UNIVERSITY OF EDUCATION, WINNEBA

STUDENTS' VIEWS OF THEIR TEACHERS AND THEIR OWN ATTITUDE TOWARDS BIOLOGY LABORATORY WORK IN THE BAWKU EAST DISTRICT

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MASTER OF PHILOSOPHY

2023

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A thesis in the Department of Science Education, Faculty of Science Education, submitted to the School of Graduate Studies, in partial fulfillment of the requirements for the award of the degree of
Master of Philosophy
(Science Education)

in the University of Education, Winneba.

FEBRUARY, 2023

DECLARATION

STUDENT'S DECLARATION

I, **Asori Cletus Agangiba**, 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. JAMES AWUNI AZURE

SIGNATURE: ……

DATE:…….…….….

DEDICATION

I dedicate this work to my wife, Mrs. Azongo Joyce Awinbood and my children – Asori Josephine Lamisi, Asori Graham Awinongti, Asori Micah Awinpass, Atiiga Jemimah and Asori Addison Apuswini.

ACKNOWLEDGEMENTS

I wish to express my heartfelt gratitude and much appreciation to God Almighty for the guidance, protection, strength, knowledge, wisdom, mercy, provision and direction given me, His servant, to successfully complete this programme.

My sincerest thanks go to my supervisor, DR. JAMES AWUNI AZURE, a senior lecturer in the Department of Integrated Science Education, University of Education, Winneba, who whole-heartedly offered constructive suggestions and directions to the successful completion of this research work. I my father, Ndeogo Mbawini, my mother, Mbawini Asummalis and my brothers and sisters for their prayers, moral love and support. Great thanks to my friends for their guidance, assistance, advice and encouragement in the course of writing this thesis, not forgetting Mr. Abindaw Thomas, Dakwari Joe, Atugum Martin, Ndebugri Denis and Ayariga Jeremiah for much support offered me.

Lastly, I am grateful to all my respondents from the various senior high schools who contributed valuable information for the study.

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ABSTRACT

This study was carried out to investigate students' views of their teachers and their own attitudes towards biology laboratory work at SHSs in Bawku-East district, Ghana. The mixed method approach and sequential explanatory design were used. A sample of 160 senior high school form 3 (SHS3) elective biology students randomly drawn from three public senior high schools were used for the study. The study was guided by three research questions. Questionnaires and checklist were developed by the researcher and used for data collection. The data collected were analysed using mean, standard deviation, and standard error. The results showed that majority of the elective biology students performed poorly in biology laboratory practical work. Results from the study showed that most of the biology students within the Bawku East district performed poorly or below expectation in biology practical work. The results suggested that none of the three (3) schools has all the laboratory equipment sufficiently, and are generally not good for use among the various schools and will definitely affect student's performance negatively. The study found out that 100.00% of the schools had laboratories but were not well equipped for practical work in their respective schools. It is imperative that biology teachers take students through a lot of practical activities to help improve students' performance in biology laboratory work in the second cycle institutions. The study concluded that, teachers have positive attitudes but few also have exhibited negative attitudes with regards to laboratory practical or work within the Bawku East District. The study has shown that, biology students within the Bawku East district exhibited positive attitudes towards biology laboratory work. Also, some of the teachers do not allow students to have hands on the practical tools during biology practical lessons.

KEY WORDS

Practical work

Biology

Task

Specimen

Labeling

Teaching and Learning materials

Biological drawing

Laboratory

Level

Teaching tools

Teaching laboratory

Performance

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter provides the basic framework of the whole thesis. It embodies the background to the study, statement of the problem, purpose of the study, objectives of the research, research questions. Also, presented are educational significance of the study, delimitations, limitations, operational definitions of certain terms, and the organization of the text.

1.1 Background to the Study

The teaching and learning of biology are very important because the knowledge of biology helps us in improving the quality of life of people and in solving many societal problems relating to health, food storage, crop production and environmental conservation (Abrahams & Reiss, 2012). In Ghana the significance derived from biology, in the school curriculum from the basic level to the senior high level reflects accurately the vital role it plays in modern society. The basis for teaching elective biology at the SHS level include the fact that, the existence of humans and the development of nations would ever depend more and more on science and skills. Biology however, as a branch of natural science is devoted to the study of life and activities of all living things from bacteria to high plants and animals. The survival of humans depends greatly on the knowledge and understanding of the structure and functions of organisms and how they interact with one another and the atmosphere. Therefore, the need to teach biology eventually is to explain the living world in terms of scientific principles although appreciating that, organisms behave in ways which often seem beyond the competences of their component parts. The knowledge, skills and attitudes acquired through the study of biology is to provide the learner with the

essential basic tools for further studies. It further prepares the learner for investigation in pure and applied discipline and technology that are vital areas for the development of society. Teaching elective biology in totality should guide the learner and make him/her capable of critical thinking, making meaningful choices and solving problems Ofori-Appiah (2015). These cannot be accomplished without practical activities. Practical work in science is defined to be any science teaching and learning activity which involves students, working individually or in small groups, manipulating and/or observing real objects and materials, as opposed to the virtual world (Science Community Representing Education (SCORE), 2008).

Practical work involves the use of apparatus in teaching biology, i.e., teaching and learning activities is based on 'real life experience' help learners to transform knowledge or information into their personal knowledge which they can apply in different situations. Practical work is viewed by the vast majority of science teachers, as an essential and integral part of science education. In fact, many regards it as an indispensable aspect of being a 'science teacher' (Donnelly ,1998 from review Practical work effectiveness in primary/secondary schools). Practical work can encompass many different components, which can be divided into two main groups as described in Woodley (2009), as follows:

(1) Core activities: These include 'hands-on' activities performed by students such as different investigations, laboratory techniques and procedures, as well as fieldwork. These types of activities can help enhance the development of students' practical laboratory skills, as well as helping them to understand key scientific concepts and phenomena.

(2) Directly related activities: These are closely connected to the above core activities, and include practical demonstrations performed by the teacher, planning and designing scientific investigations and analysis of data.

In addition, some argue that other activities such as use of computer simulations, modelling, use of surveys, presentations, group discussion and role plays can also constitute what is meant by the term practical activity (SCORE, 2008). However, others would disagree, and believe these activities would not come under the practical activity 'umbrella', and rather that they should be used complementarily alongside other practical activities, rather than be a substitute for them (Woodley, 2009).

Millar described a practical activity as 'Any science teaching and learning activity which at some point involves the students, working individually or in small groups, in observing or manipulating objects to develop understanding' (Millar & Abraham, 2009). It is 'Any activity that enables pupils to have direct, often hands-on, experience of the phenomena they are studying. In fact, the following quotation from SCORE underpins what many believe about the importance of practical work in science: 'Science without practical is like swimming without water (SCORE, 2008).

Therefore, regardless of how practical work is defined, or what activities are thought to constitute it, it can be seen as a central part of how science should be taught in schools.

Designing practical work requires the planning of appropriate scientific experiments to establish interesting learning experiences that can inspire students 'interest in biology, to attain a successful learning process. Teacher needs to appropriately design and plan quality biology lessons concerning the effectiveness. Teachers' competency in designing a practical lesson, as their capability is very limited. Teacher's ability to

design practical lessons/works is important because previous research suggested that it will have a great impact on the effectiveness of practical work itself (Naumescu, 2008). The lack of competence should be seriously taken into consideration. Abrahams et al., (2013) have mentioned that the success of student practical work depends on the ability of teachers to design the activity and to organise the objectives. Teachers must, therefore, be able to develop effective experiments to provide a better practical lesson in biology teaching.

The main purposes of practical work in biology are to engage students, aiding them to develop many important skills. In fact, practical work can support learning in a multitude of ways ranging from 'Personal learning and thinking skills' to 'How science works' (Woodley,2009).

From the beginning of the 18th century to date, educators and researchers have studied the value of practical work and its important role in scientific fields such as biology. Multiple studies showed that practical work confers many advantages, including developing laboratory skills and scientific knowledge, as well as understanding science concepts and theories Fadzil & Saat, 2013; (Schwichow etal., 2016). In support of practical work in the scientific fields, Roberts (2008) designed a booklet on high quality practical activities in science, in which he stated: "Students achieve a deeper level of understanding by finding things out for themselves and by experimenting with techniques and methods that have enabled the secrets of our bodies, our environment, and the whole universe to be discovered."

1.2 Statement of the Problem

There are numerous problems associated with practical work that are quite common to Senior High Schools in Ghana. Students these days are facing numerous challenges in

practical work especially biology in WASSCE examinations. Students can hardly look at an object/specimen and draw it to its resemblance. Specimens are drawn anyhow as if imaginative work is being done. The Chief Examiners' Reports from the West African Examination Council (WAEC) have consistently indicated poor performance of SHS students in biology (WAEC, 2016, 2017, 2018). The Chief Examiners' Reports showed that more students failed in biology because they did not perform creditably in biology practical paper in their final year examinations.

