UNIVERSITY OF EDUCATION, WINNEBA

AN INVESTIGATION INTO THE STATUS OF BIOLOGY PRACTICAL ACTIVITIES IN DESIGNATED MATHEMATICS AND SCIENCE COLLEGES OF EDUCATION IN THE VOLTA REGION, GHANA

DANIEL KWADZO AHADZI

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DANIEL KWADZO AHADZI

(7140130035)

A DISSERTATION 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 THE AWARD OF THE DEGREE OF MASTER OF EDUCATION IN SCIENCE

JANUARY, 2017

DECLARATION

STUDENT'S DECLARATION

I, Daniel Kwadzo Ahadzi, 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 SUPERVISOR: Dr. Joseph Nana Annan

SIGNATURE: ……

DATE: ……

DEDICATION

This work is dedicated to Almighty God, to my wife, Ernestine Azameti and also to my children: Judith, Josephine, Janet, Julius and Joshua Ahadzi.

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ABBREVIATIONS

CAL	Computer Assisted Learning
COE	Colleges of Education
FDC	Foundation Course
MSCoE	Mathematics and Science Colleges of Education
NCTE	National Council for Tertiary Education
TED	Teacher Education Division
DBE	Diploma in Basic Education

ABSTRACT

The study was conducted to investigate Biology practical activities in some selected Mathematics and Science Colleges of Education (MSCoE). The sampled population for the study consist of 125 students and 5 tutors from two selected Mathematics and Science designated Colleges of Education in the Volta Region; St Francis College of Education and Akatsi College of Education. The instruments used were questionnaires and observation. Data collected was analyzed using frequency counts and percentages. The research findings showed that both teachers and students from the selected Colleges of Education considered practical lessons as one of the effective means of teaching and learning science. It also came out that, both Colleges have science laboratories that were not adequately equipped with equipment and materials. Again, the study revealed that, students‟ participation in science practical lessons was mostly through the demonstration instead of the hands-on activity. This had adverse effect on students‟ understanding and experience in hands-on activities. Inadequate laboratory resources and less time allocation for practical lessons were identified as the major challenges associated with Biology practical lessons. To ensure efficiency in the teaching of the practical aspect of science in the MSCoE, the study recommends that government and all stake holders in education must supply laboratories in the studied Colleges of Education with the necessary equipment, materials and chemicals to enable trainee teachers to develop the necessary skills, attitudes and interest in science.

CHAPTER ONE

INTRODUCTION

Overview

This chapter was organised under the following: Background to the study, statement of the problem, purpose of the study, significance of the study, research questions, delimitations of the study, limitations of the study and organisation of the study.

Background to the Study

With respect to the history of education, science has held its leading position among all school subjects because it is considered to be an indispensable tool in the development of the educated person. The word „science" is variously used in ordinary discourse in English to refer to a product (a body of knowledge) a process (a way of conducting enquiry) an enterprise and an institutionalised pursuit of knowledge of the material world. Millar (2004) argued that the school science curriculum mostly, has two distinct purposes : it aims at scientific literacy and a steady supply of new recruits to jobs requiring more detailed scientific knowledge and expertise and also provides the foundations for more advanced study leading to such jobs.

The aims of science education might then be summarised as:

1. To help students gain an understanding of much of the established body of scientific knowledge as it is appropriate to their needs, interests and capacities.
2. To develop students" understanding of the methods by which this knowledge has been gained, and offer grounds for confidence in it (knowledge about science).

It is often argued that practical work is central to teaching and learning in science and that a good quality practical work helps to develop pupils‟ understanding of scientific processes and concepts. Practical work involves learning experiences in which students interact with materials or with secondary sources of data to observe and understand the natural world.

Practical work, both in the classroom and outdoors, is absolutely an essential component for effective College Biology teaching. Appropriate practical work enhances pupils‟ experience, understanding, skills and enjoyment of science, (Lord & Orkwiszewski, 2006).

There is also evidence that students find practical work relatively useful and enjoyable as compared with other science teaching and learning activities. This was supported by survey responses of over 1,400 students of a range of ages, in which Cerini, Murray & Reiss (2003) found out that 71% chose „doing an experiment in class as one of the three methods of teaching and learning science they found „most enjoyable‟. A somewhat smaller proportion (29%) selected it as not one of the three methods of teaching and learning science they found „most useful and effective

The importance of practical work in science is widely accepted and it is acknowledged that quality practical work promotes the engagement and interest of students as well as developing a range of skills, science knowledge and conceptual understanding.

There are many purposes for doing practical work in college Biology. Some of the most frequently stated purposes by teachers are to; encourage accurate observation and description; make phenomena more real; arouse and maintain interest and promote a logical reasoning method of thought.

According to Rosser-Cox (2011), teacher education refers to the policies and procedures designed to equip prospective teachers with the knowledge, attitudes, behaviours, and skills they require to perform their tasks effectively in the classroom, school and wider community.

To ensure the achievement of these objectives, teacher education is based on the following principles:

(i) To prepare teachers to function effectively in the basic schools.

(ii) To provide a comprehensive teacher education programme through pre-service and in-service training that would produce competent, committed and dedicated teachers to improve the quality of teaching and learning at the basic education level and also to develop school based support for teachers.

The core function of teacher education is the management and implementation of in-service teacher education and training through up-dating of knowledge and skills on innovative pedagogy. To accomplish these tasks effectively, Colleges of Education in Ghana were supplied with well organised, structured and comprehensive syllabi and course outlines in all subjects including Biology. These serve as guides towards the impartation and reception of knowledge appropriately and expectedly.

In order to ensure proper organisation and improvement of practical activities in College Science teaching, the Government of Ghana in collaboration with the Ministry of Education (MOE) and the Teacher Education Division (TED) through the Ghana Education Trust Fund (GETFund) have put up modern Science laboratories in all the 15 designated Mathematics and Science Colleges of Education across the country. Models

(Biological) and modern laboratory equipment were also supplied to facilitate proper implementation of the Science (Biology) programme.

Since the inception of the Diploma in Basic Education Program in the Colleges of Education, chief examiners‟ reports from the Institute of Education of the University of Cape Coast have consistently commented on poor performance of students in Integrated Science, a course of which Biology forms an integral part. (Integrated Science Chief Examiner‟s Report UCC, 2013) This low performance has also been evident in the elective Biology aspect of Mathematics and Science Colleges of Education. Most students failed to perform well or obtained low quality grades in Biology as well. In addition, the way the Biology practical work is organised in these colleges is of a great interest and worth investigating. To investigate biological phenomenon effectively, it is required that students possess the requisite skills of observation, critical thinking and appreciation, perform experiments competently; record and interpret data accurately. It was against this background that this study was conducted to investigate the conduct of Biology practical work in selected Colleges of Education in the Volta region of Ghana.

To ensure a continuous supply of science teachers to the basic schools, 15 out of the existing 38 public Colleges of Education in Ghana were designated in 2007 to run a special Mathematics and Science programme. Course outlines in the various sciences (Biology, chemistry and physics) were designed to that effect and the implementation process of the programme is underway.

The preamble of the Colleges of Education elective science syllabus by Teacher Education Division (2014) supports the use of practical activities in teaching and learning

of Biology in the Colleges of Education. The programme objectives, according to TED are to enable the students to:

1. Acquire the relevant scientific knowledge on topics treated in the science programme.
2. Organise their knowledge into concepts.
3. Acquire relevant manipulative skills to enable them to handle and operate science equipment and materials.
4. Solve conceptual problems related to topics treated in the science programme.
5. Apply the knowledge and skills acquired in the science programme to the organisation of science lessons.
6. Relate the knowledge acquired in the science program to situations in everyday life.

The programme was categorized into sections that deal with content and the practical aspects in Biology, Chemistry and Physics as separate entities. Each unit (and sub-unit) comprises topics that are closely related or deal with identical or similar concepts. Such concepts are expected to be treated sequentially to enhance understanding.

However, the Biology programme, which is the focus of this study, has its own description and objectives. As provided by TED, the Biology programme was designed to consolidate the content and skills students have acquired from their lessons in elective and Integrated Science. (Biology) at the Senior High School (SHS) level. It also reflects the topics treated at the Basic school level.

The Biology aspect was sub-divided into Biology 1 (FDC 114B and FDC 114BP) which are theoretical and practical aspects respectively to be studied in year one semester one;

and Biology 2 (FDC 124B and FDC 124BP) which are theoretical and practical aspects respectively, to be studied in the second semester of the first year.

The Biology 3 (FDC 214B and FDC 214BP) which are theoretical and practical aspects respectively, to be studied in the first semester of the second year.

The first year Biology course was designed to consolidate the content and skills students have acquired from their lessons in Elective and Integrated Science Biology at the Senior High School level.

The course covers topical areas as: Classification and naming of organisms; concept of classification; binomial system of nomenclature; cell theory; structure of flowering plants and the functions of their parts; food and nutrition in plants and animals; and digestion in humans. (Teacher Education Division, 2014).

The syllabus provides that at the end of the first semester of the first year, the learner should be able to:

Acquire knowledge in the naming and classification of organisms and the general characteristics of each of the 5 Kingdoms of living things; and cell theory.

Gain knowledge of the process of digestion in humans and also the processes of nutrition, and reproduction in flowering plants and animals.

Acquire knowledge of the structure of flowering plants and the functions of their parts.

Perform practical activities related to the different aspects of the course.

Also, the first year, second semester Biology course was designed to increase the knowledge and skills of students on topics learnt in Elective Biology and Integrated Science Biology at senior high school level. It also reflects the topics treated at the basic

school level. The course covers the following areas: Reproduction and growth in humans; Respiratory system of humans; Excretory system of humans; Circulatory system in humans; and Health and diseases.

The syllabus provides that at the end of the second semester of the first year the learner should be able to:

Acquire knowledge of the structure and functions of the respiratory, circulatory, excretory and reproductive systems in humans and also growth in humans.

Gain knowledge and understanding of the causes, symptoms, prevention, treatment/ control of diseases.

Acquire skills to perform practical activities related to the topics in the course.

In addition the second year first semester Biology course was designed to lay emphasis on the content and skills students have acquired from their lessons in integrated science at the senior high school level. It also reflects the topics treated at the basic school level. The course covers the following areas: Sexual reproduction in plants; Transport in plants; Interactions in the environment; Pollution and degradation; and Heredity/ genetics

The syllabus provides that at the end of the second semester of the second year the learner should be able to:

Gain knowledge and understanding of the movement of substances in plants and reproduction in plants.

Gain knowledge and understanding of the various interactions in the environment and also heredity.

Acquire knowledge and understanding in pollution and degradation.

Acquire skills to perform practical activities related to the topics in the course.

The syllabus stated that great importance should be given to experimental work and with control experiments. It was recommended that, whenever possible throughout the whole course candidates should be mindful of practical application of what is being studied.

From the foregoing, one can understand that Biology practical lesson is most essential for effective teaching and learning of Biology in the Colleges of Education.

This study focused on a comprehensive evaluation of the Biology practical programme, which forms part of the science programme, slated for the designated Mathematics and Science Colleges of Education in Ghana. This was to help establish the level achievement of the stated objectives of the Biology programme.

The main aim of this study was to investigate and therefore ascertain status of the Biology practical activities in the selected designated Mathematics and Science Colleges of Education in the Volta Region of Ghana. The choice of the topic was based on the fact that in 2007, the Ministry of Education, in collaboration with the Ghana Education Service, the Teacher Education Division, and the Institute of Education of the University of Cape Coast; selected and designated 15 out of the existing 38 public Colleges of Education to run a special Mathematics and Science programme according to stated aims, goals and objectives.

However, preliminary checks and systematic findings revealed that no one had investigated the Biology practical aspect of the programme since its inception. The implications of this oversight or inadvertent delay include the fact that the programme developers, implementers, (the teachers) other stakeholders and interested parties would not have any feedback on the success or otherwise of its implementation process. In effect, the quality of the students who study this programme would be questionable since

there were no empirical tests to confirm their conformity to the objectives and the demands of the programme they have studied.

The main purpose of laboratory work in science education is to provide students with conceptual and theoretical knowledge to help them learn scientific concepts using scientific methods to understand the nature of science. According to a study conducted by Tan (2008), science educators and teachers agreed that laboratory work is indispensable to the understanding of science. In the same vein, Lazarowitz and Tamir (1994) claimed that laboratory work gives students the opportunity to experience science by using scientific research procedures. This indicates that, in order to achieve meaningful learning, scientific theories and their application methods should be experienced by students. In contrast, there are concerns about the effectiveness of laboratory work in helping the students understand the various aspects of scientific investigation. (Schwartz, Lederman & Crawford, 2004).

Statement of the Problem

Although, numerous policy provisions had been made by the Government of Ghana to lay emphasis on Science Education as the engine of development of the country; its advancement has not been up to expectation, (Anamuah-Mensah, 1999). The college Biology syllabus advocates for practical approaches in the teaching and learning of Biology, but most of the teachers employed lecture approach. Inability to perform hands-on activities during teaching and learning of Biology may affect the students" performance. This act might contribute to the low level of biology practical skills and knowledge of basic school teachers who were inadequately trained in practical skills

when they were in the Colleges of Education. The seemly poor performance of students in Integrated Science of which Biology forms an integral part right from the basic schools through to the senior high schools and to the Colleges of Education, is of great concern. Therefore there is the need to investigate the Biology practical activities in Colleges of Education in Ghana.

Purpose of the Study

The purpose of the study was to investigate Biology practical activities in Mathematics and Science Colleges of Education in Volta region of Ghana.

Objectives of the Study

The study sought to critically examine the extent of the conduct of Biology practical activities in the designated Mathematics and Science Colleges of Education in the Volta Region of Ghana.

Specifically the objectives of the study are:

1. To find out the resources available for conducting Biology practical lessons.
2. To determine the extent of utilization of Biology laboratory material resource in organizing Biology practical activities.
3. To identify the challenges associated with the organisation of Biology practical lessons.

Research Questions

In order to ascertain how Biology practical work was organised in the selected Colleges of Education in the Volta region, the following research questions were addressed in the study:

1. What are the resources available for conducting Biology practical lessons?
2. What is the extent of utilization of Biology laboratory material resources in organizing Biology practical activities?
3. What are the challenges associated with the organisation of Biology practical activities?

Significance of the Study

The importance of the study cannot the overemphasized, the findings, recommendations and suggestions could be an important source of information in the selected colleges and to other Biology teachers. The study would contribute positively to teaching and learning activities to ensure maximum students participation during teaching and learning of Biology.

