters for individual differences in the class.

Researcher: What purpose/role does practical work play in the teaching and learning of biology?

ODCT said: It helped the students to understand the concept for instance individual difference. Students perform practical, they observed and it would always be in their minds. I remembered last week a student asked me' what is cotyledon?' how can I explain, the best thing was to show cotyledon to them let them see and observe what is meant by cotyledons.

> **DCT said**: Biology is life as we all know. It is all around us so if the students see what they are studying and possibly feel it then they will appreciate better. It doesn't become abstract to them anymore, but they really get to appreciate nature and then appreciate the biology they are studying because they can see with their eyes and feel it. Like one student asked me so Madam this *Amoeba* where it is that it is troubling us like that. But the fact is sometimes when you prepare slides and you are very lucky to have an *Amoeba*, then the students are very excited. Or you are teaching them about the ovary of a flower and they only imagine it, it becomes difficult for them to understand. However, when they have the flower and they observe what you tell them about the arrangement of ovules and they compare it to the same flower that has undergone fertilization to form a fruit and the seeds in the fruits are arranged in the same way as the ovules, they understand it better that ovules develop into seeds.

Practical work according to Gangoli and Gerrard, (as cited in Bello, 2015) promotes long term retention in students, enhances pupils developments of the ethical dimension of science, instils the spirit of collaboration and active participation among learners, exposes learners to scientific experience that could ultimately help them in developing scientific attitude and skills. This confirms Joyce, Weil and Calhoun (2000) who strongly emphasize that learning new materials or skills, students should be given extensive opportunities to manipulate the material in the environment because, according to Piaget (1978), students' cognitive structures will grow only when they initiate their own learning experiences.

With regards to students' attitudes towards practical work, respondents responded in

affirmative.

Researcher: How is the students' reaction when it comes to practical work?

ODCT said: Personally, I can see that they enjoy it, they have a positive attitude towards practical work.

DCT said: From my observation most of them like the practical. In fact, after some time, if students don't have practical they begin to enquire when they will have the next practical. So I think their attitude is positive. But due to the large number of students compare to the size of the laboratory control and monitoring is not always the best as some student hides behind and do not fully participate. At times they find it challenging, but when they receive the necessary guidance they are happy.

From the observation, respondent A used skills such as questioning, using examples, relating lesson to daily situations, exploration and explanation to arouse curiosity and interest in students whiles Respondent B hardly do that. The study of Bibi (2005) study mentioned that exemplification, questioning, relate lesson to daily life and proper use of teaching aids were essential skills for successful delivery of lessons. Both provided materials and appropriate equipment for the lesson.

Practices of biology teachers

On how often they organize practical lesson, where students do their write-ups, the nature of their timetable and also whether respondents teach theory before practical or practical before theory and time student are provided with feedback respondents had this to say from the semi-structured interview. Respondents indicated that they organize practical work most of the times every week. As stipulated by the curriculum for effective teaching and learning of biology.

Researcher: How often do you organise practical work?

ODCT: I organized, practical at least once a week, sometimes in a normal lesson whenever the chance comes I teach the practical but more especially for practical 2weeks or 3 weeks.

DCT: Yes, depending on the topic that is being treated. If it is a practical topic, then every week, I try to have practical.

This is in line with the quantitative results, 94 % (75) of the respondents agreed that they teach theory before practical. This contradicts Nwagbo's (2007), finding that most biology teachers use all the biology periods for theoretical aspect of the subject neglecting the weightier practical aspect which has potential for developing critical thinking and objective reasoning abilities in the students. Research has also shown that many teachers lack the competencies, skills and creativity to organize practical classes (Ofoegbu, 2003; Akubuilo, 2004). Students were rarely taught biology practical according to Ajaja (2002), at the basic and secondary levels and this affects performance at the post-secondary level.

The researcher further enquiries from the respondents whether they have practical periods on the time table. ODCT has no allocated periods on the time table for practical lesson whiles DCT has three periods per week for practical lessons for form 2and 3 and not on form 1 time table.

Researcher: Do you have practical periods on your timetable?

ODCT: Here we don't actually have practical periods on the timetable so I use some of the lesson periods for practical.

DCT said: Yes we do, three (3) periods a week for form 2 and 3 but not form. Also, students partially did their write-ups in the laboratory which does not ensure provision of immediate feedback.

Researcher: Were you able to mark and provide immediate feedback to students?

DCT said: When time was not enough, then I asked them to take it away and submit it a later date. But most of the time I tried to make them do their write ups in the laboratory.

Researcher: Did students do their write-ups in the laboratory?

ODCT: Most of the time I let them do the write up here, but, there are some occasions, time would not allow us they do the write up and bring to me the next day.

On time for conducting practical activities respondents had this to say.

Researcher: Did you teach practical work as a basis for the theory work or you teach the theory and you let students go and verify.

ODCT: I mixed them there are times I take them to observe the practical before theory, there are at times too, I taught theory before the practical, at times I mixed them.

DCT: Sometimes I taught practical before theory. Sometimes too I taught theory alongside the practical work. For example, when I'm teaching on a flower, the flower is there and as we talk about the corolla, calyx, androecium and gynaecium they are observing it. If I want them to observe what is inside the ovary they cut and examine it.

From the responses, respondents either taught theory before practical or sometimes the practical before theory or sometimes mixed both theory and practical.

Also, Respondents indicated that they partially provided immediate feedback to their students.

Researcher: Were you able to mark and provide immediate feedback to students?

ODCT indicated that: Yes, because the students are few I can take few hours to mark which helped me to provide immediate feedback. I corrected their mistakes and asked them to do their corrections where possible they repeat the exercise.