Preliminary investigation carried out by the researcher in two schools showed that, biology practical tasks were taught without teaching the students through biology laboratory work. My experience in teaching coupled with student's academic information revealed that students offering biology performed poorly in their final examination. The schools within the district also lack adequate science materials for practical lessons, teachers teaching methods, laboratories and qualified laboratory assistants to help in practical lessons. Apart from the above problems, time allocated for practical lessons is not adequate and this hinders the organization of practical lessons and a critical look at the content of the Biology Syllabus shows that it is very loaded (Asiedu &Amoako, 2010).

The students have difficulties understanding what they are taught in the biology class, where teachers only rush through the syllabus with the aim of completing it but only end up achieving little learning outcome (Asiedu & Amoako, 2010).

As a biology teacher at Tempane SHS, it was the view of the researcher that the current status of practical work at Bawku - East schools suggested that there is a miss link between issues related to science and technology education and practical work, leading

to non-effectiveness of science laboratory activities, and hence poor performance of students in WASSCE year after year.

It was therefore pertinent to carry out a study to evaluate the way laboratory work in biology was taught, the functions of laboratory classes, biology-oriented courses, the views of students and teachers on the objectives of practical work.

1.3 Purpose of the Study

This study explored students' views of their teachers and their attitudes towards biology laboratory work in some selected Senior High Schools in the Bawku East district.

1.4 Objectives of the Study

The objectives of this study were to:

1. Evaluate the resources available for practical work in schools in the Bawku East District.
2. Examine the attitude of science students towards practical work in biology.
3. Examine teachers' attitude towards the teaching of practical work in biology.

1.5 Research Questions

The following research questions were formulated to guide the study:

1. What are the resources available in the laboratories for practical work in schools in the Bawku East District?
2. What is the attitude of students towards practical work in learning biology?
3. What is the attitude of teachers towards practical work in teaching biology?

1.6 Significance of the Study

The benefits of this research cannot be over emphasised. It would help correct the negative impressions that students have toward the studying of biology in general and biology practical in particular which scares them from studying/ pursuing biology into higher level of education. This is because students' frequent exposure to different practical lessons/activities and the motivation derived from successful completion of tasks in practical lessons would help improve their performance. Innovative approaches to the teaching of biology and its practical lessons by teachers would prepare students' minds adequately and confidently towards the development of positive attitude and interest towards biology practical work and biology as a whole. This would help increase the performance of students wishing to pursue biology and science as a whole in the secondary level and after secondary school education.

Furthermore, this study would enable students give serious attention to practical activities after knowing their performance and enable them discover new ideas and knowledge for themselves as learning becomes student-oriented, allowing them to go through series of activities by themselves. This would also enable them to apply concepts being learned in school to their everyday life activities within their environment.

In addition, innovative practical lessons would enable students to easily recall concepts learned, develop their higher thinking skills as well as communicative skills thereby increasing examination performance of results by students. This would further increase the uptake of science and biology students into tertiary institutions.

Again, science teachers would recognize that the nation's economic future depend fully on biology and science and its practical activities, therefore, if more attention was given

to practical lessons, the technological development of the country would be put on a high potential. This would motivate teachers to direct their knowledge, efforts and skills to practical lessons despite any obstacles that might hinder them from organising such practical lessons. The study would also help biology teachers to come out with innovative interventions to help students in understanding biological concepts.

Also, the study would give useful information to the Ministry of Education, curriculum developers and other educational authorities to undertake interventions to promote practical lessons in biology and science within senior high schools in the country. Furthermore, the understanding of students' performance has the potential to benefit educational policy makers in helping to encourage the teaching and learning of science to better suit the needs of the students. The study would also bring into light the problems and difficulties faced by both teachers and students during biology practical lessons so that the necessary action could be taken by students, teachers, school authorities, Ghana Education service, Ministry of Education, Non-governmental organisation and stakeholders of education to help solve them. Indeed, Cook-Sather (2002) wrote, "there was something fundamentally amiss about building and rebuilding an entire system without consulting at any point those it was ostensibly designed to serve". Thus, by beginning to understand the performance of these students on biology practical work, biology lessons and biology uptake might be better comprehended. Additionally, the findings would augment the pool of data required by other educational researchers in their bid to design interventions to solve educational problems in the sciences in general and biology in particular.

1.7 Delimitations of the Study

The study focused on only some selected Senior High Schools within the Bawku East district in the upper east region of Ghana. The study was also delimited to only students' views of their teachers" and their attitudes towards biology laboratory work in senior high schools.

1.8 Limitations of the Study

The study was limited to only three (3) selected Senior High Schools at Bawku – East District of the Upper -East Region of Ghana. Also, because of the busy schedules of the teachers and some of the students, they were reluctant to complete the questionnaire in good time. The corona virus also scared some students from participation.

The sample size was small, also the number of SHS was three, and hence, the results cannot be applied to the schools in the entire Bawku East District and by implications cannot be applied to all schools in the Upper East Region. Also, issues of insecurity due to unprotracted conflict in the area.

1.9 Abbreviations

CRDD: Curriculum Research and Development Division.

GES: Ghana Education Service.

WAEC: West African Examination Council.

WASSCE: West African Senior School Certificate Examination.

SHS: Senior High School.

GASEC: Garu Senior High School.

BAWSCO: Bawku Senior High School.

SSS: Senior Secondary School.

1.10 Operational Definition of Terms

Biology: The study of both living and non-living things around us.

Performance: How well or badly a person does a particular activity.

Specimen: Part of an organism being used for study or investigation.

Labeling: This refers to naming structures of biological drawing and ensuring that they exactly touch the structure.

Teaching and Learning Materials: These are instructional materials used to support students and teachers in the process of teaching and learning. They include text books, schemes of work, lesson plans and other related resources responsible in facilitating the teaching and learning process.

Biological Drawing: This is the art of diagrammatic representation of an organism, specimen or structures that illustrate important features of the specimen or organism under study.

Level: A particular standard of skill or ability.

Practical Work/Task: Any teaching and learning activity which involves at some point the students in observing or manipulating real objects/specimens and materials.

Teaching Laboratory: Refers to a room which contains science equipment for teaching and learning of science related courses.

Teaching Tools: Equipment used in facilitating the teaching-learning process.

1.11. Organisation of the Study

This study has five chapters, and chapter one dealt with the background to the study, statement of the problem, purpose and objectives of the study. It further dealt with the research questions, significance, delimitations, limitations, abbreviations, operational definition of terms and organisation of the study.

Chapter two dealt with review of literature related to the study.

Chapter three outlined the methodology (various approaches that were followed to gather data for the study and how the data were analysed). It includes the justification for the research approach, research design, population, sample and sampling procedures, research instrument, procedure for data collection and the statistical tools used to analyse the data.

Chapter four focused on data analysis and description or discussions of the results.

Finally, chapter five focused on the summary of the study, findings, conclusion and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This section reviews some of the contributions, ideas and studies that have been undertaken by some earlier researchers and authors. The literature related to this study is reviewed under the following sub headings: The theoretical framework, history of practical work in science, meaning of practical work in science and nature of biology practical work. Also presented in this chapter are concepts of biological drawing/work, role of practical work in teaching and learning of biology, biology practical work in secondary schools, teaching methods used by biology teachers , state of facilities (science laboratory, equipment etc.) materials/resources available to biology teachers, effects of practical activities/ work on the academic performance of biology students, challenges faced by biology teachers in schools, and using practical activities and strategies to solve such challenges faced.

DaCosta (2007) defined a literature review as a systematic gathering of information related to a particular topic. He added that working systematically helps a researcher recover a wide range of resources suitable to the topic. He outlined the following reasons why a literature review is conducted: sustaining a level of current awareness in a certain field helps a researcher to stimulate fresh ideas; it provides answers to particular study questions; it allows researchers to stay updated in their study areas and it assures researchers that they are producing quality and original work. According to Winchester and Salji (2016) a researcher conducts a review of existing studies by critically conducting an in-depth analysis of the body of relevant knowledge in order to demonstrate how one understands the work of others. Winchester and Salji (2016) stress the importance of reviewing literature in any study, because it provides all the

information needed, giving a balanced view of the content that comes with the information gathered. The review of previous literature similar to the current study allows the researcher to review methods used by other researchers. This helps the researcher to choose the appropriate study methods for investigating the phenomenon.

2.1 Theoretical Framework

The study adopts the constructivist theories of learning that deal with how students develop theoretical and procedural knowledge through experiences. The constructivist theories of learning also provide teachers with useful information about how students learn (Jenkins, 2001).