The study would also provide useful information to the Ministry of Education, Teacher Education Division (TED), National Council for Tertiary Education (NCTE) and other relevant stakeholders in the educational sector to undertake interventions to promote practical lessons in the Mathematics and science Colleges of Education. The study would also be a useful source of information for further research in general and also on the topic. Additionally, the findings could augment the pool of data required by other

educational researchers in their bid to design intervention to solve educational problems in the Sciences in general and Biology in particular.

Delimitations of the Study

Although there are 38 public Colleges of Education in Ghana, of which 15 have been designated as Mathematics and Science Colleges of Education. In order to ensure a good coverage, the study was restricted to only two designated Mathematics and Science Colleges of Education in the Volta region; St. Francis College of Education (FRANCO) - College A and Akatsi College of Education (AKATSICO) – College B. This was because these Colleges are involved in the implementation process of the Biology programme. In addition, the study was limited to only the second year Elective Science students at these Colleges. The first year science students were not included in the study because as at the time the actual study was conducted, they did not undergo enough Biology practical activities as compared to the second year students who had gone through Biology practical work for two semesters. The period of the study could not have given the first year students the opportunity to provide basic information required for the study.

This study was focused on the tutors‟ and students‟ verbal and non-verbal practical lesson behaviours. It did not involve their knowledge of the subject matter in the Biology programme.

Data were collected on the second year science students and their tutors. More specifically the study was centered on only the practical activities of the Biology programme and not on theory lessons and other pure science fields, such as Physics and Chemistry.

Limitations of the Study

The subjects used for the study was limited to 125 second year elective Biology students and five (5) Biology tutors from the Two (2) Colleges of Education in the Volta Region, out of the Fifteen (15) designated Mathematics and Science Colleges of Education in Ghana. The results of this study can therefore not be generalized to all the designated Mathematics and Science Colleges of Education in Ghana. However, the results of the study could be generalized to subjects that have similar characteristics in the same settings.

Organisation of the Study

The research was organised under five chapters. Chapter one presents the introduction of study consisting of the background to the study, the statement of the problem, purpose of the study and objectives of the research. It also presents the research questions, significance of the study, delimitations, limitations of the study, and the organisation of the study. Chapter two provides the theoretical framework and the review of the literature which are related to the study. Chapter three gives detail information about the methodology used in the study, describing the research design, areas of the study, the population, sample and sampling procedure, instrumentation, validity and reliability of the main instruments, data collection procedures and methods of data analysis.

In chapter four, the data collected was organised and presented in line with the research questions. The findings/results of the study have been presented in this chapter. In addition, interpretations and analysis of the findings with reference to the results of related research WORK have been presented as the discussion in this chapter. The final

chapter, chapter five provides the summary of the major findings, the conclusion of the study, recommendations and suggestions for further research work.

CHAPTER TWO

LITERATURE REVIEW

Overview

This Chapter comprises a review of relevant and related literature on the topic under investigation. A critical conceptual and theoretical framework was done to justify the need for the study under the headings and sub-headings listed below:

i. Theoretical framework
ii. Importance of Biology practical activities
iii. Resources for Biology teaching
iv. Availability of resources for Biology practicals activities
v. Importance of laboratory space in the conduct of practical work
vi. The role of the laboratory in college Biology teaching
vii. Challenges students and tutors face in connection with Biology practical- lesson

Theoretical Framework

This study is based on the theory of constructivism. Constructivists view learning as an active process whereby learners learn to discover principles, concepts and facts for themselves.

The assertion of Crawford (1996) indicated that social constructivists, such as Vygotsky, emphasized the importance of learners being actively involved in the learning process so that they can construct their own understanding. It is believed that learners with different skills and backgrounds need to collaborate on tasks, such as when they are doing practical work together in order to arrive at a shared understanding of the truth in a

specific field. The teacher according to the constructivist theory is not seen as a person who is responsible for constructing knowledge for the learners, but is rather signified by the many responsibilities given to him or her during instruction in mediating meaning at the inter-mental plane in the classrooms. Thus, the teacher‟s role becomes that of a guide provocateur, creator of opportunity and co-developer of understanding with learners. (Ritchie & Rigano, 1996). The instructional practices of Biology teachers should therefore assist learners to acquire the process skills. The work of Woolfolk (1995) also revealed that the instructor and the learners are equally involved in learning from each other. Woolfolk also asserted that learners should constantly be challenged with tasks that refer to skills and knowledge just beyond their current level of mastery. This will increase their motivation and build on their previous success, in order to enhance the confidence of the learners. This implies that learners need to do practical work so that they can be given activities that would challenge them during the practical lessons. When learners are doing practical activities, they are motivated to learn better by doing, because learners learn better by doing rather than just being taught theoretically.

In the constructivist view, learning is also a constructive process in which the learner builds an internal illustration of knowledge, and a personal interpretation of experience. Learning then becomes an active process in which meaning is accomplished on the basis of experience. Thus, educators must consider students‟ levels of cognitive development when planning topics and methods of instruction; this was emphasized by Ritchie and Rigano (1996). In like manner, Driscoll (2000) considered learning to be authentic and real, since learners construct their own reality or at least interpret it based upon their perceptions and experiences. Learning should therefore be situated in a realistic setting.

A laboratory is considered as a realistic setting, with the instruments for practical work that are found in the laboratory, they make it real life experiences. Laboratories also allow learners to experience reality. Learners do not forget easily what they have seen with their own eyes, and during practicals they can observe with their own eyes and thus experience reality (Driscoll, 2000). He further added that many schools have traditionally held a transmission of instruction‟s model in which a teacher or lecturer transmits information to students. In contrast, Vygotsky (1978) in his theory encouraged learning environments in which students play an active role in learning. The roles of the teachers and the students are therefore shifted, because the teacher collaborates with students in order to help facilitate meaningful construction in students. Constructivism is a process in which knowledge is both built and tested. Individuals are not free to construct any knowledge, their knowledge must be viable, and it must work. Empirical evidence obtained from laboratory experiments, can be used to test new knowledge (Ritchie & Rigano, 1996).

Gauvain (2001) also pointed out that constructivism emphasises collaboration, this implies that learners should be allowed to interact during practical activities as much as possible. This view of Gauvain, buttressed the work of Martin, Mullis, González, Gregory, Smith, Chrostowski, Garden, and O‟Connor (2000) who explained that instead of putting fully formed knowledge into the learners‟ minds, the teacher should rather guide them in constructing their own knowledge through scientific approaches. Thus a teacher with a constructivist instructional philosophy would not have learners memorize rote information but give them opportunities to meaningfully construct knowledge through active participation and interaction. These theories explain knowledge as being

constructed through effective and purposeful hands-on materials instruction. An example of this learning theory is the Kurt Lewin‟s laboratory training approach explained in the model in Figure 1 below. In this model knowledge construction is conceived as a Four Stage process.

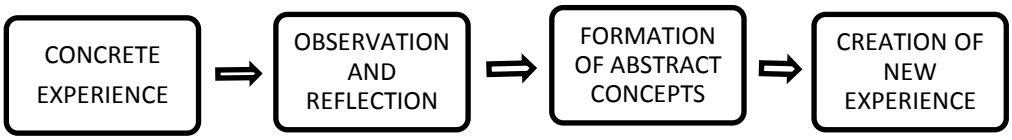

Figure 1: Model Showing Kurt Lewin‟s Laboratory Training Approach, (Lewin, & Lippitt, 1938)

Concrete experiences is the first stage, it represents the immediate tangible experiences (hands on materials) that learners are involved in. During this process they physically manipulate apparatus e.g. setting up a simple electric circuit. The experiences in the first stage lead to the second stage of observation and reflection, this stage basically entails the use of senses, which triggers sensory stimulus. The stimulus triggered lead to the third stage i.e. formation of abstract concepts. It is the stage where stimulus is assimilated into the learner‟s mind, as such concreteness turn out to abstractness. From the assimilation, new experiences and concepts are created leading to the fourth stage of creation of new experiences. These experiences generate new knowledge and represent the instructional objectives/expected learning outcomes. The four stages are interlinked as one leads to the other

Importance of Biology Practical Activities

The importance of laboratory work in science education has been detailed by some researchers such as, Ottander and Grelsson (2006) who indicated that, science educators and teachers agree that laboratory work is indispensable to the understanding of science. The main purpose of laboratory work in science education is to provide students with conceptual and theoretical knowledge to help them learn scientific concepts by employing scientific methods, to enable them understand the nature of science. They stressed that laboratory work also gives the students the opportunity to experience science by using scientific research techniques. In order to achieve meaningful learning, scientific theories and their application methods should be experienced by students. Additionally, laboratory work should inspire the development of analytical and critical thinking skills and encourage interest in science.

There are also concerns about the effectiveness of laboratory work in helping the students appreciate the various aspects of scientific investigation. This is evident in the work of Bol and Strage (1996) who claimed that teachers usually try to develop students" higher order thinking skills, like critical thinking, through laboratory work; but to what extent they can achieve this is controversial. In the same view, it is important to analyze the purposes related to laboratory work, as the purposes need to be well understood and well-defined by teachers and students alike to ensure effective laboratory work.

Again, though there are efforts to better define the purposes and role of laboratory work in science education, on the contrary, research has shown that teachers perceive laboratory activities as non-natural (Tobin, 1986). In general, teachers cannot see laboratory activities as conceptually integrated with theoretical science lessons.

In addition, teachers fail to recognize that laboratory activities may provide opportunities for students to produce innovative knowledge through scientific investigations. Also, a research conducted by Kang and Wallace (2005) revealed that, teachers perceive laboratory work solely as an activity for the purpose of verification. They have also revealed that teachers do not think of the laboratory as an environment where scientific knowledge claims are discussed.

The purposes of laboratory work have been the subject of discussion worldwide for many years. Many of these focus on carrying out experiments through scientific methods and technical skills. While some strongly emphasize effective objectives, others have dwelled on other purposes (Reid & Shah, 2007). One of these purposes was championed by Hirvonen and Viiri (2002), who said that a consequence of learning practical skills and scientific learning methods was that, students experience an increase in motivation and teachers gain the opportunity to evaluate the knowledge of their students. In addition, the researchers suggested that the nature of science and scientific knowledge requires a different approach to learning. Although it offers a biased view of the nature of science, laboratory work gives the impression that research is the core domain of science. Also, Sahin-Pekmez, Johnson and Gott (2005) examined science teachers‟ thinking on the nature and purpose of practical work in the context of the National Curriculum for Science in England. Data was collected through individual interviews with science teachers about their classroom practice. The findings suggested that little attention was being given to procedural understanding in terms of ideas relating to the quality of data. It is argued that this is a key limiting factor in the development of pupils‟ ability to engage in genuine investigative work.

In another development, Ottander and Grelsson (2006) investigated the ideas of Biology teachers on the role of laboratory work. The results of their study revealed that, teachers agreed that laboratory work is an important part of Biological science lessons. However, teachers do not focus on the most common purposes of laboratory work, such as building the connection between theory and practice and increasing motivation. Furthermore, teachers do not consider the purposes of laboratory work as being concerned with scientific process skills. Moreover, the interpretation of the learning outcomes of experimental activities differs between students and teachers.

The importance of laboratory work in science education is well known, however there is lack of clarity regarding the purposes of laboratory work and the perceptions and experiences of the students do not conform to known purposes (Reid & Shah, 2007). It is important that Biology student teachers‟ ideas about the purposes of laboratory work is understood in order for the expected outcomes to be acquired from laboratory work and for the proper planning of lesson.

Practical work is therefore very essential for effective teaching of Biology in schools and colleges. In order to able students to participate more effectively in any life situation, speak out on questions that involve both biological principles and human welfare, such knowledge will not only come out from literal literature, but mostly from practical application of the materials learnt to real life situations.

Practical activities in Biology also adequately provide opportunities for students to actualize science as opposed to theoretically learning about science**.** This supports Nzewi (2008), who asserted that practical activities can be regarded as a major strategy that could be adopted to make the task of a teacher (teaching) more real to the students as

opposed to abstract or theoretical presentation of facts, principles and concepts of subject matters. Nzewi maintained that practical activities should be designed to engage the students in hands-on, mind-on activities, using varieties of instructional materials to drive the lesson home.

In a research conducted by Nwosu, in Ibe (2004), also acknowledged that science process skills are abilities which can be developed by experience and can be used in carrying out mental and physical operations.

Practical work which is a hands-on activity is an integral component which is carried out in the study of natural science, such as Biology, Chemistry and Physics. It is based on the assumption that learning by doing is best for acquiring scientific skills and knowledge. The hands-on approaches have the potential to stimulate students‟ interest on subject matter, teach laboratory skills, enrich acquisition of knowledge and give insight into scientific attitudes and skills.

In the same vein, Freedman (1997) claimed that motivation to learn science does not only depend on interest students bring to school, but also as a result of certain learning situations, among which laboratory work is found.

Research in science teaching supports the inclusion of situations in teaching. Real-life application of science has been found to play a pivotal role in helping students reconcile their experience about their prior knowledge about the world with scientific explanations. Research also suggests that real-life application may be a way to engage students‟ interest in learning science (McComas, 1996; Simon, 2000). From the perspective of learning theories, it was hypothesized that students become more engaged in their learning, when

they perceive the practical importance of the knowledge they are studying. (Printrich & Shunk, 1996).

The current approach to Biology teaching in the Colleges of Education (CoE) is mostly based on classroom (theory) and laboratory (practical) approaches. These are intended to meet examination requirement as much as the need for the trainees to acquire basic scientific skills, knowledge and attitudes which they are expected to pass on to their pupils when they are in active in-service teaching. However, the examination driven mode of the Biology teaching in the CoE has limited to a large extent Biology practical scope and orientation of trainee teachers. This is due to the nature of the end of semester examination of test of practical work by the Institute of Education of the University of Cape Coast (UCC) which do not involve hands – on practical work, but rather a written test about practical activities.

This approach tends to make the study of Biology not to be inspiring, motivative, uninteresting boring and less enjoyable. It also results in trainees finding extremely difficult to relate the theoretical knowledge with the real- life situations as well as the use of basic scientific process skills. Process skills are some of the scientific processes which elective science (Biology) trainees need to acquire, these include: classification, communication, manipulation, classification, drawing, calculation, interpretation of data hypothesizing, prediction and inferring. According to Agboala (1984) all these science processes can be achieved through group work, during practical lessons.