DCT: Honestly, no, for most of the time I did mark but usually not immediately. Sometimes too I randomly sample and marked to know the common mistakes and correct them.

Researcher: why?

DCT said: You know, sometimes you teach and then you don't have enough periods in between and you have to set the laboratory. No laboratory technician as it is in other units. It is not always easy. Sometimes it takes a bit of the practical period time.

Furthermore the teachers did not provide immediate feedback to students due to limited time and large class sizes. However, they supervise students' work, but students were not given enough time to complete the task this they attributed to lack of laboratory technician who would assist them in setting up the laboratory. On challenges hindering effective implementation of practical work, respondents attributed it to factor such as lack of in-service training, funds, large class size, absence of laboratory technicians in their schools.

Researcher: What challenges did you face during biology practical work?

ODCT said: Sometimes getting materials, some materials were easy to come by, you can look around here we have maize. It is difficult getting money, but, sometimes you have to buy some of the items and equipment. Formally the students were paying for practical, but, now no.

DCT also said: Well, sometimes getting the specimen that would be okay for the number of students we have. Another thing too was the number of students in a class. Ideally, it would have been good if we have half the number but because of the way the timetable was you just have to combine them for one class (i.e. one session) and sometime make some students not to pay attention in class. Another thing was the absence of laboratory technician to assist. Also lack of in-service training, here we have equipment that we cannot use simply because we can't operate it.

From the quantitative data, only (37%) of the respondents were competent in organizing field trips. So the researcher enquires from the respondents about field trips.

Researcher: Did you organize field trips to supplement practical in the laboratory? How often?

ODCT: No, because students cannot afford the cost involved.

DCT: Yes, but it is done once in the students three years of study because students have to pay the cost involve.

Analysis of Related documents

In District Capital School (DCS) student workbooks indicate an average of two practical exercises in a month while in Out of District Capital School (ODCS) the average is twice in a term. However, the biology curriculum indicates that there

should be practical lesson every week. Also, students' disregard of biological drawing rules suggested inadequate supervision from the teachers. Teacher lesson note indicated no group works in the two classes observed. The notebooks also indicated that the teacher did not follow the procedures outline in the syllabus. Some preserved specimens such sea anemones and *Ulva* indicated that teachers do allow students observe organisms at their habitat. This implies teachers do not take their students out on a field trip to observe organisms in nature for better understanding of concepts that cannot be demonstrated in the laboratory. This they attributed to lack of funds.

Discussion

This study sought to determine SHS biology teachers' competence in organising practical work and their attitude towards practical work and their practices in the Eastern Region of Ghana. The study also sought to determine the relationship between biology teachers' competence and attitude towards practical work and their practices. In this chapter, the researcher discusses into details the findings of the study in relation to the research questions set to guide the study.

Biology teachers' competencies in organising practical work

The findings pointed to the fact that all (100%) of the teachers found themselves competent in giving clear explanation before students perform practical work (see Table 4.1). Lassa (2000) claimed that education cannot be provided by just anybody, it requires a teacher who plans and delivers the lessons or instruction in such a way that objectives can be achieved. Also the lessons observed and the interview responses confirmed that the teachers were competent in giving clear explanation. This is in line with Huey and Lederman (as cited in Copriady, 2014) study, which emphasized the need for a clear explanation and instructions before performing an

activity. If the teacher fails in explaining the content, students will not be able to understand what to do and resulting to failure in the practical implementation and jeopardizing safety in the laboratory.

Also biology teachers (88%) were found competent in demonstrating experiment before student carryout experiment. The respondents were also competent in the collection of (animals and plants) specimen for biology teaching. The teachers (99%) were also competent in linking lesson with past experiences, 98% defining the problem in simple language and linking concrete and abstract experiences of students (95% See Table 4.1). This confirms Khatoon et. al. (2014) finding that teachers developed a link between concrete and abstract learning experiences of students by giving examples from daily life or showing living things about lesson.

Majority of the teachers (94% see Table 4.1) were competent in handling equipment Abimbade (1999) attested that instructional or laboratory materials when appropriately used, enhances learning, improve the competence of teachers and make learning more meaningful to learners. He added that on the other hand, when these materials are misused, it is equal to lack of knowledge on how to use them, science teaching and learning process may be adversely affected. Jatau (as cited in Bello, 2015) also reported that when instructional equipment is appropriately utilized, they bring about more effective teaching and learning process. Also the teachers (85%) were competent in the use of the internet to gather information for students. The findings also pointed out that 65% of biology teachers (see Table 4.1) use an interactive whiteboard/blackboard in labelling diagrams.

Majority (64%) of teachers had competency in helping their students to write reports on experiments. The qualitative findings indicated that teachers partially

helped their students to write reports on an experiment since student normally wrote their reports after they had left the laboratory. This was stated by one of the respondents during the interview.

> **DCT**: Honestly, no, for most of the time I do mark but usually not immediately. Sometimes too I randomly sample and marked to know the common mistakes and correct them.

The responses further point out that the teachers (59%, 47) found themselves barely competent in helping their students in making science model.

Table 4.1 also indicates that biology teachers (63%) were incompetent in arranging field trips to find solutions to students' questions. This they stated during the interview as due to financial constraints and overloaded curriculum.

ODCT said: Here the students don't have money to pay transportation and the school even getting materials to teach is a problem so I don't organise field trip at all. Also the syllabus is too loaded if students should go out as the curriculum demands I can't complete it.