The personal and socio-cultural constructivist learning theories have one focus in common, that is, students are considered to be actively engaged in what they learn (Chin, 2007). According to Acar and Tarhan (2007) and Chin (2007), a student or an individual acquires knowledge by constructing new knowledge through personal or social interactions with the subject's content. Learning process is an adaptive (equilibration) and dynamic process hence, the acquisition of new knowledge by children continuously enables them to adapt better to their environment (Kaplan et al., 2018). To know an object or event is to act on it by modifying the object, and understand the process of this transformation, and consequently understand the way the object is constructed (Kaplan et al., 2018). A general consensus among constructivists is that students do not always receive information as given but rather they actively attempt to modify it in the way it makes sense to them. Learning is therefore, seen as a personal process (Acar & Tarhan, 2007; Chin, 2007).

Learning, a social process where knowledge construction is not perceived to be merely resting on the shoulders of the individual student alone but also co-constructed through

social interactions involving the process of internalization where teachers provide guidance to help the students to understand the new information better (Chin, 2007; Havu-Nuutinen, 2005).

Generally, students are active participants in a learning environment, an important arena where the teacher and the students are engaged in the process of transmitting or acquiring new knowledge. The teacher selects the best available teaching strategies in order to create a conducive environment in which students will participate actively in what they are learning while the students make themselves ready to act, and transform new knowledge in order to internalize it (Acar & Tarhan, 2007; Chin, 2007).

From a constructivist perspective, teachers expect their students to be actively engaged in practical tasks through interactions in laboratories and classrooms. According to the social constructivist view, learning in a group or alongside an expert is imperative as it offers the room for a discourse situation, whereby meanings could be negotiated at a social level (De Vries et al., 2002). As an expert, the teacher intervenes to develop and make available scientific matters and skills to all the students in the classroom by shaping, selecting, marking, sharing, checking and reviewing students' ideas at the social level (Chin, 2006). The present study embraces this form of inquiry and focuses on classroom discourses that take place in the biology classrooms/laboratories in the process of tackling a given task. In social constructivism, however, there is room for the teacher to mentor, negotiate and model in order to provide internship or mediate learning (Havu-Nuutinen, 2005).

Despite the criticisms that have been leveled against constructivism, there is no doubt that this theoretical construct currently exerts a significant impact on science curriculum development and instructional practices in many countries around the

world. Viewed in this way, the classroom is seen as a multi-social setting that has implications for the teaching/learning process (Gwimbi, 2003). The classroom/laboratory setting needs to take an account of the purposes and meanings constructed by the students. The present study is only concerned with exploring the guidance provided by the teacher as a facilitator, guardian and mentor in a constructivist classroom. The teacher, as mentor, negotiates and interprets the social knowledge in collaboration with his/her students in order to enable them to transform the social knowledge into personal knowledge (inter-mental and intra-mental) (Kittleson & Southerland, 2004; Chin, 2007). The nature of the discourse that evolves during practical work or demonstration is important because it provides some insight into the type or quality of interactions going on in that social setting.

2.2 Students Attitude Toward Practical Work

Generally, an attitude is understood to mean the conduct an individual adopts toward other individuals, things, occurrences, or happenings. In Science instruction, attitude is an imperative contributing factor affecting the execution of science learners. According to Chawla, Jain & Mahajan (2013) an attitude is a way of looking at things. An attitude may be better defined as a predisposition to respond in a favourable or unfavourable manner with respect to a given attitude object (Oskamp & Schultz, 2005). Attitudes can be positive, neutral or negative. According to Chawla. (2013), an attitude is a way of looking at things positively or negatively. Attitude towards practical work is defined as the way students' regard practical work in their biology lessons. According to Abudu and Gbadamosi (2014) learners' accomplishments are strongly influenced by the attitude with which Science subjects are conveyed. A view is understood to mean the feelings, thoughts and opinions or ideas of an individual perceived and acknowledged at a particular moment in time and context (Jiao, 2005). Aikenhead and Ryan (1992)

found that knowledge of participants' views can be investigated and gained by reading respondents' replies to given items, normally from a Likert scale format. Their responses are analysed in order for their viewpoints to be determined. He alluded to the fact that respondents will either have consistent responses or not. The authors stated that when respondents agree to the items, this does not necessarily disclose their true meaning, since in some cases, language may be a barrier. Despite practical work being accorded a pivotal role in science classrooms, the poor quality of conducting practical work in biology classroom leads students to develop certain undesirable attitude towards practical work. Even though there has been lengthy research into students' attitudes to science there is little research specifically into their attitudes to practical work. The investigation of students' attitudes towards practical and studying science has been a standing endeavor of the science education research community for the past 30 – 40 years (Osborne, 2003). There are many studies conducted to examine students' attitudes toward practical work in science lessons (Hofstein & Lunetta, 2004; Jenkins & Nelson, 2005; Hofstein & Mamlok-Naaman, 2011; Musasia, Abacha, & Biyoyo, 2012; Sharpe, 2012). These studies among other things found that teachers regard practical-hands on activities as both an effective and enjoyable way of teaching and learning science in the classroom. Other studies such as Kalender and Berberoglu (2009), and Odom, Stoddard and LaNasa (2007) went extra length to investigate the extent to which students' attitudes towards practical work and studying science influence their achievement in science. The literature revealed that there are many approaches to conducting practical science lessons but yet achievement is still low among students. Really, the attitude of students actually has an influence in the school environment with regards to their learning in biology practical. In Botswana, practical work is well established in secondary school as part of the curriculum. However, in

most secondary schools in Botswana, practical work in science generally involves 'hands on' activities where learners are supposed to follow laid down procedures to arrive at a predetermined outcome. This approach most likely lead to students working on practical activities without much thought of the actions, thus resulting in poor achievement in science at the end of their study**.** Learners' attitude towards biology is a key determinant of how students learn. Attitude development is a process that is influenced by what happens in and around the learners' learning environment. According to Osborne (2003) students' achievement continue to deteriorate in the sciences because of the nature and process of teaching science in secondary schools. In Botswana, practical work has been a cookbook trend in which instructions are conducted as a recipe. According to Kim and Chin (2011) such recipe-based practical work is insufficient to developing students 'habits of mind' principally because students are asking to do following stringent guidelines and do not require thinking through doing. Sharpe (2012) and Reid (2003) asserted that the manner in which practical work is conducted restricts the science curriculum, often confuse students, restrict students' critical thinking skills, and students mindlessly engaged in practical work just because it is a requirement. The issue of concern in this study is that the conventional methods of carrying out practical work in most Botswana secondary schools generally focuses on improving students' knowledge in science rather than on developing understanding of scientific investigative procedures. Consequently, during practical activities students do not use scientific ideas to guide their actions and to reflect upon the data collection process.

From the beginning of the 18th century to date, educators and researchers have studied the value of practical work and its important role in scientific fields such as chemistry and biology. Multiple studies showed that practical work confers many advantages,

including developing laboratory skills and scientific knowledge, as well as understanding science concepts and theories (Fadzil & Sat, 2013; Schwichow et al., 2016). In support of practical work in the scientific fields, Roberts (2008) designed a booklet on high quality practical activities in science, in which she stated: "Students achieve deeper level of understanding by finding things out for themselves and by experimenting with techniques and methods that have enabled the secrets of our bodies, our environment, and the whole universe – to be discovered." Practical work has been able to promote students' positive attitudes and enhance motivation for effective learning in science as described by Okam and Zakari (2017).

Consequently, a positive attitude toward the importance of practical work meaningfully affects students' achievement in science (Hinneh, 2017).

Practical work has also been shown in some studies to help improve the communication skills of students in order to solve problems in science and thus become more motivated in science (Woolnough, 1994). In addition to this, practical work encourages and increases students' interest in science and promotes it as an engaging subject. Most of the students consider practical work as an important part of learning biology, an interesting activity during biology lessons and an easy part of learning biology (Hinneh, 2017). The question is does students' attitude about the importance of practical work significantly influence them achievement in biology while their attitude concerning interest and difficulty of practical work do not significantly influence their achievement in biology. It can be concluded that even though students demonstrate some level of positive attitude towards practical work in biology in terms of its importance, the experienced students gain from doing practical work in the biology lessons do not

motivate them to want to pursue a career in biology beyond secondary school. A possible explanation could be the manner in which practical work is carried out in secondary school negatively influences their achievement in the subject.