Computer Assisted Learning (CAL) could also be used to make Biology lessons interesting and enjoyable. Technology devices, such as CD-ROM, videodiscs, interactive videos computers projectors and other educational technologies, present great innovative

solutions to the study of Biology so far as practical activities are concerned. This approach makes the learning experience of learning exciting.

The CAL is educational software which is a pre-programed content to facilitate learner friendly and driven interaction. This confirms the assertion of Naidoo (1999), who asserted that, use of computer in teaching, stimulates learning and it is good for concept development and reinforcement.

Resources for Biology Teaching

Teaching materials are the resources a teacher uses to deliver instruction. Each teacher requires a range of tools to draw upon in order to assist and support student learning. These materials play an enormous role in making knowledge accessible to a learner and can encourage a student to engage teaching materials such as realia, textbooks, pictures, projectors, specimen charts, and models can support student learning and increase student success. Ideally, teaching materials are tailored to reflect the content in which they are being used, the students in whose class they are being used and the teacher. Teaching materials come in many shapes and sizes, but they all have in common the ability to support student learning. It is therefore very imperative for College of Education Biology teachers to make adequate use of TLMs during the entire lesson preparation and delivery as this will enhance a better understanding of scientific concepts and hence concept acquisition by the students.

Resources according to Umeh (2006), mean something that can be used to enhance or improve educational programmes and promote teaching and learning. Biology laboratory resources can be human or material. The human resources has to do with personnel such as lecturers/teachers, laboratory technologist/assistants and students. The Biology

laboratory material resources are those materials available to the Biology teacher for teaching and learning. The main purpose of utilization of material resources is to improve the quality of teaching and learning, thereby helping to actualize the objectives of the Biology curriculum.

The Colleges of Education Biology curriculum document, (TED, 2014) was designed to prepare students to acquire:

1. Adequate laboratory and field skills in Biology.
2. Meaningful and relevant knowledge in Biology.
3. Ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture.
4. Reasonable and functional scientific attitude.

In pursuance of the above stated objectives, the content and context of the curriculum place emphasis on field studies, guided discovery, laboratory techniques and skills along with conceptual thinking. The curriculum was intended to provide a modern Biology course as well as meet the needs of the learner and the society through relevant and functionality in its contents, methods, processes and applications. The use of these material resources in teaching offers students the opportunity to develop scientific skill such as observation, objectivity, creativity, communication, and critical thinking among others.

Availability of Resources for Practical Activities

A research made by Klainin (1988) identified some problems of practical work in school science as experienced by the teachers and students in both developed and developing countries. According to him, these problems were associated with curriculum

implementation, change of emphasis in school curriculum, and problems of incentives are some of the problems associated with goals that could be attained by practical work.

Practical work for school Science classes might be very expensive in money and time and human resources. He also identified that third world countries have not been reluctant in designing their science curricula to accept the challenge of using practical-based approaches to science learning, however, many problems then arise. He pointed out that; how equipment could be obtained; how the teachers could make use of it; how this equipment could be stored and how large classes and when only one set of equipment is available are among the challenges faced by third world countries. Given the importance of practical work in enhancing understanding, ample time and resources should be made available to schools. This will enable Science teachers to ensure the attainment of Science content and processes.

In a research by Gayford (1988), it was found out that, there was a significant difference between the teachers who have science laboratories and those who have not. The teachers who found their labs well-equipped wanted to do practicals more and more in comparison with those whose labs were inadequate. This may be due to the situation in which the students have hands-on experience and therefore perform better. In the same study, Gayford found out that lack of science laboratories or inadequate equipment in science laboratories in schools affect teachers‟ attitude towards the aims of science experiments. From his research, it was clear that teachers‟ opinions related to the non-existence of laboratories and inadequate equipment in laboratories may prevent them from doing simple experiments. He further indicated that teachers may tend towards an idea that only when there is a well-equipped lab, then they can perform science experiment and reach

their goals. Consequently lack of resources for the conduct of practical work such as laboratories might prevent teachers from carrying out practical work in Biology.

Importance of Laboratory Space in the Conduct of Practical Work

From a constructivist‟s perspective, in a science laboratory, students are expected to work more independently, choose their own paths of investigation, determine their own research agenda and set up and conduct their experiments to make discoveries for themselves. Roth (1995) perceived a science laboratory as a construction site, according to him, students in this situation should not be provided with cook book recipes for the experiment, but rather be given a chance to discuss the meaning of the problem in question and the appropriate experimental design for it.

It is worth to note that, good laboratory facilities by themselves do not guarantee good practical and favourable learning outcomes, although, they can certainly facilitate better learning outcomes. Too often, because of poor laboratory design, inadequate facilities, lack of technical support and insufficient curriculum time, teachers are unable to operationalise practical work as they wish (Hodson, 1993). The lack of technicians, adequate laboratory space for the large number of students doing Biology and inadequate equipment and consumables may be impacting negatively on the conduct of practical work in Colleges of Education in Ghana.

Science laboratories have made this world very advanced and scientific in its purposes. In a laboratory or field learning environment, students work individually or in small groups on a question, problem or hypothesis. On this note, Dahar and Faize (2011) collaborated this view when they opined that, students make use of processes and materials of science to construct their own explanation of biological phenomena. In the same perspective,

laboratory or field work are student centered, with students actively engaged in hands-on, minds-on activities using laboratory or field materials and techniques. This has been known to enhance learning in science and improve the understanding level of students. (Tobin, 1990; Hodson, 1993; Hofstein & Lunetta, 2004).

School facilities have been observed as an effective factor to quantitative education. The availability and utilization of laboratory facilities are essential for effective teaching and learning of Biology and consequently promote good performance in students. This is in line with the view of Akande (1985), who claimed that learning can occur through one‟s environmental facilities that are available to facilitate students learning outcome. Students can master better the basic concepts of Biology when they can learn by doing. Appropriate facilities, equipment and adequate utilization of same are inevitable if school science course is to be successful. This implies that practical should function as the primary learning experience. In another development, Green (1989) identified one of the problems of the Biology teacher during the teaching process as, the provision of specimens in a laboratory class which can hamper or enhance the effective teaching of the subject. Consequently, it is not enough to establish laboratories, but also to equip them with appropriate materials as much as possible to allow for individual student work.

The Role of the Laboratory in College Biology Teaching

Science educators believed since in the late 19th century that the laboratory activities are important means of instruction in science. Laboratory activities were used in high school chemistry in the 1880s (Osborne, 1993). Inferring from his view, laboratory instruction was considered essential because it provided training in observation, supplied detailed information and aroused pupils' interest.

The role of laboratory was also highlighted by Travers (1973) who listed five groups of objectives that may be achieved through the use of the laboratory activities in science classes:

1. Skills-manipulative, inquiry, investigative, organisational and communicative.
2. Concepts-hypothesis, theoretical model and taxonomic category.
3. Cognitive abilities-critical thinking, problem solving, application, analysis and synthesis.
4. Understanding the nature of science-scientific enterprise, scientists and how they work, existence of a multiplicity of scientific methods, interrelationships between science and technology and among the various disciplines of science.
5. Attitudes-curiosity, interest, risk taking, objectivity, precision, confidence, perseverance, satisfaction, responsibility, consensus, collaboration, and liking science.

Writing about laboratory teaching at the college level, Svinicki and McKeachie (2012) also mentioned that laboratory teaching assumes that first-hand experience in observation and manipulation of the materials of science is superior to other methods of developing

understanding and appreciation. They further claimed that laboratory training is frequently used to develop skills necessary for more advanced study or research.

From the standpoint of theory, the activity of the student, the sensorimotor nature of the experience and the individualization of laboratory instruction should contribute positively to learning. Information cannot be however obtained by direct experience as rapidly as it comes from abstractions presented orally or in print. Similarly, Gage (1993) claimed that one would not expect laboratory teaching to have an advantage over other teaching methods in the amount of information retention, in ability to apply learning, or in actual skills in observation or manipulation of materials.

In another instance, Black (1993) asserted that sciences are practical subjects hence best learnt through experiments, observations, analysis and generalisation of conclusion. Also, Kulik (1992) noted that for Biology and other sciences to be understood better by all, there is the need to emphasis its instruction through practical approach. Again, Hickey, Moore and Pellegrino (2001) observed that the trend in educational reforms is to teach from a constructivist perspective. As such teachers should focus more on practical activities during instruction.

In a study conducted by Pickering (1980), he identified two misconceptions about the use of the laboratory in college science. One is that laboratories somehow "illustrate" lecture courses - a function that, in his opinion, is not possible in a simple one-time exercise. Pickering also contended that most scientific theories are based on a large number of very sophisticated experiments. He suggested that, if lecture topics are to be illustrated, this should be done through the use of audio-visual aids or demonstrations. The second misconception is that laboratories exist to teach manipulative skills. He again argued that

majority of students in science laboratory classes do not have a career goal of becoming a professional scientist. Further, many of the skills students learn in laboratories are obsolete in science careers. If these skills are worth teaching, they are used as tools which must be mastered for basic scientific inquiry and not as ends in themselves.

Positive research findings on the role of the laboratory in science teaching do exist. Laboratory activities appear to be helpful for students rated as medium to low in achievement on pretest measures (Boghai, 1997). Similarly, Godomsky (1971), also reported that laboratory instruction increase students' problem-solving ability and that the use of the laboratory could be a valuable instructional technique in science if experiments were genuine problems without explicit directions. The presence of the science laboratories, the judicious use of other resources during the implementation of the college Biology programme is a professional requirement of the teachers. For instance the use of Teaching and Learning Materials (TLMs) and other improvised materials during lesson preparation and delivery shows the teacher‟s level of competence and degree of mastery of the content and methodology of the subject. Besides teacher qualifications and school facilities, another important determinant of quality of education is the teaching and learning materials and it is essential for quality materials to be made available to the teachers and students in adequate quantities to support the teaching and learning processes (UNESCO, 2016). This was entrenched in Colleges of Education curriculum, where Biology students are expected to study improvisation: principles to consider when improvising and the importance of improvisation.

Challenges Students and Tutors Face in Connection with Biology Practical Lessons

Despite the expected benefits of utilizing material resources in the teaching/learning process, there has been consistent decline in students‟ performance in Biology (Umeh, 2006). This failure may be attributed to under-utilization of some material resources in teacher training institutions. Umeh again opined that audio visual aids such as television, computers and projectors are not utilized in schools due to lack of knowledge on the proper use of such resources for teaching. Similarly, Jatua and Jatau (2008) also expressed the view that material resources utilized by teachers in teaching science (Biology) include: textbooks, chemicals, charts, microscopes, chalkboards and flasks which are cheap and have wider applicability in the teaching and learning of Biology in schools. Also, Onyeji (2003) had earlier reported that none of these new media was available, accessible or used in communicating Science, Technology and Mathematics (STM) instructions in high schools. From his research findings, Biology teachers agreed that lack of skills/competencies required for resource use, insufficient period for practical work, inadequate laboratory and instructional materials, heavy teaching loads and large class size are the biggest factors hindering the use of resources in teaching Biology. In a related development, Imogie (2010) attributed the problem to increase in students‟ enrolment into science subjects (especially Biology) which made the available resources to be grossly insufficient for any meaningful activity-based learning. From this point of view, if undergraduate teachers in Colleges of Education are not trained using the modern Biology laboratory resources, the recurrent poor performance of students in the basic schools will continue, since these DBE teachers cannot impact what they do not have in terms of practical skills and knowledge.

Notwithstanding the emphasis laid on laboratory practical approach in high school Biology instruction, the methodology still faces a number of challenges that render it ineffective. There are also concerns about the effectiveness of laboratory work in helping the students comprehend the various aspects of scientific investigation. Teachers usually want to help develop students" higher order thinking skills, like critical thinking, through laboratory work; but to what extent they can achieve this is controversial (Bol & Strage, 1996). Therefore, it is important to analyze the purposes associated with laboratory work, as these purposes need to be well understood and defined by teachers and students alike for practical work in the laboratory to be effective.

Despite the efforts to better define the purposes and role of laboratory work in science education, research has shown that teachers perceive laboratory activities as contrived (Tan, 2008; Tobin, 1986). In general, teachers cannot appreciate laboratory activities as conceptually integrated with theoretical science lessons. In addition, teachers fail to understand that laboratory activities may provide opportunities for students to produce new knowledge through scientific investigations. According to a research conducted by Kang and Wallace (2005), teachers perceived laboratory work solely as an activity for the purpose of verification. The researchers have also revealed that teachers do not consider the laboratory as an environment where scientific knowledge claims are discussed.

In like manner, Bencze and Hodson (1999) claimed that problems in laboratory work arise when students do not critically follow the instructions of the teachers. Some researchers, on the other hand, claim that the laboratory, instead of being a place for science and experiments, has become a place where tasks set by the teacher are carried out. Not much attention is given to the methods or purposes during laboratory work, only

the set tasks are carried out. In a study conducted by Hart, Mulhall, Berry, Loughran and Gunstone (2000), they have connected problems with laboratory work to a poor evaluation of the purposes of the tasks undertaken in the laboratory.

In addition, there are multiple purposes of laboratory work which have been the subject of discussion worldwide for many years. These purposes have been prepared for different levels of education. Many of these lists focus on carrying out experiments through scientific methods and technical skills. While some strongly highlight effective objectives, others have settled on other purposes (Johnstone & Al-Shuaili, 2001; Reid & Shah, 2007).

Many factors may affect the success of laboratory work. These factors include: the attitudes of the teacher and the students towards the laboratory, student communications, laboratory manuals and the approaches used in laboratory instructions. Many studies have shown that teachers were not aware that the different practical activities in the laboratory have different objectives (Nott & Wellington, 1997; Wilkinson & Ward, 1997). In another study, teachers agreed that carrying out a traditional laboratory work is a good thing without fully considering what the real purpose of the practical activity Ergin, Sahin-Pekmez, and Öngel-Erdal, (2005).

In like manner, poor understanding and grasp of practical concepts by learners stem from student‟s entry behaviour. This assertion was opined by Jennings (1998) in his statements on the goals of science education states that, science and its processes should provide an opportunity for learners to develop thinking and process skills which include deductive, logical and hypothetical thinking. As such, due to poor grasp and understanding of practical concepts by learners these goals are hardly achieved.

Lack of laboratories in our schools and colleges may have contributed to the shortfall in Biology practical activities. This agrees with Solomon (1994) who observed that science teaching need to take place in the laboratory, about that at least there is no controversy. Science simply belongs there as naturally as cooking belongs to the kitchen. From this it is evident that without a laboratory it is difficult for teachers to engage students in practical activities, this impacts negatively on instruction.