But the importance of field trips cannot be overruled because field trips can provide students with meaningful contexts where they can connect their knowledge with the natural world and see examples and practical applications of scientific concepts or processes (Tytler, 2002). For example, Scherf (as cited in Cimer, 20O7) investigated the effectiveness of field trips on students' achievement and attitudes, and found that the students who participated in the lessons outside the classroom, demonstrated significantly greater ability to recognize plants than the students who studied plants only in the classroom. However, fieldwork is not always possible due to a limited teaching budget and increasingly busy curricula (Cimer, 2007). For

example, Killerman (1998) reported that the use of living animals including the earthworm, the darkling beetle and the house spider in biology lessons positively influenced students' attitudes and increased their knowledge about the animals. He pointed out that it was because the students found working with the living insects more motivating which in turn led to effective learning.

The absence of this practice in our school creates a deficiency in biology teaching. Suryawati, *et. al.* (2010) also pointed out that problem solving, arranging group discussion, and provision of opportunities of learning from environment and daily life were essential teaching competencies for producing problem solving abilities in students.

The study further revealed that biology teachers (19%, 15) were incompetent in making a botanical garden which is a curricula requirement for biology teaching at the SHS level. The CRDD (2010) recommends that the school should establish a small botanical garden. The teachers attributed this failure to their own inability to establish one and also availability of land for the garden. But Edet (as cited in Bello, 2015) revealed that student taught in ecological garden (outdoor laboratory) performed better than those taught outside ecological garden. This is because students were taught directly from natural objects with the help of equipment of ecological studies. From Fig. 3.4, 90% of the respondents were professional teachers, with their competence average mean score which was between 3.24 (SD= 1.05) to 4.58(SD= .57) indicate their high level of competence.

The result is in line with the findings of Akenroye (as cited in Arinde, 2010) that professional teachers are able to teach better because they possess, through training, the following qualities:

(a) skilfulness and ability to adjust to conditions of the society;

(b) love of the job and ability to solve simple problems in the school;

(c) good memory and high intelligence; and

(d) social responsibilities.

Another indicator of a teacher quality is a teacher's teaching experience. If teacher learning of a subject accumulates with long years of teaching, experienced (long serving) teachers should be more effective in improving students' achievement, than newly trained teachers Khatoon et. al, (2014). In this study 60% (48) of respondents had more than five years of teaching experience as shown in Fig.4.3. Also experienced teachers have a richer background of experience to draw from and can contribute insight and ideas in the course of teaching and learning. They are also open to correction and are less dictatorial in classroom. Students taught by more experienced teachers are likely to achieve at a higher level, because their teachers have mastered the content and acquired classroom management skills to deal with different types of classroom problems Gibbons et al. (as cited in) Many empirical studies have indeed shown a significant and positive relationship between number of teaching years and students' achievement (Rice, 2003). The study nonetheless, revealed that there is no significant relationship between biology teachers' teaching experience and their competence. The finding agree with Kamar (2007) who reported that lack of experience with equipment is not constraining factor in the conduct of laboratory practical according to 50% of teachers. However teachers who had taught biology for 3-5 years (4.10, SD=.41) were found to be more competent than those who had taught biology for 6 years and above (3.94, SD=.35). It could be stated that the subjects of this study constituted mainly of experienced teachers. The subjects consisted mainly of experience teacher (60). Therefore, it is expected that they would

use their experience as professional biology teachers to organize biology practical work in their schools.

Biology teachers must be equipped with subject matter knowledge to be able to handle practical work effectively.

Findings related to teachers' academic degrees (for example; bachelors or masters among others) are inconclusive. Some studies suggest positive effects of advanced degrees (Rice, 2003; Wayne & Youngs, 2003). Some argue that the requirement of a second degree raises the cost in terms of teacher education and the time it involves and may prevent quality candidates from choosing this profession (Murnane, 1996). The study revealed that second degree holders were more competent than first degree holders with their mean score of 4.04 and 3.99 respectively. This findings supports Bello (2015) who found that only teachers with M.Sc./M. Sc. Ed are good in positioning laboratory equipment during practical work, while other teachers had mean scores less than 1.5 which means they are poor in positioning laboratory equipment during practical work. The study further revealed that there is a significant relationship between the competences of male biology teachers in organization practical work and their female counterparts (0.01<.05)

Attitudes of SHS biology teachers towards practical work

From the analysis, it was observed that biology teachers had a general positive attitude towards practical work. In the responses majority (99%) were positive about biology practical work. The responses ranged between 83% and 99%, which should impact on their practices. Researchers Swindoll; Abraham (as cited in Butt & Shams, 2013) claim that attitude is more important than experience in academic preparation.

This is in line with Butt and Shams (2013) claim that teachers attitude plays an important role in developing the students' attitude. This is because attitude influences the success or overall performance of teachers. The qualitative data revealed that their students have a positive attitude towards practical work. This supports Sharpe (2012) findings which suggested that secondary students' attitudes to practical work are, generally speaking, positive. This can be attributed to their teachers' positive attitude towards biology practical. As revealed by the study.

The study further suggests that there is no significant relationship between the male biology teachers' attitude towards practical work (4.45, SD=.36) and the female (4.40, SD=0.38). This was revealed by their mean score, however, the male teachers had more positive attitude towards practical as compare to females.

The quantitative results also shows that majority 70% (56) out of the total respondents of 80 had had in-service training while 30% (24) had had no in-service training as shown in Fig.4. 8. Even though the majority (70%, 56) of the respondents had in-service training in the teaching of biology the situation where 30% (24) had never attended an in-service training seemed not too good, since it could have an impact on the way biology practical lessons are organized in those schools. Fagbemi and Abiri (as cited in Sharpe, 2012) in their respective studies agreed that high quality teachers through professional training will eventually ensure a high quality job. The respondents who have not had in-service training attributed the situation to the rotational system the GES and the schools employ whenever in-service training is organized for teachers. GES and headmaster must ensure effective in-service for all teachers more especially science teacher. The distribution of in-service training of teachers is shown in Figure 4.8.