In other words, students' general attitude towards practical work is positive but would it influence their achievement in biology. There is clearly an overall positive attitude towards practical work and there are some good examples but there are also several messages that need to be addressed. There is well-documented evidence, in secondary school in general and diaspora secondary school in particular, about the shortcomings of equipment funding, particularly in secondary schools; the need is to ensure that those who make decisions in these matters are well-informed. There are currently no serious threats to practical science from health and safety requirements, but the situation needs to be kept under review. Locally, in some secondary schools, pupils' behaviour and a lack of technical expertise may result in significant reductions in practical science. Frequent use of live organism in biology lessons and/or practical works may increase students' interest towards biology (Prokop, 2007). Attitudes towards science involve the students' affective behaviours, for example, preference, acceptance, appreciation and commitment. The practical instructional method has a significant effect on improving students' attitudes towards science. Science teaching cannot be effective without students being interested in it. Thus, more practical secession is needed if science teaching has to be effective. Moreover, the way practical teaching is planned and conducted has to be well thought out so that it will boost the students' attitude. While students' negative attitudes towards science are related to a traditional approach in science instruction, their positive feelings are associated with constructivist science classrooms (Hacieminoglu, 2016). Traditional teaching and overdependence on textbooks could be responsible for the increasing negative student attitudes about

science. Students with positive attitudes towards science tend to have higher scores on the achievement measures. This result showed that students having a more positive attitude towards science preferred to undertake meaningful learning rather than rote learning, resulting in the achievement of higher scores (Hacieminoglu, 2016). Making the teaching-learning process more practical helps teachers to build a positive attitude towards the subject they are teaching and to enhance learners' achievement. There is a range of purposes for practical science, indeed there are several purposes for science education as a whole (e.g., science as general education as well as training for future career paths). Ample evidence is available that indicates the existence of a positive attitude that teachers and pupils have to practical science. Although the evidence of pupil attitudes is equivocal, more research in the issue would benefit the effectiveness of practical work. Bell (2008) argues that teachers' and other stakeholders' have positive attitudes based on their answer to the question 'how important is practical work in science education.' Practical activities or laboratory teaching is found to positively affect the learners' attitude towards lessons in biology. More and effective practical work has led to a more positive attitude. In particular, it was found to enhance the students' interest in biology, future career in biology, importance of biology, possibility of becoming a biology teacher, level of difficulty in learning and the use of equipment. Practical activities or laboratory teaching is found to positively affect the learners' attitude towards lessons in biology. More and effective practical work has led to a more positive attitude. In particular, it was found to enhance the students' interest in biology, future career in biology, importance of biology, possibility of becoming a biology teacher, level of difficulty in learning and the use of equipment. As one head of science put it 'it is vital and teaching science without practical work is like swimming without water' (Bell, 2008). Hence, implementing more practical work in science education

improves learners' attitudes as well as their achievement in biology. Practical teaching is carried out in most secondary schools with whatever facility, input and manpower that is available. However, to what extent such activities affect the attitude of students towards biology lessons and their achievement largely remains an open question. Practical work has a significantly positive effect on learners' performance (Israel, 2014). Teaching science without practical activities has effect on student's interest towards science disciplines which results in less student enrolments in science class. Ozlem (2011) established that hands-on activity, as opposed to traditional instruction, enriched students' achievement and attitude towards learning. An interest in biology influences performance, because it provides the drive within students to participate in the learning process. Good attitude and better interest learners display particularly in biology practical serve as encouragement even to the teacher (Owino, 2015).

Biology as a Science subject is pre-selected as a key learning area in science education. The subject is known to be a platform for learners to gain a balanced learning experience, through which they can develop different aspects of science such as knowledge, understanding and attitudes that are needed for personal development as well as for contributing towards a scientific and technological world. Biology in this sense prepares learners well for tertiary courses which revolve around Biology, such as Medicine and Health Sciences (Aloovi, 2016). The Ministry of Education (2010) outlines the practical aims of Biology as follows: Develop attitudes relevant to Biology such as objectivity, enquiry and initiative. Through Science instruction, learners are said to become acquainted at first hand with science education, especially with scientific inquiry and conceptual knowledge through the learner centred strategy of investigation. For this reason, the learning process is considered to be more important than a teacher-centred strategy. A teacher-centred strategy does not effectively include

learners in learning, which in turn makes it difficult for them to explore the topic completely. Marques, Praja and Thompson (2010) allude in their study of science to the fact that currently practical work is the centre of the aims and procedures of science education. Their study also shows that when they questioned teachers about science implementation and conceptualisation, they gave their answers based on their experience, mentioning practical combination of aims as follows: Practical work is the best method to motivate learners, Practical work develops scientific attitudes and, Practical work assists learners in achieving a proper understanding of scientific concepts. Marques, Praja and Thompson (2010) agree that practical work develops general skills that can be used by pupils in their daily lives; not only in science-related aspects but also to solve everyday problems. Lee and Sulaiman (2018) argue that practical work can serve as a useful platform to develop a positive effect on learners' motivation and understanding towards learning. Moreover, Kaptan and Timurlenk (2012) assert that practical work is an exclusive feature in science subjects which is typically regarded as having an influence on improving learners' attitudes towards practical work. It mostly shows that learners tend to have a positive attitude if they show an interest in doing practical activities, as compared to mere theoretical learning.

2.3 Teachers Attitude Toward Practical Work

The construct attitude has been described as the behaviour a person adopts toward other people, things, incidents, or happenings. In science education, it is noted that learners' performance is highly influenced by attitudes. According to Yara (2009), the attitude that a teacher has in delivering a lesson, including the teaching strategy used, has a great influence on learners' attitudes towards the lesson content. For the learning of science to occur successfully to the advantage of the learners, there should be a strong interplay between the teacher and learners. Most learners do not benefit from a one-way delivery

technique from the teacher to learners and therefore practical work is important as it creates an interaction between teachers and learners. Moreover, Yara (2009) described attitude as a behaviour adopted by a person toward other people, things, incidents, or happenings. In science education, attitude is an important contributing aspect influencing the accomplishment of science learners. Teacher attitude or the attitude of a learner towards practical work, affects performance. According to Ogembo et al., (2015), the attitude the teacher displays when delivering a lesson, including the instructing technique utilized, has a great impact on the learners' state of mind towards the lesson content. So also, the way an attitude is communicated may lead to either positive or negative results. The current researcher postulates that a teacher's attitude can effectively impact a learner's state of mind. Abudu and Gbadamosi (2014) state that a common hypothesis with respect to teachers' attitudes and learner achievement is that learners taught using the right approach or right attitude have high performance scores. The learners' achievements are strongly affected by the attitudes with which the science subjects are delivered. Hattingh, Aldous and Rogan (2007) add that teachers' attitudes towards innovation in the school are to a certain extent important. A school that is strongly in favour of development appears to be working well and this empowers Science teachers to profoundly involve practical work. These authors state further, in a state where learners have a durable impact in propelling their teachers to supply higher levels of practical work, they recommend that teachers should be trained in imaginative ways to carry out practical work at a much higher level for the advantage of learners. If learners show a level of excitement in this practice, teachers are automatically motivated to engage in practical work. According to a study conducted by Hailombe (2011), the EFA Global Monitoring Report 2005 defines quality as a set of desired characteristics of learners. This merely refers to (the motivation and health of learners),

processes (competent teachers using active pedagogies), content (relevant curriculum) and systems (good governance and equitable resource allocation). Willemse and Deacon (2015) confirm that quality education is easily hindered by the negative attitude of a teacher in the teaching and learning processes. Learners' interest in science has declined significantly and this was expected to have an impact on the teachers who taught Science subjects. This diminishing of interest in science has an impact on the lack of interest shown in science-related careers as a choice. According to Chawla, Jain and Mahajan (2013) attitude is a way of looking at things. However, the definition of the term attitude is vague but the term may be defined as an inclination to reply in a positive or ominous way with regard to a given attitude object (Oskamp and Schultz, 2005). A study by Willemse and Deacon (2015) focusing on teachers' attitudes towards their work, indicate that there are components that impact on the attitude of a teacher. In most cases a strong support system behind a teacher is what pushes and enhances a positive attitude of teachers towards their work. The support system is anticipated to be given by the school administration, learners' guardians and the community around the school, in order to assist teachers to deal with everyday challenges. Besides, other perspectives such as a friendly working environment, taking into consideration the environment on school grounds and acceptable conduct from learners, assist teachers to create a positive attitude, and to develop a love of their work. In order to foster a positive attitude in teachers, a career development process should be in place at work. Job security, satisfaction and commitment are important for career development. These three factors will help teachers build a positive attitude towards their work generally and towards practical work specifically (Willemse and Deacon, 2015). Studies reveal that attitude can be affected by an individual's background, experience and character and other factors such as relationships amongst people. Nacionales et al., (2015) define

science as a way of knowing and understanding through exercises of reason and a construction of the mind based on actual observation, to explain natural phenomena. These authors allude to the fact that learners' attitudes towards science are based on the way the subject is taught at all levels of education. Studies have shown that there should be a mutual interaction between a learner and a teacher, if mutually positive attitudes towards content are to exist. Johansson, Heldt and Per (2006) conducted a study on attitudinal traits and choices and hypothesize that people have different attitudes towards all situations. This can, however, lead one into contemplations and a lack of security in situations they may find themselves. When teachers adopt a learner-centred approach to convey a subject theme, this has an effect on teachers' attitudes towards the academic accomplishment of learners. In this case, teachers' attitudes can, however, have an effect on learners, in various academic ways. Abudu & Gbadamosi (2014) believed that there is a need for a close relationship between a teacher and his/her learners for good interaction. Ninnes (2011) stated that if the teaching and learning processes occurring in a subject are of a poor quality, the scores from examinations written by learners, compromises up to 50% of the mark towards promotion. This raises the chances of having a high number of learners who do not reach the required level of competency. Madukwe et al., (2019) contend that attitude is a major determinant of a person's behaviour in affecting the way a teacher relates to learners, which in turn influences the academic performance of a learner. Hinneh (2017) noted that learners consider practical work an important component of their science education. He argues further that his study concluded that practical work is seen as an important aspect of science education because learners showed a positive attitude towards practical work. Since learner motivation is highly affected by the teacher, it is important for teachers

to have positive attitudes and views towards practical work in order to motivate learners to carry out practical work and in the end perform well.