Again, in a study conducted by Kapting"ei and Rutto (2014) it was identified that limited space in the laboratory, no laboratory technicians in schools, untrained laboratory technicians and inadequate textbooks or practical guides as some of the factors which retard science practical lessons. They again asserted that insufficient laboratory resource such as laboratory equipment; apparatus and chemicals are some of the factors that militate against effective practical science activities. They further indicated that, minimal or no funds allocated for purchase, repair and maintenance of laboratory equipment; very poor working conditions apparatus have negative impact on practical instruction.

In a related development, Tsuma (1997) pointed out that a science laboratory is an indispensable facility in science education, if well equipped with the right kind of apparatus and chemicals then it should provide the best setting for teachers to assist students in acquiring scientific knowledge and skills. From these, it is evident that inadequate laboratory resources jeopardize Biology practical instruction.

Summary of the Literature Review

This study was based on the theory of constructivism, which views learning as an active process whereby learners learn to discover principles, concepts and facts for themselves. The teacher according to the constructivist theory is not seen as a person who is responsible for constructing knowledge for the learners but rather is denoted by the many responsibilities given to him or her during instruction in mediating meaning at the inter-mental plane in the classrooms. Thus, the teacher‟s role becomes that of a guide provocateur, creator of opportunity and co-developer of understanding with learners. Laboratory activities are based on theory. The importance of laboratory work in science education is well known. However, there is a lack of clarity regarding the purposes of laboratory work and the perceptions and experiences of the students do not conform to known purposes (Reid & Shah, 2007). It is hence important that Biology teachers need to understand the purposes of laboratory work to unsure the expected outcomes acquired from laboratory work facilitate effective planning of lesson. It is therefore very imperative for the Colleges of Education Biology tutors to make adequate use of TLMs during the entire lesson preparation and delivery as this will enhance a better understanding of scientific concepts and hence concept acquisition by the students. It is also very essential for quality laboratory materials to be made available to the teachers and students in adequate quantities to support the teaching and learning processes. This was entrenched in the course outline of Colleges of Education curriculum TED (2014) where Biology students are expected to study improvisation: and apply principles when improvising to ensure availability of materials for practical lessons. Lack of skills/competencies required for resource use, insufficient period for practical work,

inadequate laboratory and instructional materials, heavy teaching loads and large class size are the biggest factors hindering the use of resources in teaching Biology. It is thus very essential for trainees in the colleges to have enough hand-on experience in practical aspect of their course to facilitate scientific skill acquisition.

CHAPTER THREE

METHODOLOGY

Overview

This chapter describes the research design of the study, the population, the sample procedure employed, the research instrument, validity and reliability of the instrument, data collection procedure and method of data analysis.

Research Design

The research design used in the study is descriptive survey. This was employed to describe what pertains with respect to how Biology practical work is conducted in Colleges of Education in Ghana.

Descriptive survey was perceived by Fraenkel and Wallen (2000), as a research design that attempts to describe existing situations without actually analyzing relationships among variables. It is also designed to obtain information concerning the current status of the phenomena.

In a related case, Huysamen (1994) described research design as the plan, which specifies how the subjects are going to be obtained and what is going to be done with them with the view to reaching conclusions about the research problem.

This design was chosen because it has the advantage of producing a good amount of responses from a wide range of people. It also provided a clear picture of events and people‟s behavior on the basis of data gathered at a point in time. Furthermore, in-depth follow-up questions can be explained using a descriptive survey design.

In the same vain, Gay (1990) said that descriptive sample survey involves collecting data in order to test hypothesis or to answer questions concerning the current status of a

subject of study. The descriptive survey was also recommended by Babbie (2001), he mentioned that, it could be for the purpose of generalisation from a sample of a population so that reference can be made about some characteristics, attributes or behaviour of the population. The use of the survey design will enable the researcher to gather a wide variety of data on the problem rather than the use of case study approach. On the same trajectory, Polit and Hungler (1995) mentioned that a descriptive survey aims predominantly at describing, observing and documenting aspects of a situation as it naturally occurs rather than explaining them.

The major purpose of a descriptive survey research was to observe, describe, and document aspects of a situation as it occurs naturally (Amedahe & Asamoah, 2001). They again maintained that descriptive research ranges from simple surveys that do little more than ask questions and report answers about the status of something (phenomena) to studies that present explicit statements about relationships and variables. However, Seifert and Hoffnung (1994) observed that there is the difficulty in ensuring that the questions to be answered using the descriptive survey design are clearer and not misleading. This is because survey results can vary significantly depending on the exact wording of questions. They also revealed that untrustworthy results may be produced because questions may delve into private matters that people may not be completely truthful about. They further maintained that questionnaires require respondents who can articulate their thoughts in writing. Questionnaire is limited by disability and literacy. Qualitative research, according to Experiment Resource (2009) cited in Seidu (2012), aims primarily at providing a complete, detailed description of the subject of the study, with the purpose of uncovering prevalent trends and patterns in thought and in opinion.

This study involved both quantitative and qualitative approaches. Unscheduled observation guide was used to collect qualitative data from practical lessons in the colleges. The quantitative approach involved the use of questionnaire to collect data from both the science tutors who teach elective Biology at the selected Mathematics and Science Colleges of Education and science students who study Biology as an elective course at these Colleges of Education. The tutors‟ questionnaire helped to identify science (Biology) tutors‟ qualification and areas of specializations. It also helped to find out the resources that were available in the teaching and learning of Biology at these colleges.

The students‟ questionnaire further helped to gather students‟ views about how they perceive the Biology practical programme, the resources that were available for the implementation of the Biology programme in their colleges as well as how the subject was taught particularly the status of the practical aspect of the Colleges of Education Biology programme. The questionnaire also helped to collect data on the students‟ perception of teaching and learning of Biology.

Though descriptive research may not answer all of the fundamental questions pertaining of Education the status of Biology practical activities in the designated Mathematics and Science Colleges, however it may offer useful data which can serve as a basis for further research using more rigorous experimental design. Descriptive survey design was therefore the most appropriate for this study because it only found out the ideas of tutors and their students on some aspects of Biology program of Colleges of Education programme.

The Study Area

The municipality and the district, within which the Colleges of Education involved in the study are located, are described below:

The Akatsi College of Education is situated in the Akatsi South District which is located between latitude 6° S - 7° North 0° W - 1 ° W. in the South-Eastern part of the Volta region. It has a total land area of about 960.445 square kilometers. The total land under cultivation is about 51,438.12 hectares. The district is bounded to the South by the Keta municipal; to the North by North Tongu districts to the East by the Ketu North District; to the West, Adaklu-Anyigbe District and the republic of Togo to complete the demarcation of the Akatsi District.

St. Francis College of Education, Hohoe Municipality is one of the 25, and also one of the 216 administrative districts of Volta region and Ghana respectively. The Municipality is located within longitude 0° 15‟E and 0° 45‟E and latitude 6° 45‟N and 7° 15‟N and lies almost in the heart of the Volta Region. It has a total land surface area of 1,172 km^2 which constitute 5.6 percent of the Volta Region and 0.05 percent of the National land surface areas. The Hohoe Municipal Assembly was established in 1989 by Legislative Instrument (LI) 1869 with its capital at Hohoe. There are 20 Traditional Areas with a population of about 153,047. It shares boarders with the Republic of Togo on the East, forming part of Ghana‟s international boarder; on the southeast and south with Ho Municipal Assembly; on the southwest with South Dayi Districts; on the North with Jasikan District; and on the Northwest with Kpando and Biakoye Districts.

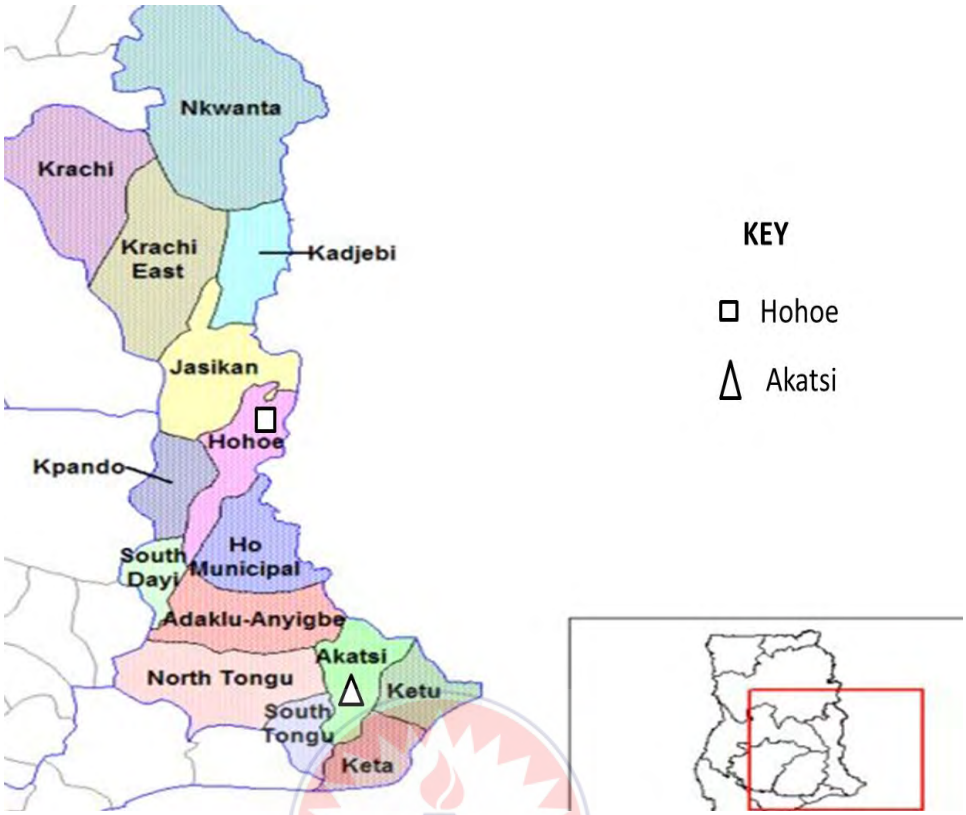

Figure 2: Map of Volta Region Showing the Municipality and the District within which the Colleges of Education Used for the Study are Located.

Population

The targeted population for this study was all the science students and their tutors at all the 15 designated of Mathematics and Science Colleges of Education in Ghana. However, the accessible population was drawn from the two designated Mathematics and Science Colleges of Education in the Volta region.

Sampling Techniques and Procedure

The sample size was 130 Biology students and Tutors from the selected Colleges. This comprised 75 second year science students and the three (3) Biology tutors at one college – St. Francis College of Education, (FRANCO) and the 50 second year science students and the two (2) Biology tutors at the other college- Akatsi College of Education (AKATSICO). These provided a total sample size of 125 science students and 5 Biology tutors for the study.

The sample size was purposively selected because according to the Colleges of Education programme in Ghana, science students study Biology for two years; that is in the first and second semesters of the first year, and in the first semester of the second year. This implies that the category of subjects selected as the sample had studied Biology in the first semester of first year and for that matter have been introduced to the College Biology programme.

In addition, out of the seven state Colleges of Education in the Volta region, these two colleges are the only Colleges of Education that offer the designated Mathematics and Science Programmes.

Instrumentation

The following research instruments were used to collect data

(i) Questionnaire

(ii) Observation

Questionnaire

In the development of the questionnaire for this study, it was ensured that the questions were unambiguous, unbiased, not loaded, relevant, succinctly conceptualized as well as

avoiding vagueness as suggested by May and Flack (2001). Also, Nworgu (1991) indicated some characteristics of a good questionnaire: clarity, relevance, usability, legibility, consistency and quantifiability. These were also applied in designing the questionnaires for the study.

Two types of questionnaires were designed for the study. One set was designed for the tutors and another set was designed for the students. Both sets were designed to contain open-ended and closed-ended items. In the closed-ended questionnaire, both tutors and students were required to respond by selecting from a list of item options while in the open-ended option, respondents were required to write their views about the questions. The tutors‟ and the students‟ questionnaires were open and close-ended types, and consisted of two sections A and B in each case (Appendix A and Appendix B).

The questionnaire was designed in a manner not to disclose the identity of the respondents in order to respect privacy and confidentiality. This was done to avoid or alleviate the fear of victimization and to ensure maximum cooperation from respondents. The Biology tutors‟ questionnaire was made up of 21 items for the tutors to answer. The close-ended type items were in the form of multiple choice questions to enable respondents answer them easily whilst the open-ended items were meant for soliciting subjective data from the respondents. Section A which was made up of four items which sought for background information and characteristics about the respondents. All the items in this section were open-ended types. The questions sought to find out the highest qualification of the science tutors who teach college elective Biology, and their areas of specialization.

Section B consists of 11 items which were made up of both open-ended and close-ended. The close-ended items consist of a five point Likert rated on a 1-to-5 Disagree-Agree response scale which has 10 items. They were formulated to find out the Biology practical resources available in the colleges and how these resources are utilized during Biology practical lessons. The items required the respondents to indicate the availability and the state of the science resources available at the colleges for the conduct of practical aspect of the Biology programme. Some of the items were also meant to find out Biology tutors‟ attitude and interest towards the conduct of practical aspect of the Biology programme, as well as the types of pedagogical skills (practical or theoretical approaches) employed during the classroom conduct of practical aspect of the college Biology programme. In addition, one item required a „Yes‟ or „No‟ response with a follow up open-ended item.

Section C contains a three point Likert rated on a 1-to-3 which is made up of nine items. Here the respondents were required to provide their views on the extent to which certain constrains affect effective organisation of biology practical lessons. In addition, one item required a „Yes‟ or „No‟ response with a follow up open-ended item.

The students‟ questionnaire consisted of 18 items. Section A of the students‟ questionnaire was made up of two items which required students to indicate the name of their college and a given coded name. All the items in this section were open-ended. Section B of the students‟ questionnaire was made up of six items which focused on the science resources available at the colleges under study for the effective conduct of practical aspect of the Biology programme. All the items under this section were close-ended and were of the five-point Likert type scale. The negative items were scored as

follows: Strongly Disagree (5) Disagree (4) Not Sure (3) Agree (2) and Strongly Agree (1). Section C contained eight items which were close-ended five-point Likert type scale the scale. The items were scored as follows: All of the Time (1) Most of the Time (2) Sometimes (3) Not Often (4) and Never (5). The respondents were required to state their view on how often certain Biology practical activities occurred in the colleges. Also, three (3) close-ended items which were made up of „multiple-choice" type items. These item expected respondents to indicate the most frequently used method of teaching biology in their college, sufficiency of time available for practical lessons and how frequent biology practical lessons are conducted in their colleges.