The study also indicated that there is a significant relationship between attitude of biology teachers who had taught biology between 3-5 years and those who had taught biology for 6 years and above with their significant level of 0.02 which is less 0.05.

The study revealed that there is significant relationship between the attitudes of biology teacher who had had in-service training (4.51) and those who had no in-service training (4.27) with a significant value of 0.005. The mean score however, indicates that those who had in-service training had more positive attitude towards practical work.

Practices of biology teachers

Majority of the teachers (99%) supervised their students during practical this according to Bello (2015), good and effective supervision of instruction enhances better performance on the part of students, maintain standard in schools and make possible the achievement of objectives of schools and schooling. These finding confirms the position of Lawal (2003) who strongly maintained that supervision of instruction guided each individual teacher within the school system to perform the duties for which he was scheduled and to improve the effectiveness of teachers so that he can contribute maximally to the achievement of system goal.

Most of the responses at first phase show that biology teachers provide immediate feedbacks to students when they need direction to proceed, but the interview and analysis of students' workbooks and observation revealed that teachers do not provide immediate feedback to students. This situation they attributed to large

class size with limited time for the practical lesson and lack laboratory technician to assist them.

> For example DCT had this to say: Honestly, no, for most of the time I do mark but usually not immediately. Sometimes too I randomly sample and marked to know the common mistakes and correct them.

This DCT earlier attributed to large class size, time and workload. But according to Ip (2005) an important dimension of feedback is its immediacy. The longer the time gap between the completion of the work and its feedback, the less effective the feedback becomes. Studies of researchers such as Ajayi (as cited in Gbore & Daramola, 2013), revealed that no significant relationship exists between teachers workload and students' academic achievement while Kolawole (as cited in Gbore and Daramola, 2013) found that a negative relationship exists between the academic performance of students and class size, but Walberg (as cited in Owoeye & Yara, 2011) argued that a significant and consistent relationship exists in the academic achievement of students in small classes of between 1-20 students that obtained higher scores in science tests than their counterparts in large classes of more than 20 students. The rate of interaction between teachers and students in the classroom where students' population is far above the normal (35) or recommended number of pupils per class by Ghana Education Service would be very stressful. A situation where sixty or more students are packed in one classroom does not provide for effective conduct of practical activities in the laboratory. In situation as this, work might be cumbersome for the teachers in terms of attending to individual student's needs, marking students' class work, home-work / assignments, hence, the teacher may decide to continually reduce the amount of practical lessons that should be given

to the students to avoid been stressed. The over loading of teachers with congested classes would invariably end up in high reduction of efficiency while students' performance bears the consequences. Olaleye (2006) also claimed that some schools have the problem of overcrowded classroom. This has serious implication for academic performance of the students. Teacher competence in organization of practical work involves planning learning activities, preparing learning materials, using time and keeping general order. This implies that for effective use of feedback GES must ensure its policy of 20 students to a teacher and also organize in-service training for teachers on how to provide immediate feedback.

Although most of the teachers (73%) indicated in the first phase, they often organize group work, observation of lessons and student workbook revealed that teachers hardly organize group work if not at all. The teachers' reason was that it allows individuals to inactively participate during the learning process. But studies indicate that group work is essential in practical lessons. For example Toplis (2012) reported, group work in practical work can influence positive affection to practical work where there is a sense of togetherness to which there were similar responses. Also, Dr William Glasser, who specializes in educational counselling, has estimated that we remember 10% of what we read, 20% of what we hear, 30% of what we see, 50% of what we see and hear, and 70% of what we discuss with others (Bakke, 2005). Also Phillips and Germann (2002) said that working in groups help student to be rational and respect the different opinions, try to find the right alternative and be more sensitive. Therefore, teachers must ensure group work in their teaching. This suggests that Biology teacher must integrate group work in their instructional practices.

Furthermore, the study showed clearly, that majority (86% see Table 4.3.) of the respondent indicated that, the theory students learn in Biology is related to the

practical they perform. Also the study revealed that even though there is equipment for practical work, it is not enough for the large class size. Biology teachers must, therefore, incorporate group work to ensure effective organization of practical.

Additionally from the two observed lessons, biology teachers provide appropriate equipment for Biology practical and also grant students the opportunity to handle equipment in the laboratory. The teachers (99%) assert that equipment in the Biology laboratory give accurate results which enhance their teaching. This attests to Ciroma and Bakori (2010) claim that working in science laboratory can only be possible if there are sufficient pieces of equipment for experiment. To them laboratory equipment is the key to any practical work, which promotes long term memory in students, enhances pupils' development of the ethical dimension of science, instils the spirit of collaboration and active participation among learners, exposes learners to scientific experiences that could ultimately help them in developing scientific attitudes and skills and inculcate in the students the spirit of inquiry and scientific mode of thinking.

In designing an experiment, biology teachers (63%) design experiment for their students during practical which refute majority of the teachers (65%) claim that they allow their students to perform experiment base on WAEC past questions and from GES approved textbooks. This is in line with Copriady, (2014) claim that teachers must be able to design and develop experiments to perform better practical in teaching.

The research further indicated biology teachers had enough specimens and also improvised materials for teaching biology. Data from the questionnaire indicated that teachers taught theory before students perform practical. But from the observation

and interview, respondents either taught theory before practical or sometimes the practical before theory or sometimes mixed both theory and practical. But the biology syllabus indicates clearly teaching of theory before scientific inquiry skills which are the practical lesson. Also, according to Albert, Osman and Yungungu (2014) practical work help students to put what they learned in theory into reality thus, making practically livelier. This implies biology teacher must teach theory before students perform practical. The research further indicated biology teachers had enough specimens, design and develop experiments to perform better practical and also improvised materials for teaching biology.