Learners gain confidence in learning through the attitudes and behaviours portrayed by their teachers in the process of teaching, which includes the teaching methods used in presenting a lesson (Ulug et al., 2011). A positive relationship between a teacher and a learner creates a good communication platform. Madukwe et al., (2019) note that an attitude involves aspects such as feelings, opinions and dispositions which affect the way a learner behaves in a class. He adds that the behaviour of children determines how successful they can be, as it will affect the goals, they have set for themselves. Ulug et al., (2011) expressed the view that a teacher's attitude certainly affects the performance of learners in his/her class. Similarly, the way a teacher responds to a learner endorses the atmosphere amongst learners in a classroom. So, if a teacher responds negatively to learners in the classroom, he or she sets a bad example for other teachers and learners in the school (Madukwe et al., 2019). In the same vein, the attitude of learners towards subject knowledge can be impacted by the attitude of teachers and their methods and teaching strategies (Madukwe et al., 2019). The teaching strategies as well as the personality of the teacher account greatly for a positive attitude towards the subject. Madukwe et al., (2019) explain that when a teacher lacks curiosity about and positivity towards the subject, it reduces the performance of learners. They further agree that it is important for a teacher to create a positive relationship with learners and to set activities which require learners to participate actively. An interested and steady educator promotes a productive learning environment which is profoundly recommended. Negative attitudes portrayed by teachers result in a decrease in learners' marks. Learners are deprived of the opportunity to ask questions in class because the teacher's attitude does not allow this. Ulug et al., (2011) noted that it is essential for teachers to

have good communication with their learners. Studies show that learners' interpersonal skills somehow depend on their teachers. They added that the teacher's ability to connect with a learner, by portraying positive conduct and showing interest in the learner's concerns, may expand the learner's inspiration and success, which in turn leads to positive results. Through teacherlearner interaction, learners are motivated by their teachers through their actions and attitudes. Failure results from negative attitudes whereas positive attitudes promote success. Negative ego attitudes result from failure while a positive ego results from success (Ulug et al., 2011). Ulug et al., (2011) stated in their review that literature confirms that learners' performances are affected by many factors other than just their hard work and effort. The primary factor influencing learners' performance is the attitude portrayed by teachers conveying subject knowledge. Therefore, a teacher's positive state of mind influences learners' inspiration, state of mind and school work; which ultimately influences learners' assurance and self-esteem. Furthermore, teaching is more than just talking and explaining. Learners require positive expectations and strong support. The same study confirms that learners' positive experiences of learning are derived from positive expectations. Hinneh (2017) concluded that although learners may portray a positive attitude towards practical work, in terms of importance, they gain very little motivation to pursue Biology careers from the experience gained from practical work. In addition, the way in which practical work is carried out has an impact on how learners execute the work (Hinneh, 2017). Ulug et al., (2011) acknowledged that in the education system, it is a condition for a teacher to be in a favourable teaching environment in order to gain good results. They concluded that these teachers are excellent communicators. They are teachers who know how to handle their learners, since they study them and understand their feelings, interests, fears, worries and more important,

offer them complete support in various aspects of life. Teachers should foster in learners a feeling of acceptance and love (Ulug et al., 2011). Finally, Ulug et al., (2011) conclude that teachers are second only to the learner's parents as a deciding determinant for the improvement of the individual. They stress that children look up to their teachers which may be why the conduct and attitude of teachers has a greater impact on children's personalities than those of their parents, because more time is spent with teachers than with their parents. Teachers exert a great influence since their views on life and their conduct guide their learners. A supportive learning environment is highly recommended and this develops from an interested and supportive teacher. Studies show that a learner gains low marks when confronted with a teacher's negative attitude in class, as this limits learners in asking questions and limits their levels of understanding.

2.4 Meaning of Practical Work in School Science

Practical work under the guidance of competent teachers with scientific equipment and procedures are vital aspects of scientific training. Millar (2004) found that practical work helps students of biology to experience an increase in motivation and teachers also will have the opportunity to evaluate the knowledge of their students and determine the practice connection at the highest level. Practical work' means any teaching and learning activity that engages teachers and students in observing or manipulating concrete objects and materials (Millar, 2004). By way of explanation, Millar used the term 'practical work' in preference to 'laboratory work' because location is not a critical feature in characterizing this kind of activity. The observation or manipulation of objects might take place in a school laboratory, but could also occur in an out-of-school setting, such as the student's home or in the field. He also chose not to use the term 'experiment' (or 'experimental work') as a general label, as it is often used to

mean the testing of a prior hypothesis. Practical work turns abstract concepts into concrete experiences. It creates not only skills which are appropriate for scientific inquiry, but it also inculcates attitudes and conceptual perspectives which are necessary for skilled scientific inquiry.

Yeboah (2010) observes that effective teaching and learning require accurate and exact observations, carefulness and thoroughness of technique and logical interpretation of data. He emphasized that practical work is the part of the study of biology and should go hand in hand with theory. He further noted that sound theoretical and practical knowledge of biology is needed for the management of our natural resources, provision of good health facilities, adequate food supply and favourable life environment. Science Community Representing Education (SCORE, 2009a) produced a framework for practical science in schools defining practical work as 'a "hands-on" learning experience which prompts thinking about the world in which we live'. An associated report SCORE (2009b), considered two main categories of activities that are considered as practical work. These categories are core activities which include investigations, laboratory procedures and fieldwork. These hands-on activities support the development of practical skills and help to shape students understanding of scientific concepts and phenomena.

Direct related activities which include teacher demonstrations, experiencing phenomena, designing and planning investigation, analyzing results and data analysis using ICT. These activities are key component of an investigation or provided valuable first-hand experiences for students.

In addition, some argue that other activities such as use of computer simulations, modeling, use of surveys, presentations, group discussion and role play can also

constitute what is meant by the term practical activity (SCORE, 2008). However, others disagree and believe these activities would not come under the practical activity 'umbrella' and rather they should be used complementarily alongside other practical activities, rather than be a substitute for them (Woodley, 2009).

Nzewi (2008), asserted that practical activities can be regarded as approach that could be adopted to make the task of a teacher (teaching) more real to the learners as opposed to abstract or theoretical demonstration of facts, principles and concepts of subject matters. Laboratory experiments (activities) are characteristic features of science teaching at all levels of education (Adane &Adams, 2011).

Abel and Lederman (2007), also provided what they called classical definition of school science laboratory activities as learning experiences in which students interact with materials or secondary sources of data to observe and understand the natural world.

In conclusion, most stakeholders would accept a definition of practical work in science which includes investigation and laboratory/field work procedures and techniques. There is some concern that, too wide a definition may reduce students' opportunities to engage with the physical world, but general agreement on the importance of activities which link these to the concepts, theories and context of science. A potentially significant difference is between primary and secondary teachers with respect to the role of teacher demonstration.

Practical work is an important part of science but as to what value is practical work as part of science education still remains unfounded. Since then, there have been many educational researchers who have produced categories of reasons for conducting practical work within science education.

Millar (2004) suggested five major aims of practical work in science education as follows:

1. To arouse and maintain interest, attitude, satisfaction, open-mindedness and curiosity in science.
2. To develop creative thinking and problem-solving ability.
3. To promote aspects of scientific thinking and the scientific method (e.g., formulating hypotheses and making assumptions).
4. To develop conceptual understanding and intellectual ability.
5. To develop practical abilities (e.g., designing and executing investigations, observations, recording data, and analyzing and interpreting results).

Over the years, there have been several studies that have each identified 10 aims of practical work viewed by teachers (Swain, Monk & Johnson, 2000; Ferreira & Morais, 2018; Constantinou &Fotou (2020). However, the four most popular aims in all three studies were: to encourage accurate observation and description, to make phenomena more real, to arouse and maintain interest, to promote a logical and reasoning method of thought.

Four aims were rated more highly in the Swain, Monk and Johnson (2000), study than they were in the Ferreira & Morais' (2018), study. These aims were: to practice seeing problems and seeking ways to solve them, to develop a critical attitude, to develop an ability to cooperate, and for finding facts and arriving at new principles.

Millar (2004)) argued that it is also important to distinguish, and keep in mind that, the school science curriculum in most countries has two distinct purposes. First, it aims to provide every young person with sufficient understanding of science to participate

positively and effectively in the modern world, with a 'scientific literacy'. Second, advanced societies require a steady supply of new recruits to jobs requiring more detailed scientific knowledge and expertise; school science provides the foundations for more advanced study leading to such jobs.