Observation

Biology practical lesson observations were made to find out how the elective Biology practical aspect of the Biology programme is being implemented in the two colleges under study. That was to identify the normal practical session activities in the selected colleges. It was also used to determine whether the views that were expressed by the respondents in the questionnaires were consistent with the outcomes of what the researcher has observed. This was to enable triangulation of the data collection systems to provide specific outcomes. This was in line with King (1994), who asserted that where quantitative study has been conducted, qualitative data are required to validate particular measures or to clarify and illustrate the meaning of the findings, and to see whether their experiences agree with the ratings on the measure.

The observation was based on taking personal field notes of some biology practical lessons without the knowledge of the tutors and the students during Biology practical

lessons. This agrees with Barnes (1985), that researchers undertake unscheduled observations.

This process was also based on listening and observation. The emphasis was laid on the teaching strategies used by the tutors and the responses of students throughout the research were observed during specific lessons. The observed Biology lessons provided information on how Biology (practical) lessons are being taught in those colleges. During the observation, the researcher considered students contribution to lessons, participation, ways of asking and answering questions and how they participated in activities performed.

The observation guide consists of two parts which was made of the preliminary statements and the main guide. The main observational guide has seven categories which were made up of classroom setting, resources to support the practical lesson, introduction, teacher/learner interaction, presentation of classroom activities, role of the teacher during the practical lesson and conclusion of the practical session. These categories are described as follows:

1. Classroom Setting**:** This consists of four items of which one is a close-ended item ("yes" or "No") type item and others are of the open-ended type items which were made up of three items.
2. Resource to support the practical Lesson: it has a total of 11 items of which eight are close-ended and 4 open-ended items. The close-ended has 7 "Yes" or "No" responses and one (1) „multiple- choice" type item.
3. Introduction: this is made up of five items of which there were two open-ended items and three close-ended items which were made up of one "multiple-choice" and two „Yes or No" type items.

4. Teacher/learner interaction: This aspect of the observation guide was made up of only close-ended items consisting of six „Yes or No" type items.
5. Presentation of classroom activities during the practical lesson: This category was made up nine (9) items of which one was an open-ended item and the remaining eight were „Yes or No" close-ended item types.
6. Role of the teacher during the practical lesson: This aspect of the guide was made up of seven items; four were close-ended „Yes or No" item type and three open-ended item types.
7. Conclusion: This category has six items , which consist of one (1) open -ended item and 5 close –ended items .The close-ended items were made up of 1 "multiple choice " type and five „Yes or No" items. This category was codded;

In addition, the guide was designed to enable the researcher state any other observation about the practical lesson.

Validity of the Research Instruments

In order to enhance the content and validity of the instruments, the questionnaires and the observation schedules were given to some lecturers of the department to examine. After the examination of the instruments and the research questions the lecturers" comments and suggested changes were effected; the instruments were also subjected to face validity.

Reliability of the Research Instrument.

A pilot test of the instruments was carried out with thirty (30) students and five (5) tutors from the selected colleges. The students and the tutors that were used for the pilot test were not included in the sample for the study.

Table 1: Reliability Statistics of the Questionnaires for Students

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No. of Items
.758	.799	30

The reliability test using the Cronbach"s Alpha shows that 0.758 representing 75.8% of the items were truly reliable. This was tested on the data retrieved from 30 students whose data were reliably piloted by the researcher. Each item had strong correlation between them (Table 1)

Table :2 Reliability Statistics for the Questionnaire for Tutors

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No. of Items
.745	.788	5

The reliability test using the Cronbach"s Alpha indicates that 0.745representing 74.5% of the items were truly reliable. This was tested on the data retrieved from 5 teachers whose data were reliably piloted by the researcher. Each item had strong correlation between them (Table 2)

Data Collection Procedures

The data collection for this study was in three (3) phases. These are outlined as follows:

Phase 1: Seeking approval to access the colleges for the study.

Phase 2: Distribution and administration of the questionnaire.

Phase 3: Observation of Biology practical lessons.

Phase 1 - Seeking approval to access the colleges for the study: A set of two introductory letters were obtained from the Head of Science Education Department of the University

of Education, Winneba. A copy of this letter was sent to each of the Principals of the two Colleges of Education used for the study to seek their approval for the study to be conducted in their respective colleges. This was to facilitate in introducing the researcher to the teaching staff and the students involved in the study for their needed cooperation.

Phase 2 – Distribution and administration of the questionnaire: In all, one hundred and thirty (130) respondents in the two Mathematics and Science Colleges of Education in the Volta region were selected for the study.

This number consists of one hundred and twenty-five (125) second year science students and five (5) Biology tutors. The questionnaires were distributed to the respondents and the instructions well explained to them.

To ensure a high return rate of the questionnaires, the researcher personally supervised the distribution and collection of the entire questionnaire after completion in order to achieve a 100% return rate for both the students and the tutors. Also it provided opportunity for the researcher to further clarify any part of the questionnaire that might be a problem to the respondents. This was made possible because, the instruments were administered during class hours.

Phase 3 – Observation of Biology practical lessons: Five different Biology practical lessons were observed on different days and on different topics in Biology practical as taught by each of the five (5) tutors at their respective colleges. This was done, with respect to the teaching time table used at these colleges, using the Observation Instrument. During the teaching and learning process, all observable behaviours of both the teacher and the students were recorded.

Data Analysis

The collected data was analyzed statistically, using the statistical package for social sciences (SPSS). Descriptive statistics was used to represent data in the form of tables‟ column graphs and pie chart to ensure easy and quick interpretation of data.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

Overview

This chapter explores the status of Biology practical in some selected special Mathematics and Science Colleges of Education. The findings of the data collected covered a wide range of background information such as areas of specialization and academic qualifications. There are two groups of respondents namely Biology tutors and students. In all, Five(5) Biology tutors and 125 students from two designated Mathematics and Science Colleges of Education in the Volta region specifically St. Francis‟ and Akatsi Colleges of Education, used for the study. Presentation and analysis of results were done with respect to the three research questions. The instruments used for data collection were questionnaires and observations. Analysis and discussions were presented under the following headings:

1. Demographic data of respondents
2. What are the resources available for conducting Biology practical lessons?
3. What is the extent of utilization of Biology laboratory material resources in organizing Biology practical activities?
4. What are the challenges associated with the organisation of Biology practical activities?

Demographic characteristics of respondents.

Teacher qualification and specific area of specialization are identified as important factors that could influence the quality of Biology practical activities in the selected Colleges of Education. Out of the five Biology tutors used for this study; 60% have Masters in Science Education degree with Biology as an area of specialisation; 20% have Master of Philosophy degree with specialisation in Botany, and 20% have Master of Philosophy degree with specialisation in Agriculture (Table 3).

Table 3: Tutors' Responses on their Highest Qualification

Qualification	Area of Specialisation	Frequency	Percentages (%)
M.ED Sc.	Biology	3	60
M. Phil Sc.	Botany	1	20
M. Phil Sc.	Agriculture	1	20
Total		**5**	**100**

Research Question 1

What are the resources available for conducting Biology practical lessons?

In investigating the resources available for conducting Biology practical lessons the researcher used items 1-6 of students" questionnaire(Appendix A) and items 1, 2 and 3 of the tutors" questionnaire (Appendix B).

Ten respondents, which represent 8.0% of the total respondents, strongly disagreed that the colleges were well resourced for the teaching of Biology. At the same instance, 68% of them disagreed to the same statement, 4% of them were not sure of the statement, whilst 16% of them agreed to the statement. However, only 4% respondents strongly

agreed that their respective colleges are well resourced for the teaching of Biology. This indicates that majority of the respondents 76% were not in favour of the statement while only 20% said the selected colleges are well resourced for the teaching of Biology. Looking at this it is indicative that the selected colleges are not well resourced for the teaching of Biology since majority of the respondents 76% were not in favour of the statement

(Table 4).

In another instance, 46.4% respondents agreed whereas 7.2% strongly agreed that the colleges have modern science laboratory for the teaching of Biology. However, 7.2% and 33.6 % of them strongly disagreed and disagreed respectively to that statement. Finally, 5.6% of the student respondents were not sure of that statement. This result revealed that most respondents were of the view that the colleges have a modern laboratory space designated for Biology practical lessons.

When the respondents were asked to indicate whether their colleges science laboratories are well equipped for the teaching of Biology, whilst some 17.6 % and 6.4% respondents agreed and strongly agreed respectively, others, 12% and 56% respondents strongly disagreed and disagreed respectively, however, 8.% were not sure. In line with this statistic, it can be deduced that the college Biology laboratories are not well equipped for teaching Biology (Table 4).

Looking at how adequate were the tutors prepared to teach Biology practical lessons, 2.4% strongly disagreed with the statement, 9.6% disagreed, 4.8% were not sure, 66.4% and 16.8% agreed and strongly agreed respectively that tutors in theses colleges are well prepared to teach Biology practical lessons. In respect to these views the popular view

among the respondents revealed that the tutors at the colleges were adequately prepared to teach Biology practical lessons.

When students were asked to indicate if tutors at these colleges are reluctant to organise regular practical activities in Biology, 8.8% and 68.0% strongly disagreed and disagreed to the statement receptively, on the other hand, 6.4% and 8.0% respectively agreed and strongly agreed that tutors at the colleges under study were reluctant to organise Biology practical lessons, whiles 8.8% were not sure about the statement. Since most of the respondents were not in favour of the statement, it was clear that, tutors in the selected colleges were mostly reluctant to organise Biology practical lessons.

Respondents‟ reaction to the statement whether, enough time is allocated on the college time table for Biology practical lessons, 19.2% strongly disagreed, 58.4% disagreed, 8.8% were unsure, however 10.2% agreed and 3.2% strongly agreed to the statement. Inferring from the above, the popular view of the respondent was that, the time available for Biology practical activities was woefully inadequate and this can consequently affect the frequency of trainees‟ exposure to hands-one activities in Biology (Table 4).

Table 4: Students' Response on Resources Available for Organisation of Biology practical lessons

Item	SD (%)	D (%)	NS (%)	A (%)	SA (%)	Total (%)
The college is well resourced for the teaching of Biology	10(8.0)	85(68.0)	5(4.0)	20(16.0)	5(4.0)	125(100)
The college has a modern science laboratory for the teaching of Biology	9(7.2)	42(33.6)	7(5.6)	58(46.4)	9 (7.2)	125(100)
The science laboratory is well equipped for the teaching of Biology	15(12.0)	70(56.0)	10(8.0)	22(17.6)	8(6.4)	125(100)
Tutors are adequately prepared to teach Biology practical lessons	3(2.4)	12 (9.6)	6(4.8)	83(66.4)	21(16.8)	125(100)
Tutors at this college are reluctant to organise regular practical activities in Biology	11(8.8)	85(68.0)	8(6.4)	11(8.8)	10(8.0)	125(100)
Enough time is allocated on the college time table for the teaching and learning of practical Biology	24(19.2)	73(58.4)	11(8.8)	13(10.2)	4(3.2)	125(100)

Note: SD = Strongly Disagree, D = Disagree, NS = Not Sure, SA = Strongly Agree and percentages are in parenthesis

When the tutors were required to indicate whether their colleges have adequate equipment, facilities, and laboratory specifically for conducting Biology practical work, 20% strongly disagreed and 40% of them disagreed to the statement. At the same time, 20% of them strongly agreed that the colleges have adequate equipment, facilities, and laboratory specifically for conducting Biology practical work. However, 20% of the total respondents was not sure of the statement (Table 4). It can be inferred from this result that, most tutors in the selected colleges were of the view that their respective college do not have adequate equipment, facilities specifically to organise practical lessons in Biology.

On the issue of whether there were enough materials and equipment for each learner to carry out practical work in Biology, 40% and another 40% of the tutors strongly disagreed and disagreed respectively with the statement, however, 20% of them was not sure of the statement. It was thus a popular perception among the tutors that the materials available for practical activities in Biology were not enough to enable each trainee to carry out practical activities effectively. During practical lesson observation it was observed that the trainees were most of the time working in groups due to inadequate quantity of materials. However, this practice stimulated collaborative work and hen helped to promote learning.

Two tutors which represented 40% of the total respondents strongly disagreed that there was sufficient time for carrying out practical lessons, 40 % disagreed, 20 % was not sure of the statement (Table 5). In view of this, it is evident that there was inadequate time on the college time table for organising Biology practical activities.

Table 5: Teachers' Response on Resources Available for Biology Practical Lessons

Item	SD (%)	D (%)	NS (%)	A (%)	SA (%)	Total (%)
Your college has adequate equipment, facilities, and laboratory available for Biology practical work	1(20.0)	2(40.0)	1(20.0)	1(20.0)	0 (0.0)	5(100)
There are enough materials and equipment for each learner to carry out practical work in Biology	2(40.0)	2(40.0)	1(20.0)	0 (0.0	0 (0.0)	5(100)
There is sufficient time enough for carrying out practical lessons	2(40.0)	2(40.0)	1(20.0)	0 (0.0	0 (0.0)	5(100)

Note: SD = Strongly Disagree, D = Disagree, NS = Not Sure, SA = Strongly Agree and percentages are in parenthesis.

Research Question 2

What is the extent of utilization of Biology laboratory material resources in organizing Biology practical activities?

Items 7 to 14, 16, 17 and 18 of students" questionnaire(Appendix A) and items 4 to 10 of the tutors" questionnaire (Appendix B) were used to address how Biology practical activities were organised in the selected colleges.

With reference to how often the tutors made use of sufficient resources (pictures, tables, animations, computers, etc.) during Biology practical lessons, two students, which stood for only 1.6% were of the view that tutors made use of sufficient resources during Biology practical lessons, 16.0% said sufficient resources were used most of the time, 58.4% said sometimes, 23.2% indicated not often, but only one respondent which translated to 0.8% said sufficient resources were not utilised (Table 6). This view of the respondents suggests that the Biology tutors sparingly made use sufficient resources during practical sessions.

On the item of how often students were allowed to ask questions to aid understanding of concepts, 6.4% indicated, at all of the time, 53.6% and 30.4% respectively said that students were most of the time and sometimes allowed to ask questions to facilitate understanding of concepts, however, 7.2 % and 2.4% were of the view that students were not often allowed to ask questions to aid understanding and never allowed respectively (Table 5). Looking at these views it can be said students are mostly allowed to ask questions to facilitate their understanding of concepts.