The relationship between SHS biology teachers' competence and attitudes towards biology practical work on their practices?

The result of the bivariate pearson correlation which was used to test the null hypothesis indicated that there is a perfect relationship between biology teachers competence and attitudes towards practical on their practices r was 1 (Table 4.4). The correlation was significant at the 0.01 level. This implies there is statistically significant relationship between competence, attitudes and practices of the respondent.

Correlation between the background variables and the three constructs (Appendix F) revealed that there is significant relationship between sex of respondents and their competence in organising practical work. The correlation coefficient value, r was -.29 at a significant level of 0.01. Also there was a significant relationship between years of teaching experience and attitude of respondents. The correlation coefficient was -.26 and the significant level was 0.05. Studies on the effect of teacher experience on student learning have found a positive relationship between teachers' effectiveness

and their years of experience. The evidence available suggests that inexperience teachers are less effective than more senior teachers (Rivkin, Hanushek, and Kain, 2000). However there was no correlation between the other background variables such sex, academic qualification, area of specialization and the other constructs.

Further analysis of the result revealed that there is significant relationship between in-service training of biology teachers and their attitude towards practical work at a significant level of 0.01 with correlation coefficient of -.31. This implies that for effective practical lessons in the SHS level biology teacher needs training on the job to able to conduct practical work. A study on in-service professional development has found positive relationship between teachers' effectiveness and pupils' achievement. Wenglinsky (2000) found a positive effect of professional development on students' achievement. Coonen (as cited in Wambugi, 2014) emphasizes that teachers involved in in-service training were more effective in classrooms as compared to teachers who had not undergone training.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATION

Overview

In this chapter, a summary of the major findings of the research, the conclusion and recommendations are presented in addition to suggestions for further studies. The study was to determine how the attitude of biology teachers and their competence affect practical activities.

Summary of the Study

This section focuses on the summary of the major findings of this study. It includes a summary of the biology teachers' competence in organizing practical work, their attitudes towards practical and their practices during practical work. Findings about the relationship between biology teachers' attitudes, competence and their practices have also been presented.

Main findings of the study

1. The study indicated that majority (mean score 3.24 - 4.58, SD=1.05-.57) of the teachers teaching biology were competent in organising practical work Table 4.1.
2. The study further indicated that majority (82% - 100%) of the respondents had positive attitude towards practical work.
3. The study also revealed that biology teachers employ good practices in their teaching.
4. Testing of the research hypothesis revealed that there is significant relationship between respondents' competence, attitude and their practices.

5. The study revealed there is a significant relationship between biology teachers' sex and attitude, in-service training and attitude and years of teaching experience and attitude.
6. However, biology teachers were partially competent in arranging field trips and making a botanical garden in their schools to teach biology.
7. In addition, biology teachers were found to have positive attitudes towards biology teaching.
8. Finally, the findings indicated some challenges biology teachers faced in connection with biology practical such as large class size and lack of trained laboratory technicians.

Conclusions

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

There is significant relationship between biology teachers' competence and attitudes towards practical work and their practices in the Eastern Region of Ghana. Also there is a significant relationship between biology teachers' in-service training status and their attitude towards practical work.

Finally, biology teachers sometimes overlook some of the practices associated with practical work, such as organizing field trips, making botanical garden, organizing group work and providing immediate feedback of the activities to students.

Recommendations

Base on the findings of this study, the following recommendations were made:

1. Biology teachers in SHS must be encouraged in order to sustain the competence and positive attitude they exhibit towards practical work in the Eastern Region of Ghana.

2. Stakeholders in education such as GNAT, NAGRAT, GAST and GES should be motivated to continue organising in-service training for biology teachers in the Eastern Region of Ghana.
3. As much as possible teachers should make botanical gardens in their various schools to enhance teaching and learning of biology.
4. School authorities should employ qualified laboratory technicians to assist biology teachers in organizing practical work.

Suggestions for Further Studies

The following suggestions were recommended for further research:

1. This study was limited to only SHS in the Eastern Region of Ghana so further research can be carried out among SHS in other regions.
2. A research could also be carried out to find out whether the Qualifications and Area of Specialisation of the teacher have any influence on organization of biology practical work so that an appropriate decision could be taken.
3. A study could also be conducted to find out whether teacher competence in practical work has an influence on students attitude towards practical work.