In reviewing literature surrounding the nature and purpose of practical work, what is reflected is how there is no research precisely, into what, and why, students think and feel about practical work as well as whether practical work has an affective value in influencing students' decision to continue with science post compulsion. It appears that practical work is seen as motivating by teachers as shown through the enormous amount of empirical data Holstermann et al., (2009).

According to Dikmenli (2009), the main purpose of practical work in science education is to provide students with conceptual and theoretical knowledge to assist them learn specific concepts and scientific methods to understand the nature of science. practical work stimulates learners' interest in science when they are made to personally engage in useful activities; knowledge obtained through practical work and experience, promote long term memory that theory alone cannot do. In addition, practical activities in biology provide opportunities for students to actually master science and become exposed to learning about science (Nwagbo & Chukelu, 2011).

However, there is a need to ask students direct questions regarding their affection to practical work, such as "do they enjoy practical work? Does it motivate them?" (Wellington, 2005, p. 101) and probe further as to what is it that they are indeed motivated to do and why this is so.

As Bennett and Hogarth (2009) pointed out, the plurality of adopted aims for practical work in science make the task of assessment very difficult. As is currently practiced, students claim to find practical work an 'enjoyable and effective way of learning (Swain, Monk &Johnson, 2000; Jenkins & Pell, 2006).

The justification for practical work in science at the senior high school level is supported by the aims of practical science in the West African Examinations Council Syllabus as follows:

1. To acquire adequate laboratory and field skills in order to carry out and evaluate experiments and projects in physics, chemistry and biology.
2. To acquire necessary scientific skills, for example, observations, measuring, manipulating, classification and interpretation of scientific data.
3. To be able to interpret and illustrate knowledge of physical, chemical and biological principles and to develop the ability to perform simple experiments and makes inferences from the results established.
4. To acquire scientific attitude for problem solving
5. To be able to apply scientific principles in everyday matters in order to solve personal, social, environmental, community, health and economic problems.

Justification for the use of practical work generally include but not limited to:

1. developing practical scientific skills and techniques.
2. being a problem-solving scientist**.**
3. getting a 'feel for phenomena

Hodson (2005)) suggested five possible aims of the purpose and justification of practical work based on teachers' responses, these were:

1. To motivate by stimulating interest and enjoyment.
2. To teach laboratory skills.
3. To enhance the learning of scientific knowledge.
4. To give insight into scientific method, and develop expertise in using it.
5. To develop certain 'scientific attitudes', such as open-mindedness, objectivity and willingness to suspend judgment.

The position of practical work in science is generally accepted as it is acknowledged that good quality practical work promotes the engagement and interest of students as well as developing a range of skills, science knowledge and conceptual understanding. The importance of practical work in school science is widely accepted, but it is important to ensure that such practical work genuinely supports learning and teaching, and that the teacher is allowed to do this in relation to their students' needs and the courses they are studying.

According to SCORE (2008), the problem with understanding the true purpose of practical work within science education is still an issue. This unclear focus lead to different approaches of practical work that potentially influence the learning outcomes for the students

2.4 The Nature of Biology Practical Work.

Examination of works on the nature of practical work looked at the entirety and the whole embodiment of biology practical work. This includes the instruction and learning atmosphere for practical work, approaches used in teaching practical work, period for teaching biology practical work and the teaching and learning materials available for biology practical. There have been agreements about the place of practical work in the learning of science education but there seems little agreement of the nature of this

practical work conducted in secondary schools. Teaching biology through study, research activities, project method and problem unravelling and by connecting these with a focus on local setting achieves better understanding of biology as opposed to rote learning of scientific facts and theories for examinations after which learning ends. Real approaches that are likely to progress attainment in senior high school biology practical work include co-operative based learning instructional strategies (activity-based) which have been found to improve biology learning outcomes (Slaivan, 2011 and Opara, 2017) and project base learning. Peer tutoring is a personalized system of instruction which is learner rather than teacher oriented, it emphasizes active student participation in the learning process. It is an individualized attention to a learner by a person of similar status who serves as the tutor. Instructional strategies benefit the students being tutored and the tutor, with greater cognitive gains from the teacher than the student being taught. It has also been observed that when biology lessons are done in groups students are allowed to make valuable decisions which result in satisfactory accomplishment. Working in groups during practical is a pervasive and influential feature of the classroom ecosystem which must be encouraged in the teaching and learning of biology in the senior high schools. Activity-based methods of teaching, in the form of group work during practical, enable students to be actively involved in seeking information that can be applied to solve real life problems. The activity method is used to teach science in which the child is placed at the center of the learning process and made to interact with materials and experience things for themselves. Practical work is an inquiry and hands on activity which makes it possible to transfer knowledge on higher order cognitive levels and create curiosity in students. Practical work develops problem-solving skills and a deeper understanding of the concepts and principles in biology for students. When students do biology hands on, they will

understand it and will enjoy the learning process since it will be relating to what they would have learnt to real life situations, and hence, practical work makes students for adult life since it fosters the theory they would have learned. Students, through doing practical work, would be doing what real scientists do and they would appreciate that theories are generated from research. Doing practical work forms the basis for good research skills in students.

According to Leung (2020), stated that "The Project Approach, involves children selecting a topic of interest, researching and studying it, and solving problems and dilemmas as they arise." The Buck Institute of Education describes it as, "Project Based Learning (PBL), where students go through an extended process of inquiry in response to a complex question, problem, or challenge". Project work is a scheme of work in which students work either singly or groups, for a period of duration from a few days to several weeks". Khan and Zafar (2011), carried out an experiment in which they sought to compare the effectiveness of the traditional laboratory and the inquiry (project) methods in developing scientific process skills in grade nine pupils using selected topics in the biology syllabus. They determined that, using a science process skill scale device, students taught using the inquiry method developed better science process skills than those taught the traditional way. Benson (2004), argues that teaching strategies should be based on the premise that learning is a series of connections and goes on to suggest that the project method and theme teaching fit this description.

The activity-based method of teaching considers students as very important in the instructional process, where teachers build on the students' experiences. Also, the procedure used for the activity-based method of teaching is based on current information and research in developmental psychology involving cognitive, affective,

experimental and maturational issues. The curriculum structure for the activity-based method of instruction is multifaceted, including local and community relevance as well as considering values ethical and moral dimension of problems and issues, using the natural environment and community resources. Some of the approaches used for the activities include group activity, project work, practical work, inquiry, discovery, discussion and demonstration. In all the approaches mentioned, practical work is found to permeate in all aspects and they in turn relate to one another. In science practical work, it is necessary for students to offer each other assistance. Practical work is found to enhance the teaching and learning of science and for that matter biology at all levels.

Co–operative learning enables students to have cognitive and social benefits as they clarify their understanding and share insights and ideas with others when interact during biology practical Teacher–centered instruction is expected to increase average science achievement and minimize gaps in achievement between individuals of different socio-economic statuses.

Advantages of using the Activity–Based Method in teaching biology practical includes:

1. Students are trained to easily identify problems with local interest and impact.
2. Students are also encouraged to use local resources in locating information that can be used in problem resolution.
3. It also extends the learning situation beyond the classroom.
4. Teaching and learning become more realistic and meaningful to students who explore and share ideas together.
5. High order thinking skills in the context of the problem, rather than seeing problems as separated entities in the school program is enhanced.

6. Creativity, freedom of expression, initiative and leadership qualities are inculcated into students.

Though the activity-based method is perceived to be one which help students to explore, there are some disadvantages. They include the following:

1. Lesson may take a very long time for students to go through the activity successfully.
2. Students normally become frustrated especially, when they fail to discover or find the solution to a problem.
3. Organizing, managing and controlling of students towards effective achievements of results can be difficult.
4. It can be an expensive method of teaching considering resources, materials and funds to be provided for the learning process.

In spite of the disadvantages of the activity-based method of teaching, it enables students have more" hands on" than "minds-on" experiences in the teaching and learning of science.

The debate regarding the nature of practical work (the method of practical work that would suit the learning of science best both effective and affectively) has taken a variety of forms throughout history including "the discovery approach, the process approach and 'practical work by order' (Wellington, 2002).

The process approach, to some extent, had more extensive criticism than the discovery approach (Wellington, 2002). The model involved the notion that science could be as set method of discrete processes whereby skills and processes could be separate from the natural theoretical aspects of science. The approach was trying to provide a science

for all abilities. There was the view that if students were less able, learning scientific transferable skills would be more appropriately suited to them, over any scientific content (Wellington, 2002).

According to Chalmers (2006), the model of science that is constructed within a process approach, is based on a naïve intuitivism that many views as unsound (Leach et al., 2000). Moreover, the process approach was teaching skills learnt naturally from a nearly age such as observing that a plant grows if it is provided with the right amount of nutrients or the classification of objects according to certain properties.