Two respondents, representing 1.6% pointed out that tutors involved students in practical activities all of the time, 8.8% said most of the time, 28.8% indicated sometimes, 60% mentioned not often and only one student which translate into 0.8% said students were never involved in Biology practical activities (Table 6). It was therefore not a popular perception of the respondents that students were not involved in practical activities rather most of them were of the view that they are made to take part in practical Biology activities.

When asked how often Students work in groups with other course mates, Nine respondents , which is 7.2 % indicated all of the time, 62.4% and 27.2% said most of the time and sometimes respectively, One respondent representing 0.8% and three respondents 2.4% however said not often and never respectively (Table 5). When theses perceptions are looked at, it is instructive to note that group work was mostly employed during Biology practical sessions.

On the item of how often students held class discussions with others on the various practical topics, 6.4% said it occurred all of the time, 20% believed that it happened most of the time , 54.4% indicated sometimes, but 16.8% stated not often, 2.4% indicated never (Table 6). It was therefore a majority view that class discussion among students occurred most of the time.

Six respondents representing 4.8% stated that tutors allowed students to use the materials and equipment during practicals lessons, 6.4% were of the view that, it occurred most of the time, 40.8% said sometimes, on the contrary 46.4% mentioned not often 1.6 said never (Table 6). Although more than half of the respondents were of the view that they sometimes made use of equipment and materials during practical sessions, majority of the respondents believed that the frequency of usage of materials and equipment were not often (Table 5).

The researcher wanted to know the view of the respondents about how often students write a practical laboratory report at the end of each practical lesson. While 5.6% said it happened all of the time, 4.8% stated most of the time. Twenty-eight respondents which represent 22.4% and 66.4% indicated sometimes and not often respectively, also, 0.8% asserted that they were never made to write post laboratory report (Table 6). It is

instructive to note from the data that majority of the respondent agreed to the fact that post laboratory reports were often written after Biology practical activities to reflect the outcome of the practical session.

In respect of respondents‟ view on how often tutors mark quizzes, class exercises and lap reports on time and give feedback accordingly, 8.0% and 11.2% indicated all of the time and most of the time respectively, also, 47.2% and 30.4% of respondents pointed out sometimes and not often respectively, however, only four respondents, representing 3.2% said the item never occurred often (Table 6). It is therefore a popular perception among the respondents that the tutors do mark their post lab reports and the feedbacks are given to them on time.

Table 6: Students' response on utilization laboratory resources in organizing Biology practical activities.

Item	AT (%)	M (%)	ST (%)	NO (%)	N (%)	Total (%)
The teacher makes use of sufficient resources (pictures, tables, animations, computers, etc.)	2(1.6)	20(16.0)	73(58.4)	29(23.2)	1(0.8)	125(100)
Students are allowed to ask questions to aid understanding of concepts	8(6.4)	67(53.6)	38(30.4)	9(7.2)	3(2.4)	125(100)
The teacher involves students in practical activities	2(1.6)	11(8.8)	36(28.8)	75(60.0)	1(0.8)	125(100)
Students work in groups with other course mates	9(7.2)	78(62.4)	34(27.2)	1(0.8)	3(2.4)	125(100)
Students hold class discussions with others on the various practical topic	8(6.4)	25(20.0)	68(54.4)	21(16.8)	3(2.4)	125(100)
The teacher allows students to use the materials and equipment in practical	6(4.8)	8(6.4)	51(40.8)	58(46.4)	2(1.6)	125(100)
Do you write a practical laboratory report at the end of each practical lesson?	7(5.6)	6(4.8)	28(22.4)	83(66.4)	1(0.8)	125(100)
The teacher marks quizzes, class exercises and lap reports on time and gives feedback accordingly	10(8.0)	14(11.0)	59(47.2)	38(30.4)	4(3.2)	125(100)

Note: AT = All of the time MT = Most of the time ST = Sometimes NO = Not often N = Never

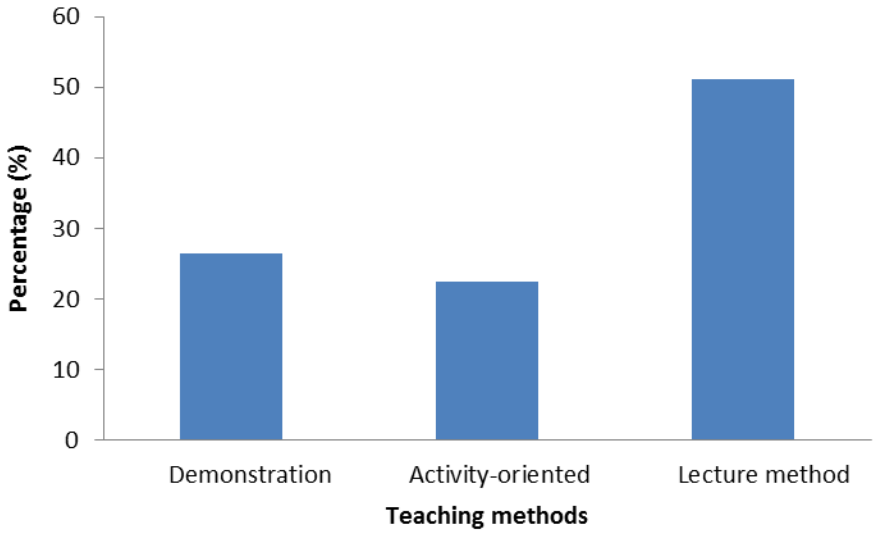

Figure 3: A bar graph showing the teaching methods used for Biology lessons

The researcher sought to find out the teaching method which was mostly used to teach Biology in the selected colleges, 26.4% of the respondents stated that demonstration was the strategy which was mostly used to teach Biology in the colleges, 22.4% also mentioned activity-oriented method, however, 51.2% indicated the lecture method as the most frequently used teaching method in teaching Biology in the selected colleges. With reference to this outcome, it could be said that activity-based method was the least used method for teaching Biology in the colleges. It is also indicative that practical lessons were not often conducted since practical lessons are activity- based. Again the demonstration method was also used more than the hands-on activity. It is therefore concluded that practical-oriented lessons were not sufficiently used in teaching Biology in the selected colleges. Again as lecture method was mostly used instead of hands-on activities (Figure 3), this situation will not enhance understanding of scientific concepts.

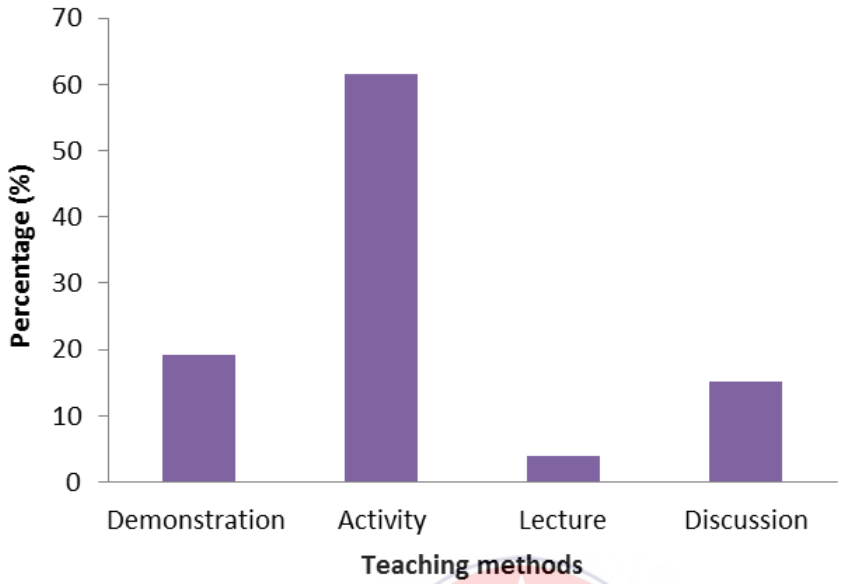

Figure 4: A bar graph showing students' preferred method of teaching Biology

Students‟ perception on their most preferred method for teaching Biology in the Colleges, 19.2% mentioned demonstration method, 61.6% stated activity method, only 4% of them perceived lecture method, and 15.2% of the respondents indicated discussion. From this result, it can be concluded that most of the students preferred activity mode of teaching Biology (Figure 4).

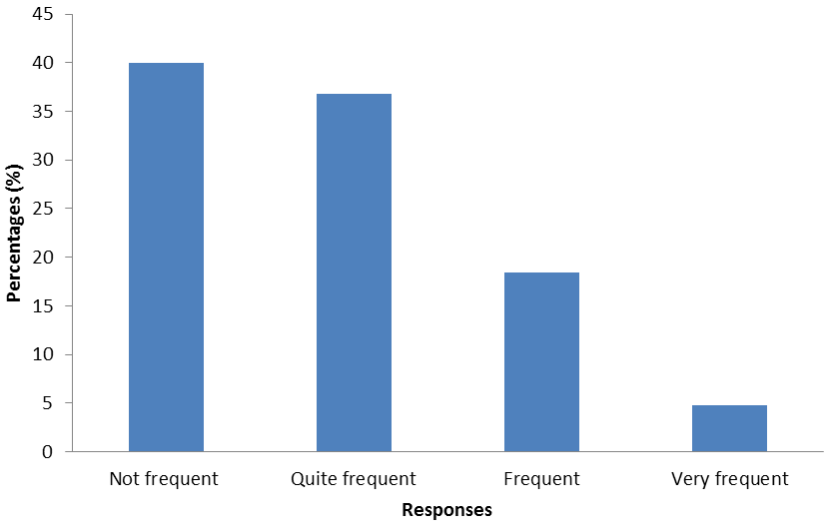

Figure 5: A bar graph showing how frequent Biology practical lessons are organised in the selected colleges

Twenty-three respondents which represent 18.4%, indicated that practical lessons in Biology were frequently organised in the colleges, 40% said not frequent, 36.8% asserted quite frequent but only 6% of the respondents perceived that practical lessons were very frequently organised in the colleges. From the above statistics, it is established that the frequency of organising Biology practical lessons was mostly low in the selected colleges (Figure 6). Consequentially, this situation can hinder the trainees‟ understanding of scientific concepts.

The researcher wanted to find out from the tutors about how Biology practical lessons are organised in the selected colleges. All the tutors unanimously agreed to the statement that they had sufficient training to teach practicals in Biology. Comparing this outcome with tutors‟ academic qualification (Table 3), it is obvious that the educational background and areas of specialisations of tutors also affirmed the belief among tutors that, they had the requisite training to teach Biology practicals (Table 7).

Two tutors, representing 40% strongly disagreed that enough time was available for preparing and delivering the requirements of the Biology course. i.e. enough time to collect materials and specimen and for the conduct of practical lessons also, another two which represent 40% disagreed with the statement, however, only one of them representing 20% was uncertain of statement (Table 7). Inferring from this outcome, it revealed that majority of the respondents were of the view that the time available for pre-lab preparations was not enough to ensure effective organisation of practical lessons in Biology. When the tutors were asked whether they carry out (pre-perform) practical work before class or in advance, 40.0% disagreed and another 40% also agreed. However, 20% strongly agreed to the statement (Table 7). Although equal number of the tutors both agreed and disagreed to the statement, it could be inferred that most of them are of the view that they did carry out or pre- performed practical work ahead of teaching practical lessons, since one tutor, representing 20% strongly agreed to the statement.

When the tutors were asked whether students write practical laboratory report or answer post laboratory questions at the end of each practical lesson, 40% disagreed with the statement. However, 40% and 20% agreed and strongly agreed that students write a practical laboratory report or answer post laboratory questions the end of each practical lesson (Table 7). Though less than half of the tutors disagreed with the statement, it is evident from the result that it was a popular view of the respondents that they let their students write post laboratory report at the end of each practical lesson.

Twenty percent of respondents disagreed that the college curriculum was loaded and as a result it adversely affected Biology practicals activities. However, 40% and another 40 % respectively agreed and strongly agreed. Deducing from this, one can conclude that Biology practical lessons were adversely affected due to the loaded nature of the college curriculum (Table 7).

In order to find out whether the practical lessons prescribed in the Biology course outline was relevant to the learners‟ experiences and background knowledge, 20% strongly disagreed, another 20% also disagreed whiles 40.0% were not sure of the statement. On the contrary, 20 % strongly agreed. It evidently clear that most tutors in the selected colleges were of the view that the practical activities prescribed in the Biology course outline was relevant to the trainees‟ background and experience.

On the item; the Biology programme enables students to acquire the relevant manipulative skills that enable them to handle and operate science equipment and materials effectively at the end of the practical lessons, one respondent representing 20% strongly disagreed and 40% disagreed with the statement. Also, one of the respondents, 20%was not sure, again, another 20% agreed to the statement. This result obviously revealed that tutors believed that the current Biology programme for Mathematics and Science Colleges of Education does not enable trainees handle and operate science equipment and materials in order to acquire relevant manipulative skills (Table7).

Table 7: Tutors perception of conduct of Biology practical lessons in the selected colleges.

Item	SD (%)	D (%)	NS (%)	A (%)	SA (%)	Total (%)
Do you have sufficient training to enable you teach Biology practicals	0 (0.0)	0(0.0)	0(00.0)	5(100.0)	0(0.0)	5(100)
There is enough time available for preparing and delivering the requirements of the Biology course. e.g. enough time to collect materials, and specimen and for the conduct of practical lessons	2(40.0)	2(40.0)	1(20.0)	0 (0.0)	0 (0.0)	5(100)
Do tutors carry out (perform) practical work before class or in advance?	0 (0.0)	2(40.0)	0 (0.0)	2(40.0)	1(20.0)	5(100)
Do students write a practical laboratory report or answer post laboratory questions the end of each practical lesson?	0 (0.0)	2(40.0)	0(0.0)	2(40.0)	1(20.0)	5(100)
The college curriculum is loaded; therefore Biology practicals suffer because of this.	0 (0.0)	1(20.0)	0 (0.0)	2(40.0)	2(40.0)	5(100)
The practicals prescribed in the Biology course outline is relevant to the learners‟ experiences and background knowledge	1(20.0)	1(20.0)	2(40.0)	0 (0.0)	1(20.0)	5(100)
The Biology programme enables students to acquire the relevant manipulative skills that enable them to handle and operate science equipment and materials effectively at the end of the practical lessons	1(20.0)	2(40.0)	1(20.0)	1(20.0)	0(0.0)	5(100)

Note: SD = Strongly Disagree, D = Disagree, NS = Not Sure, SA = Strongly Agree and percentages are in parenthesis.