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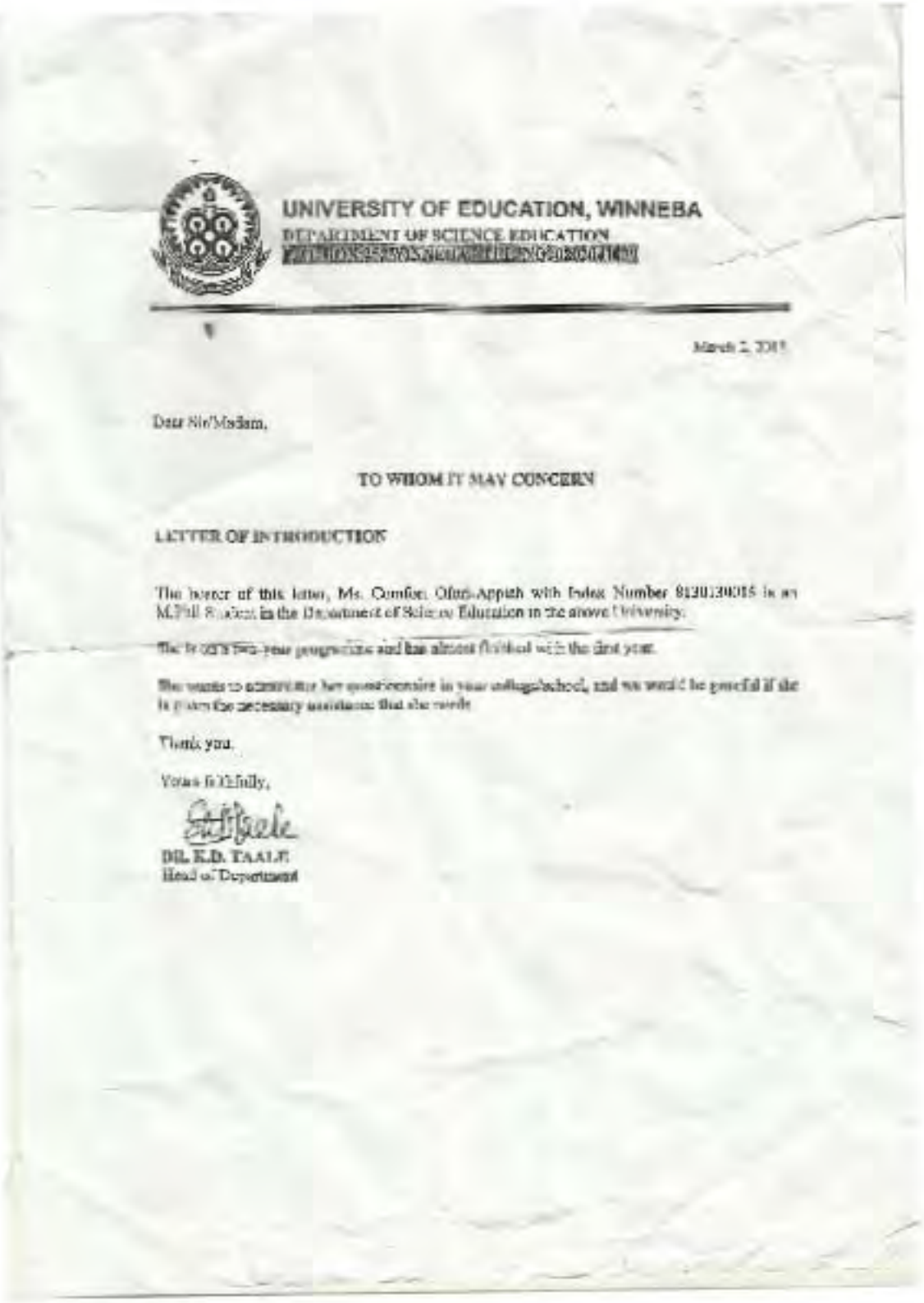
APPENDIX A



UNIVERSITY OF EDUCATION, WINNEBA
DEPARTMENT OF SCIENCE EDUCATION

March 2, 2015

Dear Sir/Madam,

TO WHOM IT MAY CONCERN

LETTER OF INTRODUCTION

The bearer of this letter, Ms. Comfort Ofori-Appiah with Index Number 8130130015 is an M.Phil Student in the Department of Science Education in the above University.

She is on a two-year programme and has almost finished with the first year.

She wants to administer her questionnaire in your college/school, and we would be grateful if she is given the necessary assistance that she needs.

Thank you.

Yours faithfully,

DR. E.D. TAALI
Head of Department

APPENDIX B

UNIVERSITY OF EDUCATION, WINNEBA.

QUESTIONNAIRE FOR THE BIOLOGY TEACHERS

Dear Respondent,

This study is purely for academic purposes. You will be contributing to its success if you answer the item as frankly and honestly as possible. Your responses will be kept confidential. Moreover, your anonymity is assured by neither writing your name nor indicating your school. Kindly read through each of the items carefully and indicate the opinion that is the nearest expression of your view on each of the issues raised.

General instruction

Please tick [√] the appropriate bracket or column or fill in the blanked spaces where necessary.

SECTION A: BIO DATA

Sex:

Male [ ] Female [ ]

Age:

Below 20yrs [ ] 26-30yrs [ ] Above 30yrs [ ]

1. How long have you been teaching biology?

3-5yrs [ ] 6-8yrs [ ] 9-11yrs [ ] 12-13yrs [ ] above 14yrs [ ]

2. What is your academic qualification?

(a) Diploma [ ]

(c) 1st Degree [ ]

(e) 2nd Degree [ ]

3. What is your area of specialization?

(a) Biology (b) Chemistry (c) Physics

(d) Any other, specify ……

4. What is your professional status?

(a) Professional [ ]

(b) Non-professional [ ]

5. Have you ever had any in-service training in the teaching of biology?

(a) Yes (b) No

6. Who organizes the in-service training programme?

(a) GES [ ] (b) GAST Organizers [ ]

(c) Any other, specify ……..

SECTION B

QUESTIONNAIRE FOR BIOLOGY TEACHERS IN SHS

This questionnaire contains statements about attitudes towards Biology practical. Each statement is followed by five responses with corresponding weight;

Strongly agree=5; Agree=4; Neutral=3; Disagree=2; Strongly disagree=1

There is no "right" or "wrong" responses. Your feeling about each statement is what is important. Tick [√] the appropriate column under the response that expressed your opinion about the item. Be sure to respond to all items. If you change your mind about your response to an item, just cross it out [√] and tick another.

Some statements in this questionnaire are fairly similar to other statements,

don't worry about this. Simply give your opinion about each of the statements.