The missing link between learning biology to pass an examination and learning biology to select a career can be attributed to the need for innovativeness, improvisation and foresight by teachers to consciously expose the students to biology in action through the use of modern teaching aids, application of videos, education tours etc. There is the need by the biology teacher to demystify the teaching and learning of biology and science as a whole and to make the process more interesting and to promote the inquisitiveness of the students. Three areas to be addressed to demystify the teaching and learning of biology and all the sciences and also make the process more interesting are;

1. introducing new ideas, knowledge and educational technologies (including audio-visuals aids)
2. improving the teaching and learning environment
3. embarking on outreach programme.

Also, interactions and conversation during practical work play a very important role. The teacher provides guidance during the teaching-learning process. Classroom

conversations involve utterances, which include (e.g., teacher talk, student talks) and other means of communication tools such as images and class activities (Scott & Jewitt, 2003) which combine to help students during the planning and carrying out of the practical work. The teacher and the students talk around the given activity and in so doing attempt to establish the scientific concepts about what is being learned (Scott & Jewitt, 2003). These scholars note that for most of the time the teacher is directing and guiding the talks during an activity and the students also may directly influence the flow of classroom discourse.

2.5 Available Resources for Biology Practical Work

For the Biology practical lessons to be effectively taught, teachers are encouraged to use instructional materials. Some of the materials that could be used by teachers include virtual laboratory, realia, models and mock-ups, phenomenal materials and manipulative materials (Kishor, 2003). Collaborative learning environment where students are actively involved in their learning through use of animations and simulations for abstract topics provides students with opportunities to easily construct and comprehend challenging concepts (Tüysüz, 2010).

Many scholars view virtual reality technology as a provision of new insights to support education. Using virtual laboratories or simulation programs, minimises problems experienced in ordinary laboratory applications and results in accomplishment of educational goals. Laboratory improved attainment levels of students and influenced the attitudes of students positively towards science education when done virtually. Realia such as specimen, exhibits, and cut-away objects have great value in every subject including Biology. The use of realia can do much to promote the student's interest in life science. Realia eliminate distortion in student's knowledge on the topics

being taught. Phenomenal materials such as community engagement, field trips and service-learning result in educational benefits by enabling students to interact with community members, exposing students to environments, which might be hard or impossible to imitate in the classroom (Tortop, Uzunkavak & Ozek, 2009). One way to increase student engagement is the use of manipulative materials during instruction (Bello, 2015). A study by Ruffato (2012) in United States of America showed that when students were using hands-on methods of learning biological processes, they were more engaged than with previously used methods like lecture and following drawings on the board and performed well in short term assessments of knowledge.

The availability of teaching and learning materials for biology practical work plays an important role in the learning of biology.

When physical and material resources are available in schools, students will have access to reference materials maintained by the teacher, will also learn at their own pace. This means that adequate availability of school buildings, number of classrooms, chairs, desks, laboratories, equipment and other instructional materials for science teaching are important for the attainment of any educational objectives. Facilities as a major factor contributing to academic achievement in the school system.

Rafi et al., (2019) found a positive relationship existing between the independent variables of laboratory facilities, recommended text books, number of science books in the library and teachers' qualifications and the dependent variable, academic performance of students in biology, chemistry and physics. Effort must therefore be made to renovate the dilapidated science laboratories and schools offering science without separate laboratories for science must be assisted to construct more

laboratories. Teaching materials are described as aids materials used in teaching for illustrative purposes.

Teaching and learning materials may be defined to include materials which can be seen or heard and contribute to the teaching and learning process. Teaching and learning materials are divided into three groups; these are audio materials, those that appeal to the sense of learning. Examples are radio, cassette recorders, drum etc. Visual materials are those that appeals to the sense of sight, examples are real objects (realia), chalks, textbooks, charts. The last group is the audio-visual materials which appeal to both the sense of sight and hearing; examples films, video, television etc. (Amoatey, 2001). The use of teaching and learning materials arouse the interest of students in what is being taught and make understanding and remembering concepts easily. Teaching and learning materials also serve the teacher the trouble of explaining at length hence the teacher talks less and also encourages students to find more on their own and thereby stimulating self- learning. The use of teaching and learning materials in science lesson delivery brings variety, curiosity and interest among students to assist retention and recall. Therefore, the use of teaching and learning materials must be encouraged in the teaching and learning process during science lessons in Schools in Ghana. Resources include financial, human, material and infrastructural facilities. The human resources include the biology teachers both trained and untrained (professional and non-professional), laboratory technicians, laboratory assistants and laboratory attendants. The material resources also include equipment, apparatus, glassware, herbarium, chemicals, preserved specimen, models (human parts, organisms, skeletal system etc.) and biological charts. Also, the material resources play an integral role in the teaching and learning of science as they serve to stimulate thinking, make learning enjoyable,

interesting, exciting and concrete. The infrastructural facilities include biology laboratory, preparation rooms, storerooms and ancillary rooms.

Achimagu (2006), classified resource materials into classroom/laboratories equipment/chemicals and textual/audiovisual materials. Resources or facilities according to Udo (2006) refer to facilities that can be used to enhance or improve educational programmes and promote teaching and learning. Science laboratory resources/facilities can be human or material (Kankam, 2013). The human resources have to do with personnel such as lecturers/teachers, laboratory technologist/assistants and students. The science laboratory material resources are those materials available to the science teacher for teaching and learning. These include textbooks, computers, thermometers, fire extinguishers, first aid kits, oven, incubators, chalkboards, model/mock-ups, television, radio and other electronic devices. Sources of financial resources are through the schools' internally generated funds (IGF), Parent Teacher Association (PTA), Old Students Associations (Alumni), and Government through the Regional or District Offices.

Science is "doing" and involves regular hands—on practical work for learners to develop scientific literacy to face global challenge (Millar, 2004). The teaching of biology should be student-centered and activity-oriented whilst the teacher acts as a facilitator (Asare, 2010). Biology being a natural science can be studied both indoor and outdoor as most biological specimen are plants and animals, which abound in the environment. However, some laboratory equipment and materials may not be found outside the laboratories such as reagents, equipment and charts. Hence, there is the need to have a well-stocked laboratory with available and adequate equipment and materials. For science teachers to play their roles in teaching science most especially biology,

laboratory facilities should be available and used appropriately to improve the performance of students.

2.6 The Role of Practical Work in the Teaching and Learning of Biology

Goka (2019) stated that practical work coupled with demonstration help to improve students understanding and performance in science lessons. Practical work is necessary for acquisition of skills, and understand science lessons better through practical work. In practical lessons, students handle apparatus and carry out experiments themselves and when this happens the experience is impressed more firmly in their minds than if they listen to or see from distance. The young are curious to know about how events occur in the laboratory and it helps to improve their understanding of science lessons if they observe or perform experiments. Activities carried out during science lessons, broaden student's knowledge and boost their interest. It also helps to consolidate theoretical knowledge. Activity based lessons help students to develop independent ability to work and interpret scientific problems and solution.

The activity-oriented teaching of science is an important skill, technique and methods of science such as handling of apparatus, demonstration and investigative type of learning. Instructional materials create interest which helps reinforce students' interaction with learning experiences.

Students, through doing practical work, would be doing what real scientists do and they would appreciate that theories are generated from research. Doing practical work forms the basis for good research skills in students. The extended interactions with learning materials enable students to learn new material and transfer understanding to other new situations. Practical work in Biology provides opportunities for students to actually do

science as opposed to learning about science. Practical work is a key factor in engaging, enthusing and inspiring students, thus stimulating lifelong interest in science.

Activity-based methods of teaching practical in the form of group work during practical, enable students to be actively involved in seeking information that can be applied to solve real life problems.

Science and practical need to be taught in a holistic manner to reflects the real situations, and this complements Benson (2004), who argues that the implication is, therefore, that teaching strategies should be based on the premise that learning is a series of connections and goes on to suggest that the project method and theme teaching fit this description.

2.7 Performance of Students in Biology and Biology Practical in Secondary Schools

Biology among the sciences have been given a special recognition by most educators not only because of its educational values, but also its close relation to humans as living organisms, the peculiar field of experimentations and interrelationship with other career sciences. It is found to be the leading way to professions such as Medicine, Pharmacy, Agriculture, Dentistry and many others. In Ghana, it is a common knowledge that biology as a subject usually has a relatively higher number of students' enrolment than chemistry and physics in recent years in the Senior High Schools. However, these high numbers do not match with students' achievement in biology. There is also enough evidence that most students fail biology because they do not perform well in paper 2, which is a practical paper. For instance, the West African Examinations Council (WAEC) Chief Examiners report over the years (2010 - 2015) have been identifying some weaknesses on the part of biology students, some of which include the following:

Candidates' answers show that they have not been taken through adequate practical lessons. Students' answers indicate that they have not done any practical along the lines of the tested questions.

Candidates wrote unobservable features. Thus, they answered the practical questions from the theory they have learnt. Standard of students' drawing were poor which indicates they do not practice biological drawing as required by practical examination.