Research question 3:

What are the challenges associated with the organisation of Biology practical lessons?

This research question was addressed using items 15 of students‟ questionnaire, (Appendix A) and 1 to 22 of the tutors‟ questionnaire (Appendix B).

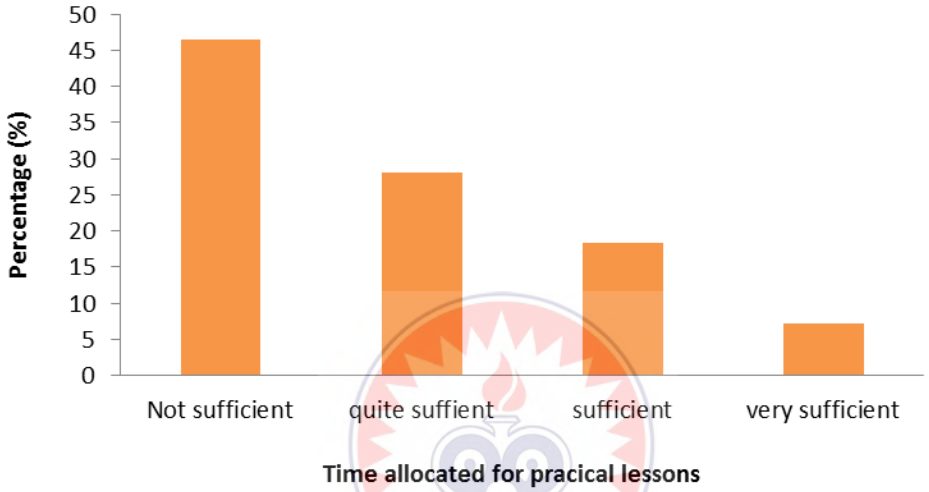

Figure 6: A bar graph showing students' perception of time allocation for Biology practical lessons

The analysis of the result revealed that 46.4% of the respondents indicated that the time allocated for Biology practical lessons was not sufficient whiles 28% perceived that the time allocated was quite sufficient. Also, 18.4% of the respondents asserted that the time was sufficient, however only 7.2% of them were of the view that the time allotted for practical lessons in Biology was very sufficient. Based on these responses, it is indicative that majority of the respondents‟ perception about time available for Biology practical lessons in the selected college was not sufficient for effective hands-on activities (Figure 6).

The analysis revealed that all the tutors accepted that they face challenges when organising Biology practical lessons (Table 8). These constrains included: lack of funds, inadequate materials , large class size, ignorance about the use of basic science tools by students, insufficient time to organise practical lessons , and no separate time allocation for Biology practical work on the college time table . Looking at these pitfalls it is an indication that practical lessons were adversely affected

Table 8: Tutors' response on the existence of challenges when organising Biology practical lessons

Response	Frequency	Percentage
Yes	5	100
No	0	0
Total	5	100

These findings affirmed the claim of Kapting"ei and Rutto (2014) who indicated that inadequate laboratory equipment, small laboratory space, and time constrains in many cases affect practical activities.

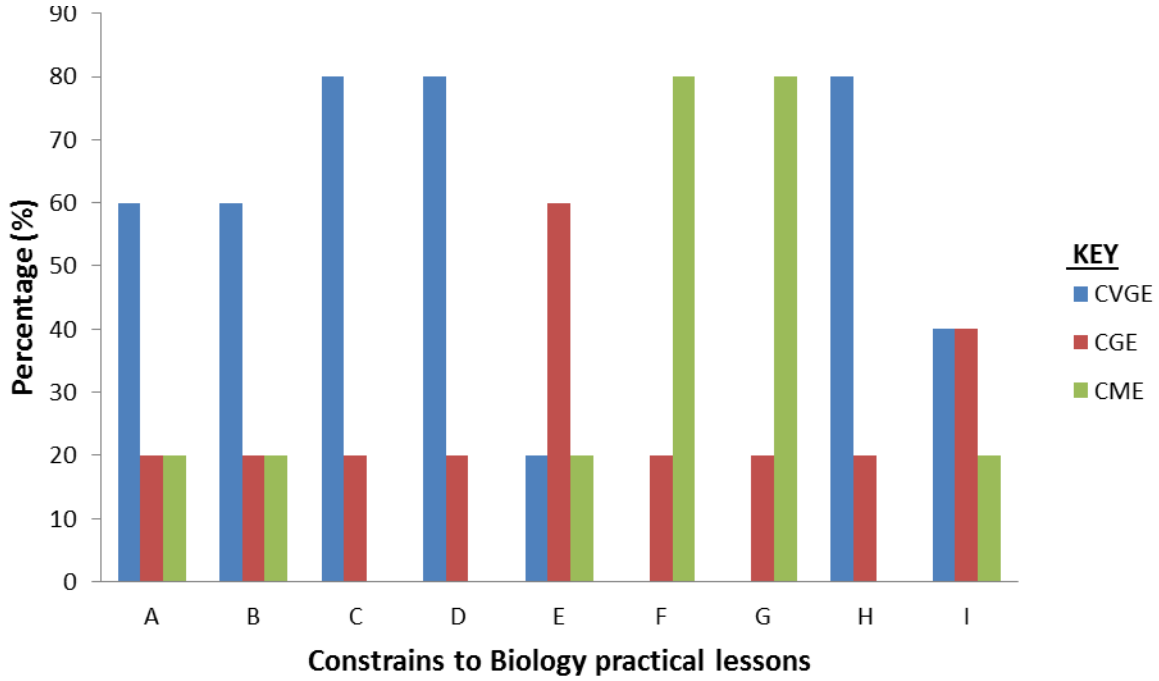

Figure 7: A bar graph showing the extent to which constrains affected Biology practical lessons

KEY
CVGE= Constrained to a Very Great Extent;

CGE = Constrained to a Great Extent; CME= Constrained to a Moderate Extent

Constrains To Biology Practical Lesson

A: Over populated classes.

B: Inadequacy in quantity of resources/ materials

C: Short time/periods for Biology classes.

D: No separate time for Biology practicals

E: Ignorance on proper use of materials.

F: Lack of security services

G: Lack of specious and well ventilated laboratory.

H: Insufficient fund

I: Lack of quality resources.

Addressing the extent to which identified challenges served as constrains to the organisation of Biology practical activities in the selected Mathematics and Science Colleges of Education, 60% of the respondents were of the view that, over populated class constrain to a very great extent affected the conduct of Biology practical lessons in the selected colleges, 20% mentioned it was to an great extent, also, another one respondent which amount to 20% was of the view that this constrain was to a moderate extent affected the organisation of practical lessons in Biology (Figure 6).

Three respondents representing 60% indicated that inadequacy in quantity of resources/materials to a great a very extent affected practical lessons, 20% mentioned great extent and another 20% was of the view that the constrain was to a moderate extent. On the issue of short time/periods for Biology classes, 80% and 20% asserted to a very great extent and great extent respectively (Figure 7). It is concluded that time constrain adversely affected the conduct of Biology practical lessons in the colleges.

Talking about challenge of the colleges not having separate time for Biology practicals, 80% indicated very great extent, 20% said it was to a great extent.

The researcher wanted to know the extent to which ignorance of proper use of materials negatively affected the conduct of Biology practical lessons in the college, only 20.0% indicated very great extent, 60% were of the view that it was to a great extent, and 20% believed that it was to a moderate extent. This result means ignorance of proper use of materials to a very great extent militated against effective biology practical lessons. None of the tutors believed that lack of security services to protect Biology practical resources was a constrain to a very great extant, but 20% and 80% asserted great extent and moderate extent respectively. Inferring from this, lack of security was not a major

hindrance to biology practical lessons. Again the researcher attempted to find out the view of the tutors on the extent to which lack of specious and well ventilated laboratory affected the organisation of practical lesson in the colleges, 20% said great extent and 80% indicated moderate extent. Ventilation in the laboratories was not a major hindrance to the organisation of practical lessons in Biology in the colleges.

Looking at insufficient fund, 80% perceived that this constrain was to a very great extent while 20% claimed it was to a moderate extent, affected the effective organisation of Biology practical lessons (Figure 7). A critical look at this outcome revealed that lack of funds to organise hands-on activities in the colleges was one of the key setbacks to Biology practical lessons.

The view of the tutors are sought on the extent to which lack of quality of resources negatively affected the organisation of Biology practical lesson in the colleges, 20% mentioned very great extent, 40% pointed out to great extent and another 40% specified moderate extent. Therefore, lack of quality material resources greatly affected Biology practical activities in the selected Colleges of Education (Figure7).

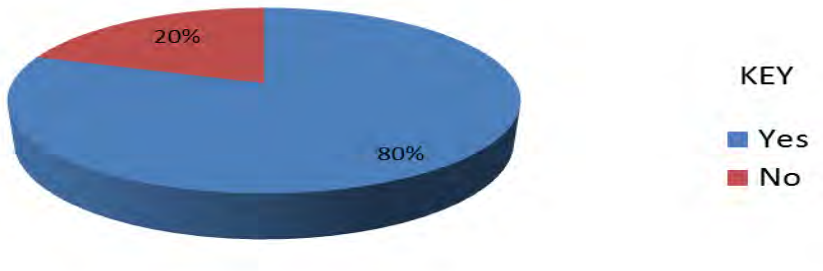

Figure 8: A pie chart showing large class size as a challenge to effective practical lesson

Four tutors, who represent 80% of the respondents, believe that large class size per practical section adversely affects effective conduct of practical activities in the colleges whiles only one tutor representing 10% was of the contrary view. It is obvious that most of the tutors acknowledged that large class size negatively affected effective conduct of Biology practical lesson (Figure 8).

It is therefore established that due to inadequate quantity of materials large class for practical lessons will not present a good opportunity for most students to have access to the materials to perform activities that would enable them acquire basic practical skills in Biology.

Discussion

The study showed that the selected Mathematics and Science Colleges of Education have laboratories designated for teaching Biology practical, but the laboratories were mostly used for theory lessons rather than practical lessons. This situation according to the study was as a result of the laboratories been ill-equipped with requisite materials and equipment required to meet the needs of all trainees for the conduct of effective Biology practical activities. This has confirmed the assertion of Ogunyemi (1990) that when materials are provided to meet the needs of a school system, students will not only have access to reference materials but individuals will also learn at their own pace to increase their academic competence.

The research findings showed that a practical lesson was considered as one of the most effective means of teaching and learning Biology. Nevertheless, there were some

challenges associated with the organisation of Biology practical activities which adversely affected the frequency of organisation of biology practical lessons.

This situation could hinder the trainees‟ understanding of scientific concepts. This outcome confirms the assertion of Freedman (1997), that motivation to learn science does not only depend on interest the students bring to school but also as a result of certain learning situations among which laboratory work can be found.

The study revealed that though there was time allocated for Biology course, however the time allocated for Biology practical activities was inadequate to enable the tutors organise effective Biology practical lessons. Consequently, these Biology practical lessons become infective and therefore could not yield the right result for students. This observation is in line with that of Kraft (1994). In his submission, he indicated that Ghanaian students spend less time in learning in school and that the learning time was less by two or three hour a day. This time constrain associated with Biology practical lessons made most of the tutors to overlook some integral part of the college Biology course. These constrains had also made tutors pay little attention to practical lessons and this will eventually adversely affect students‟ performance and the ability to acquire basic scientific science skills needed to effectively teach science when they leave college.

From the study, it came to light that most tutors organised Biology practical lessons through demonstration rather than the hands-on method to facilitate trainees‟ understanding, retention and acquisition of skills, knowledge and learning experiences. This confirms the view of Von Secker and Lissitz (1999) who were of the view that teacher-centered instructions are negatively associated with achievement. On the other

hand, it means science achievement is expected to increace with the amount of laboratory inquiry. They also concluded that de-emphasizing traditional teacher-centered instruction is expected to increase average science achievement and minimise the gaps in achievement between individuals of different socio-economic status. Enquiry approaches to the study of Biology therefore yield achievement than teacher-cantered aprproach.

These approaches to teaching Biology in the colleges do not give room to the trainees to develop their creative abilities as declared by Adepoju (1999). Also, Young (1990) stressed that when students are involved in hands-on activities they learn to be curious, creative and acquire knowledge meaningfully. Practical Biology lessons are therefore important and should be used by tutors to aid their students abstain better results and be well equipped in-service science tutors.

The study also revealed that large class size per practical lesson in the selected colleges coupled with inadequacy of laboratory resources did not help to promote effective Biology practical lessons. It was found out that the laboratories resources were not sufficient to enable all students have access to materials for hands-on activities at the same time. These outcomes affirmed that of Gayford (1988), who found out that lack of science laboratories or inadequate equipment in science laboratories in Colleges affects tutors "attitudes towards the aims of science experiments. These occurrences to a great extent, prevented most trainees from engaging in self-initiated exploration to promote basic scientific skills acquisition.

In a nut shell, the study unearthed a number of challenges which confronted both trainees and their tutors in the course of conducting of Biology practical lessons. These constrains include; lack of well-equipped laboratory, insufficient apparatus/equipment, insufficient

time for practical activities, luck of certain critical specimen, large class size, insufficient chemicals, inadequate quality of resources, no separate time for Biology practicals, insufficient laboratory space and luck of funds for effective and frequent organisation of Biology practical activities. Since these constrains adversely affected Biology practical lessons in the colleges, these outcomes therefore agree with Tsuma (1997), who pointed out that a science laboratory is an indispensable facility in science education, if well equipped with the right kind of apparatus and chemicals then it should provide the best setting for teachers to assist students in acquiring scientific knowledge and skills.

CHAPTER FIVE

SUMMARY, CONCLUSION, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER STUDIES

Overview

This chapter contains summary of the findings of study, conclusions, recommendations and suggestions further study.

Summary of Findings

From the analysis, the following major findings were unearthed:

1. Both trainees and tutors in the selected Mathematics and Science Colleges of Education; St. Francis College of Education, Hohoe and Akatsi College of Education, Akatsi indicated that their respective colleges have separate Biology laboratory for practical activities , which was however under resourced.
2. Biology tutors from the selected colleges are all qualified in their respective areas of specialisation and therefore are well equipped with the requisite competencies to teach Biology at the Colleges of Education.
3. The tutors in the colleges mostly pre-perform practical activities in advance before engaging students in Biology practical lessons.
4. The students in the selected colleges were of the view that practical activities are the most effective means of teaching and learning of science.
5. The students were made to write post-lab reports to reflect the outcomes of practical activities.