QUESTIONNAIRE ON BIOLOGY TEACHERS COMPETENCE LEVEL IN ORGANIZING PRACTICAL

Item	Statement I have competence in :	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	Giving clear explanation before practical work.					
2	Demonstrate experiments before students carryout experiment.					
3	Helping students to write report on experiment .					
4	Collecting animals and plants for biology teaching.					
5	Helping students in making science models.					
6	Arranging field trips for finding answers to students' questions					
7	Making botanical garden in school for teaching biology					
8	Using interactive white board for labelling diagrams.					
9	Linking lesson with past experience.					
10	Linking concrete and abstract experiences of students.					
11	Using internet to gather information for students.					
12	Defining problem (topic) in simple language.					
13	Handling equipment.					

QUESTIONNAIRES ON TEACHERS ATTITUDE TOWARDS BIOLOGY PRACTICAL

	Statement	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
1	I like biology practical					
2	I wish I don't have biology practical so often					
3	Biology practical helps me to teach the theory well in class					
4	Biology practical motivates students					
5	I like to expose my students more to science equipment during practical					
6	I like working with science equipment despite the problems I have when using them					
7	Biology practical make me appreciate biology better.					
8	Writing up Biology practical is a very useful exercise to me					
9	Biology practical help me acquire scientific skills					
10	Biology practical is boring					

QUESTIONNAIRE ON TEACHER PRACTICES ON BIOLOGY PRACTICAL

	Statement	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
1	I supervise what students do during practical.					
2	At school, I teach the theory before students perform the practical.					
3	I allow students to work in groups during practical lessons.					
4	I give students immediate feedback when they need directions to proceed.					
5	The theory lessons are not related to the practical.					
6	I organize group work because there is no enough equipment.					
7	I don't go round to supervise students during practical					
8	I provide the appropriate equipment/materials for Biology practical.					
9	Students perform Biology practical in the school laboratory without any guidance					

	Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
10	There are no equipment or materials in the school laboratory so I don't organise Biology practical.					
11	students don't get the opportunity to handle every equipment in our school laboratory					
12	The equipment in the Biology laboratory give inaccurate result so I don't organize Biology practical					
13	I allow students to design their own experiment during biology practical					
14	I allowed the students to perform experiment based on WAEC past questions					
15	I select practical tasks from GES approved textbooks					
16	I have enough specimens for biology practical					
17	Where there are no materials I improvise					

APPENDIX C

OBSERVATION CHECKLIST

Date..... Location of School.....

Time of Observation..... Start..... End.....

Class..... Teacher's Gender.....

Number of Students.....

Number of Boys..... Number of Girls.....

A Laboratory Context: Rate the adequacy of the physical environment.

1. Laboratory resources:

   Rich in resources..... Sparsely equipped.....

   Comments.....

2. Laboratory space:

   Crowded..... Adequate space.....

   Comments.....

3. Laboratory arrangement:

   Inhibits interaction among students..... Facilitate interaction.....

   Comments.....

B. Laboratory Activities during Practical Lesson

1. Does the teacher set-up practical for students?

   ……

   ……

2. The teacher supervise students while performing practical task……

……

3. Teacher teaches theory before practical is organized……

……

4. Teacher provides enough materials/ equipment during practical lesson……

……

5. Students work in groups during practical lesson……

……

6. Teacher marks students work and provide immediate feedback……

……

7. Teacher guides students during biology practical lesson……

……

8. Students follow biological rules in their drawing……

……

9. Students are given enough time to complete the task……

……

10. Student use the right equipment during

    practical……

    ……..

APPENDIX D

SEMI-STRUCTURED INTERVIEW PROTOCOL USED TO INTERVIEW BIOLOGY TEACHERS.

1. Why practical work in the teaching and learning of biology?

2. What challenges do you face during biology practical work?

3. Did you use practical activities to help them understand the theory?

4. Did you teach practical work as a basis for the theory work or you teach the theory and you let students go and verify

5. Did students do their write-ups in the laboratory?

6. How much emphasis is put on practical work?

7. Did you organised practical for all the classes you teach i.e form one, two and three?

8. What purpose does practical work play in the teaching and learning of biology?

9. Did you have enough apparatus for practical work?

10. Are you able to mark and provide immediate feedback to students?

APPENDIX E

RELIABILITY (Cronbach's Alpha Table for items)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.703	.509	13

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
COMPETENCE 1	42.8500	49.187	-.022	.700	.713
COMPETENCE 2	43.1500	52.871	-.402	.615	.744
COMPETENCE 3	43.1500	51.187	-.239	.688	.732
COMPETENCE 4	43.2500	49.671	-.088	.813	.722
COMPETENCE 5	44.1500	39.187	.609	.695	.646
COMPETENCE 6	43.8500	49.713	-.103	.712	.735
COMPETENCE 7	45.3000	42.432	.574	.736	.664
COMPETENCE 8	43.2000	51.011	-.187	.828	.746
COMPETENCE 9	44.3000	33.379	.699	.910	.613
COMPETENCE 10	43.9000	30.305	.881	.957	.568
COMPETENCE 11	44.1000	31.989	.825	.895	.587
COMPETENCE 12	43.8500	32.029	.786	.922	.593
COMPETENC 13	43.1500	46.555	.205	.751	.699

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.650	.752	10

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
ATTITUDE 1	34.2000	16.379	.450	.690	.616
ATTITUDE 2	34.2000	16.063	.355	.635	.620
ATTITUDE 3	34.8500	14.555	.491	.840	.588
ATTITUDE 4	35.3000	14.011	.376	.360	.612
ATTITUDE 5	34.8500	16.661	.443	.441	.621
ATTITUDE 6	35.1500	14.871	.337	.567	.620
ATTITUDE 7	35.9500	15.524	.133	.556	.686
ATTITUDE 8	34.9000	17.253	-.017	.404	.715
ATTITUDE 9	33.8500	16.029	.629	.741	.601
ATTITUDE 10	34.1500	14.029	.678	.836	.556

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.626	.552	17

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
PRACTICE 1	50.0000	38.842	-.155	.941	.643
PRACTICE 2	49.8500	38.555	-.116	.884	.638
PRACTICE 3	50.1000	38.200	-.058	.747	.640
PRACTICE 4	50.2000	35.116	.370	.915	.602
PRACTICE 5	52.8000	29.537	.560	.709	.552
PRACTICE 6	50.8500	34.345	.143	.921	.632
PRACTICE 7	53.1500	40.029	-.233	.700	.673
PRACTICE 8	50.3000	37.379	.037	.941	.633
PRACTICE 9	52.7500	30.197	.384	.975	.584
PRACTICE 10	53.1500	30.661	.679	.972	.550
PRACTICE 11	53.0000	27.789	.654	.956	.528
PRACTICE 12	53.0500	29.103	.663	.980	.537
PRACTICE 13	52.2000	29.537	.555	.851	.553
PRACTICE 14	50.8000	38.063	-.069	.302	.653
PRACTICE 15	50.4000	37.621	.000	.888	.637
PRACTICE 16	51.1500	35.397	.130	.886	.628
PRACTICE 17	50.6500	37.292	.022	.952	.637

APPENDIX F

Correlations

		sex	attitude scale
Sex	Pearson Correlation	1	-.069
	Sig. (2-tailed)		.541
	N	80	80
attitude scale	Pearson Correlation	-.069	1
	Sig. (2-tailed)	.541	
	N	80	80

Correlations

		sex	competence scale
Sex	Pearson Correlation	1	-.288**
	Sig. (2-tailed)		.010
	N	80	80
competence scale	Pearson Correlation	-.288**	1
	Sig. (2-tailed)	.010	
	N	80	80

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

		sex	practice scale
sex	Pearson Correlation	1	-.109
	Sig. (2-tailed)		.337
	N	80	80
practice scale	Pearson Correlation	-.109	1
	Sig. (2-tailed)	.337	
	N	80	80

Correlations

		Age	attitude scale
Age	Pearson Correlation	1	.064
	Sig. (2-tailed)		.570
	N	80	80
attitude scale	Pearson Correlation	.064	1
	Sig. (2-tailed)	.570	
	N	80	80

Correlations

		Age	competence scale
Age	Pearson Correlation	1	.184
	Sig. (2-tailed)		.103
	N	80	80
competence scale	Pearson Correlation	.184	1
	Sig. (2-tailed)	.103	
	N	80	80

Correlations

		Age	practice scale
Age	Pearson Correlation	1	.100
	Sig. (2-tailed)		.379
	N	80	80
practice scale	Pearson Correlation	.100	1
	Sig. (2-tailed)	.379	
	N	80	80

Correlations

		duration of teaching	attitude scale
Years of teaching experience	Pearson Correlation	1	-.261*
	Sig. (2-tailed)		.020
	N	80	80
attitude scale	Pearson Correlation	-.261*	1
	Sig. (2-tailed)	.020	
	N	80	80

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations

		duration of teaching	competence scale
Years of teaching experience	Pearson Correlation	1	-.156
	Sig. (2-tailed)		.167
	N	80	80
competence scale	Pearson Correlation	-.156	1
	Sig. (2-tailed)	.167	
	N	80	80

Correlations

		duration of teaching	practice scale
Years of teaching experience	Pearson Correlation	1	-.096
	Sig. (2-tailed)		.399
	N	80	80
practice scale	Pearson Correlation	-.096	1
	Sig. (2-tailed)	.399	
	N	80	80

Correlations

		Academic qualification	attitude scale
Academic qualification	Pearson Correlation	1	-.100
	Sig. (2-tailed)		.375
	N	80	80
attitude scale	Pearson Correlation	-.100	1
	Sig. (2-tailed)	.375	
	N	80	80

Correlations

		Area of specialization	practice scale
Area of specialization	Pearson Correlation	1	-.040
	Sig. (2-tailed)		.723
	N	80	80
practice scale	Pearson Correlation	-.040	1
	Sig. (2-tailed)	.723	
	N	80	80

Correlations

		Area of specialization	practice scale
Area of specialization	Pearson Correlation	1	-.040
	Sig. (2-tailed)		.723
	N	80	80
practice scale	Pearson Correlation	-.040	1
	Sig. (2-tailed)	.723	
	N	80	80

Correlations

		professional status	practice scale
professional status	Pearson Correlation	1	-.110
	Sig. (2-tailed)		.331
	N	80	80
practice scale	Pearson Correlation	-.110	1
	Sig. (2-tailed)	.331	
	N	80	80

Correlations

		in-service training	attitude scale
in-service training	Pearson Correlation	1	-.310**
	Sig. (2-tailed)		.005
	N	79	79
attitude scale	Pearson Correlation	-.310**	1
	Sig. (2-tailed)	.005	
	N	79	80

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

		in-service training	competence scale
in-service training	Pearson Correlation	1	-.156
	Sig. (2-tailed)		.169
	N	79	79
competence scale	Pearson Correlation	-.156	1
	Sig. (2-tailed)	.169	
	N	79	80

APPENDIX G

Analysis of Observation Schedule

Percentages of Observation of Teachers Behaviour

Behaviour (Percentage)	**DCT freq. (percentage)**	**ODCT freq.**
Setting of practical		1 (100%)
Supervision	3 (100%)	3 (100%)
Provision of Materials	4 (100%)	2 (50%)
Procedure	0	1 (50%)
Provision of feedback	0	1 (100%)
Explanation	2 (100%)	2 (100%)