6. There was no separate time for Biology practical work and that the time available on the college timetable was not adequate for effective practical work.
7. Few laboratory resources present were used in groups in the colleges.
8. In the colleges, the class sizes were too large for practical activities.
9. Tutors do provide clear written instructions for students to follow during practical sessions
10. Hands-on activities were not often used in the teaching of biology lessons.
11. Most of the practical lessons were dominated by demonstrations by the tutors

Students were allowed to work in group and interact among themselves.

Conclusion

From the findings, it was revealed that each of the selected Colleges of Education has separate Biology laboratory for practical activities, but they were not well resourced enough to promote effective organisation of practical work. It could also be inferred that inadequate supply of laboratory resources in the colleges had also adversely affected the conduct of Biology practical lessons. It could be concluded from the study that practical work is the most effective method of teaching and learning Biology, however tutors in the colleges sparingly organise practical lessons due to lack adequate materials and equipment.

The major mode of practical activities was the demonstration due to inadequate supply of resources and funds. The study again shows that the large class size had been a major setback towards effective practical work in the selected college since trainees had to always work in groups during practical sections.

Inadequate time allocated for Biology on the college timetable coupled with no separate time allocated to Biology practical lessons did not promote regular and frequent use of practical lessons in Biology.

Recommendations

From the findings of this study, it is obvious that the status of Biology practical activities in the selected colleges leave much to be desired. Based on this, the following recommendations have been made:

1. The government should refurbish the science laboratories at the selected Colleges and upgrade them to modern status to enhance effective organisation of hands-on activities and lessons. A well-organised laboratory should be provided to promote the effectiveness in exposing college students to the enquiry-based scientific learning.
2. There should be regular supply of chemicals, specimen, apparatus and general teaching and learning materials to the laboratories at these two colleges. This will help in ensuring that, expired and obsolete materials, chemicals and equipment will not be used to teach modern concepts in Biology.
3. Separate time should be allocated on the college timetable to increase the time available for practical activities
4. Large class size should be reduced to ensure effective management of the limited laboratory resources at the colleges.

5. Tutors should also be well motivated and encouraged to improvise materials from the college communities to supplement scares and sophisticated ones during lessons.
6. The use of technological devices such as computer simulations, videos, Power-Point presentations and internet based research should be encouraged among both the tutors and students of college Biology programme at the two colleges. These will supplement the shortfall of materials and equipment
7. The current system in which Biology is only studied in only three semesters of the entire 3-year Diploma in Basic Education programme should be reviewed
8. College Councils should work with the Academic Boards to increase the duration for the study of college Biology by increasing the number of credit hours and also allow the programme to be studied in all the semesters of students‟ On-campus period. The college administrations should also be asked to increase the time allocated to the study of Biology on the college time table.
9. End of semester examinations in practical Biology courses (FDC 114BP FDC 124BP and FDC 214BP) which are organised and supervised by the Institute of Education, of the University of Cape Coast should be strictly hands-on whilst that of theory oriented courses (FDC114B, FDC 124B and FDC 214B) should be minds-on. This will help increase the level of commitment in the students and the desire of the Biology tutors to organise practical lessons and activities during the programme implementations.

Suggestions for Further Studies

In Ghana and elsewhere, many studies have been made to investigate the teaching and learning of science as well as the factors that militate against effective teaching and learning of science in Colleges. This study has contributed new knowledge by engaging Biology tutors and students at the Colleges of Education level in practical Biology activities to get a true picture of the practical aspect of the elective Biology program was organised .

Although a descriptive survey design was used in this study, the findings cannot be said to be representative of the situations in all other 13 designated Mathematics and Science Colleges of Education in Ghana. It is, therefore, suggested that similar survey be carried out in other designated Mathematics and Science Colleges of Education as well. This will help to provide a good basis for more generalization of conclusions to be made on some aspects of Biology practical work.

Again a study could also be conducted to find out whether gender has any influence on the Biology programme in the Colleges of Education in Ghana

Comparative study of the status of Biology practical activities in the designated Colleges of Education to ascertain whether there is a significant difference between the quality of Biology practical among the various Mathematics and Science Colleges of Education in Ghana

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APPENDICES

APPENDIX A

Students' Questionnaire

This questionnaire seeks information on the topic: *An Investigation into the Status of Biology Practical Activities in Mathematics and Science Colleges of Education in the Volta region, Ghana.* The exercise is purely academic. Any information given is solely for academic purposes. The questions are intended to seek your views on how the practical aspect of elective Biology programme is undertaken in your college. You are highly assured of confidentiality and anonymity. Thank you.

SECTION A:

1. Coded Name of the college ……. Coded Name of student

SECTION B: **Resources Available for Teaching Elective Biology**

Please tick (√) inside the box that corresponds to your choice of response. Your objectivity and fairness in response selection will be highly recommended and appreciated. The rating is as below:

SD = Strongly Disagree; D = Disagree; NS = Not Sure; A = Agree; SA = Strongly Agree

SN	RESOURCE ITEM DESCRIPTION	SD	D	NS	A	SA
1	The college is well resourced for the teaching of Biology.					
2	The college has a modern science laboratory for the teaching of Biology					
3	The science laboratory is well equipped for the teaching of Biology.					
4	Tutors are adequately prepared to teach Biology practical lessons					
5	Tutors at this college are reluctant to organise regular practical activities in Biology.					
6	Enough time is allocated on the college time table for the teaching and learning of practical Biology					

SECTION C:

How often do the following activities occur during your Biology practical lessons?

AT = All of the time MT = Most of the time ST = Sometimes NO = Not often N = Never

SN	During Biology Practical Lessons:	AT	MT	ST	NO	N
7	The teacher makes use of sufficient resources (pictures, tables, animations, computers, etc.)					
8	Students are allowed to ask questions to aid understanding of concepts.					
9	The teacher involves students in practical activities					
10	Students work in groups with other course mates					
11	Students hold class discussions with others on the various practical topics.					
12	The teacher allows students to use the materials and equipment in practicals					
13	Do you write a practical laboratory report at the end of each practical lesson?					
14	The teacher marks quizzes, class exercises and lap reports on time and gives feedback accordingly.					

15. How sufficient is the time allocated for biology practical activities?

(i) Not sufficient (ii) Quite sufficient (iii) sufficient (iv) very sufficient

16. Which of the following method is mostly used in teaching biology lessons?

(i) Demonstration (ii) Activity-oriented (iii) Lecture method

17. Which of the following method do you prefer to be used to teach biology?

(i)Demonstration (ii) Activity-oriented

(iii) Lecture method (iv) Discussion method

18. How frequent are biology practical lessons organised in your colleges

(i) Not at all (ii) Frequent (iii) Not frequent (iv) Quite frequent (v) Very frequent

APPENDIX B

Tutors' Questionnaire

Dear respondent,

This questionnaire seeks information on the topic: *An Investigation into the Status of Biology Practical Activities in selected Mathematics and Science Colleges of Education in the Volta region, Ghana.* The exercise is purely academic. Any information given is solely for academic purposes. The questions are intended to seek your views on how you undertake the practical aspect of elective Biology programme. You are highly assured of confidentiality and anonymity. Thank you.

SECTION A:

a) Coded Name of College…….. b) Coded Name of Teacher……
c) Qualification: Academic/ Professional……
d) Area of Specialization…….

SECTION B:

Please tick (√) inside the box that corresponds to your choice of response. Your objectivity and fairness in response selection will be highly recommended and appreciated. The rating is as below:

SD = Strongly Disagree; D = Disagree; NS = Not Sure; A = Agree; SA = Strongly Agree

SN	ITEM DESCRIPTION	SD	D	NS	A	SA
1	Your college has adequate equipment, facilities, and laboratory available for Biology practical work					
2	There are enough materials and equipment for each learner to carry out practical work in Biology					
3	There is time enough for carrying out practical lessons					
4	Do have sufficient training to teach practicals in Biology?					
5	There is enough time available for preparing and delivering the requirements of the Biology course. E.g. enough time to collect materials, and specimen and for the conduct of practical lessons.					

6	Do tutors carry out (perform) practical work before class or in Advance					
7	Do students write a practical laboratory report or answer post laboratory questions the end of each practical lesson?					
8	The college curriculum is loaded; therefore Biology practicals suffer because of this.					
9	The practicals prescribed in the Biology course outline is relevant to the learners‟ experiences and background knowledge					
10	The Biology programme enables students to acquire the relevant manipulative skills that enable them to handle and operate science equipment and materials effectively at the end of the practical lessons.					

11. (i) Do you face challenges in organising biology practical lessons?

YES [ ] NO [ ]

(ii) If yes, mention the challenges you face?

……
……
……

SECTION C

To what extent do the following constrains affect biology practical lessons?

CVGE= Constrained to a Very Great Extent; CGE = Constrained to a Great Extent; CME = Constrained to a Moderate Extent

SN.	Constrains To Biology Practical Activities	CVGE	CGE	CME
12	Over populated classes			
13	Inadequacy in quantity of resources/ materials			
14	Short time/periods for biology classes			
15	No separate time for biology practicals			
16	Ignorance on proper use of materials			
17	Lack of security services			
18	Lack of specious and well ventilated laboratory			
19	Insufficient fund			
20	Inadequacy quality of resources			

21. (i) Does large class of students per practical section posse problem to effective learning?
YES [ ] NO [ ]

If yes, what effect does your class size have on doing practicals?
……
……

APPENDIX C

PRACTICAL BIOLOGY LESSON OBSERVATION GUIDE

GENERAL INFORMATION

Date: ……Name of College…… Year Group: ……..

Number of students attending the practical lesson ……Duration of the practical lesson: ……

1. **Classroom Setting: Descriptor 'Yes, 'No', comment**

(a) Are students sitting in groups? YES [ ] NO [ ]

b) If yes, in how many groups? ……

(c) Number of students per group ……

(d) If they are not seated in groups, how are they seated?
……

2. **Resources to Support the Practical Lesson: Descriptor; 'Yes' or 'No' comments**

(a) Does the teacher have a guide for the practical lesson? YES [ ] NO [ ]

(b) Do the students have a lab manual? YES [ ] NO [ ]

(c) If yes are they using it for the practical lesson? YES [ ] NO [ ]

(d) If yes, is the instruction in the lab manual clear? YES [ ] NO [ ]

(e) Are there enough apparatus and equipment for all the students to use during the practical lesson? YES [ ] NO [ ]

(f) Are the apparatus in a good condition YES [ ] NO [ ]

(g) Are students stating the names of all the apparatuses and equipment during the practical (as they talk to each other?) YES [ ] NO [ ]

(h) If students do not have a laboratory manual, what are they using as a guide for the practical?

(i) (A) Are they using a laboratory or a classroom for the practical lesson?

Laboratory [ ] Classroom [ ]

(b) If they are using the laboratory, in which condition is the laboratory?

……

(c) Is the laboratory big enough to accommodate all the students during the practical lesson? YES [ ] NO [ ]

3. Introduction: Descriptor; 'Yes' or 'No' comments

(a) How did the teacher introduce the practical lesson?

(b) Did the teacher give clear instructions on what is going to be done during that practical lesson? YES [ ] NO [ ]

(c) Is the instruction verbal or is it written?

(i) Verbal [ ]

(ii) Written [ ]

(iii) [ ]

(d) How did the teacher make sure that all the students got the instructions clear before they started the practical?

……
……
……
……
……

(e) Did the teacher do any demonstration to familiarize students with the practical before they started with the practical lesson? YES [ ] NO [ ]

4. Teacher/ learner interaction. Descriptor; 'Yes' or 'No' comments

(a)Is there any interaction between the teacher and the students during the practical lesson?

YES [ ] NO [ ]

(b) Is the teacher walking from group to group of students? YES [ ] NO [ ]

(c) Is the teacher doing some explanations as he\she walks from one learner to the next?

YES [ ] NO [ ]

(d) Are students doing the practical themselves, are they handling the equipment themselves?

YES [ ] NO [ ]

(e) Did the teacher make sure that all students are handling the practical equipment during the practical lesson? YES [ ] NO [ ]

(f) Are the students interacting with each other during the practical lesson? YES [ ] NO [ ]

5. Presentation of Classroom Activities during the Practical Lesson: Descriptor; 'Yes' or 'No' comments.

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(a) Did students ask questions on what they did not understand? YES [ ] NO [ ]

(b) Did the teacher provide feedback? YES [ ] NO [ ]

(c) Was the feedback helpful to the students? YES [ ] NO [ ]

(d)Did the teacher briefly explain all the steps involved in the practical lesson? YES [ ] NO [ ]

(e) Are all students involved/ participating in the practical lesson? YES [ ] NO [ ]

(f) Are the students recording their results during the practical lesson? YES [ ] NO [ ]

(g) Where all students following the steps as stipulated by the teacher? YES [ ] NO [ ]

(h) Did most of the students have the same results after the experiment? YES [ ]NO [ ]

(i) If some students did not get the anticipated results, what did the teacher do in order to help them get the results?

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6. Role of the teacher during the practical lesson: Descriptor; 'Yes' or 'No' comments

(a) How did the teacher make sure that students were involved in the practical lesson?

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(b) Is the teacher mentioning the names of all the apparatus and equipment to be used during the practical? YES [ ] NO [ ]

(c) Is the teacher mentioning the functions of all the apparatus to be used during the practical?

YES [ ] NO [ ]

(d) Did the teacher remind the students about the remaining time before the practical lesson ends? YES [ ] NO [ ]

(e) Did the teacher make sure most of the students were following the right procedures in order to get the results that were anticipated? YES [ ] NO [ ]

(f) If yes, how did he\she made sure that most of the students were following the right procedures to get results?

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g) How did the teacher make sure that most of the students were involved?

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7. Conclusion: Descriptor; 'Yes' or 'No' comments

(a) Did the experiment yield the expected results? YES [ ] NO [ ]
(b) Did most of the students get similar results at the end of the experiment?
YES [ ] NO [ ]
(c) Did Students hand in any work to the teacher for assessment after the practical?
YES [ ] NO [ ]
(d) Did they finish the practical lesson on time before the lesson ends? YES [ ] NO [ ]

(e) At the end of the practical lesson. Did the students write a practical report or answered post lab questions, or wrote nothing

(i) Post Lab questions [ ]
(ii) Practical report [ ]
(iii)Wrote nothing [ ]

(f) How did the teacher conclude the practical lesson?

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Any other comments

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