This seems to give the impression that, students were either not taken through enough practical work or were not serious with the practical work. Biology is a unique discipline where experiments with living organisms do take place both in the laboratory and in the field.

The teaching of biology as a subject in secondary schools is faced with many problems. The poor academic performance of students in biology as indicated in the report of WAEC Chief Examiners' report has become a persisted public outcry as regards the falling standard of biology education. Biology is a very important subject; it has to be given more priority. It enables one to understand himself and his intermediate environment. Nevertheless, the knowledge acquired in biology subject is applied in many fields as Medicine, Biochemistry, Pharmacy, Microbiology and Agriculture among others. Students' performance in Biology subject in Senior Secondary Certificates Examination (SSCE) has been unsatisfactory over many years. Various reasons have been attached to this problem by scholars.

Dinah (2013) found that, inadequate availability of text books, laboratory apparatus and other learning resources contribute significantly to the poor performance of students in biology examination. She added that, students with positive attitude towards the subject

register better performance than those who had a negative attitude. Those with positive attitude are motivated to work hard and this is reflected in the good marks scored in the examination. Suman (2011), conducted research on influence of parents' education and parental occupation on academic achievement of students. He concluded that education and occupation of parents positively influence the academic achievement of children in biology.

Mamalanga and Awelani (2014), noted that the possible factors responsible for the poor performance in biology included lack of financial support, lack of equipped libraries, lack of laboratories and biology textbooks, method of teaching and accessing biology. Furthermore, practical biology examination if highly scored improves students' grade in biology. Teachers should be encouraged to assess' learners regularly on practical skills. Perhaps, more practical lessons should be availed and documented so that teachers would plan for them and regular inspection to ensure the actual order is adhered to (Wabuke & Mukhwan, 2013).

Cohen, Manion and Morrison (2007), put it that "directly or indirectly classroom interactions are controlled by the teacher for it is he who promotes particular learning situation through his choice of objective, organization of experience, selection of materials and methods in order to facilitates the students' academic performance. Owino et al. (2014), linked the problem with inadequate supply of teaching and learning resources such as chemicals, charts, apparatus, models, local specimens, laboratories, textbooks, and libraries led to poor performance in biology. They added that irregularities related to the teaching of biology such as irregularity in administration of practical, class discussion, teachers not allowing students to ask questions, teachers not giving prompt feedback on assignments or exams, by not making the biology subject

interesting and teachers not conducting demonstration during practical. Most teachers lacked the knowledge of curriculum objectives as indicated by their failure to implement them. (Ibe & Nwosu 2017).

The above-mentioned studies indicate the possible factors responsible for low academic performance of students. In order to improve student's achievement and arouse their interest, students have to be taught biology with hands on and different learning materials so as to enable them acquire the cognitive competence and professionals of biology that they need in passing biology.

2.8 Effect of Practical Work on the Performance of Students in Biology.

By providing students with practical laboratory lessons, that are academically stimulated, students are more engage meaningfully with tasks and subsequently achieve higher assessment grades (Karental et al., 2015). However, WAEC Chief Examiner (2013) that academic performance of candidates in biology fell below expectation observed it. The chief examiner lamented that "there were many candidates who could not answer correctly a single question in biology practical, in most instances, they have to guess unrelated answers that were sometimes not biological. Also, the candidates were faulty in experimental procedures". Students that neglect practical work often encounter problems with questions that require some mathematical skills, deductive reasoning, proper observation and interpretation of data. Enquiry based practical work when properly done help offer students experience where the answer is not always predetermined which students require to come up with ideas from their observation. students are always scared by figures of graphs during examinations and due to this, they find it difficult to understand the figures and for correct interpretations. Eze and Ezemagu (2018) observed that schools which are involved

in practical classes perform better in SSCE than those that neglect practical work. There is a gradually alternatives in methodologies in biology with good academic performance and improvement and support from national science and other institutions with now good progress. From the above, it can be stated categorically that biology practical has a positive effect on the academic performance of students in biology examination.

Resources such as diagrams, field works and real objects when effectively used will explain the subject matter very well than a lecture. Biology being one of the science subjects cannot be taught or learnt effectively in the absence of practical activities (Iloeje, 2007). Practical work, which is 'hands on' activities, is an essential component when it comes to the study of the natural sciences, such as biology, chemistry and physics.

In this work, biology practical occupies the central position of effective teaching of bi ology. Hence, it is also logical to state that biology practical contributes to effective learning of biology.

According to Kuren et al., (2015), many students expressed their interest and enthusiasm in practical exercise hence, students who enjoy practical do well in science. The researchers believed that students' attitude and interest towards practical classes contributes immensely to the effective learning of biology. Good laboratory practical experience is a highly contributing factor towards effective teaching and learning in biology in particular. Behaviour of students towards laboratory work supports effective teaching and learning of biology and improve academic performance of students in generally.

It is clearly observed that practical biology has constructive effect on student enthusiasm since hands-on activities enhance skills attainment and the quality of learning because the students can understand better by deliberating about the work done. Amichebe (2007) in his study emphasized that teachers must understand their students as individual knowing how they learn best and how they may best transmit their skills and knowledge in order that the students may be educated. Finally, practical laboratory experiences are unique to biology in that it allows students to gain hands-on experience in the subject matter. It clearly provides students with the opportunity to become highly engaged in the process of learning and promote academic performance of students.

2.9 The Concept of Biological Drawing and Labeling

Drawing is a critical aptitude in biology and is viewed as a sort of information accumulation since diagrams help to record information from examples. A diagram is the consequence of a significant lot of perception at various profundities of Centre and at various amplifications.

Drawing is more or less as old as mankind, dating back from the prehistoric era through to the Middle Ages to date. Drawing has been defined in many ways by different writers and some are follows: According to the Longman Dictionary of Contemporary English (2007), drawing is “the art or skill of making pictures, plans among others with a pen or pencil or a picture that you draw with a pencil, pen, etc.” The New Encyclopedia Britannica Macropedia (2003) describes drawing as a formal artistic creation which serves as a means of visualizing ideas, a production of a successful planning as well as an interactive tool between draftsmen and their environment.

Biologists attach a lot of importance to making of diagrams with correct labeling of the specimen under study in practical classes. Tan (2018), reported that biology diagrams are different from those of fine art in which artists are expected to make colorful artistic diagrams. In drawing and labeling of biology specimen, the following are considered: size, proportionality, title and view or perspective. Observation is a vital aspect of practical biology. The importance of close observation of specimen in a practical biology examination can never be overemphasized. Candidates are expected to observe the specimen given to them very carefully and critically without which, proper specimen's identification, full representation in drawing and realistic comparative analysis cannot be done. Different reasons have been given to the problems relating to laboratory work (Tan 2018). Problems in laboratory work arise when students blindly follow the instructions of the teachers. Some researchers on the other hand claim that the laboratory instead of being a place for science practical and experiments has become a place where tasks set by the teachers are carried out, no attention is given to the method or purpose during laboratory work, only the set tasks are carried out. The problem of laboratory work is due to a poor evaluation of the purpose of the tasks undertaken in the laboratory.

Knowing the appropriate ways of drawing a biological diagram can really improve a student's overall performance in the subject. We have seen many students performing well in the descriptive and the experimental parts of biology (things involving definitions, descriptions, and experiments), but as soon as biological diagrams crop up in their examinations or homework, they develop a tendency to struggle. For students to improve their grades in biology, they must know the technically-feasible rules of drawing a biological diagram. The following rules can come in handy for you:

Rules in biological drawings

Pencil

Make sure you use a good quality pencil for your diagrams. 2H pencils are more advisable, but you may also use those technical drawing pencils for your biological diagrams. Never draw your diagrams with a pen. It's not acceptable at any possible cost.

Simplicity is what's preferable

Try to make your diagrams as simple as possible. Remember, sketching isn't what's acceptable in biological diagrams. So, avoid doing that at all cost, draw using clear-cut lines; that's it.

Drawings should be done on an unlined sheet

Biological drawings must be done on unlined sheets for more authenticity. This rule should be followed particularly when you are drawing a diagram for your biology lab copy. You would notice that a lab copy usually has unlined pages on your left and lined pages on your right. Draw your diagrams only on the unlined pages, in particular. A simple practice like that can go along way indeed.

Biological drawings should be conspicuous for easier comprehensibility

Avoid crowding parts of the diagram. Things like that can make you lose marks before you can even realize it. A biological drawing must bear all relevant parts that are conspicuous enough to the human eye. It should also be large enough to present all intricate details of the diagram to the observer. Do not shade or colour your drawing. Use stippling to show contrast.

Labeling and positioning

It is more advisable to keep your diagram to the left-hand side of your page. You should use the right-hand side for labeling purposes. Remember, proper positioning of the diagram can make it look aesthetically pleasing to the eye. So, if you want to create a good impression on the observer, this should be your way to go.

As far as labeling is concerned, follow the following rules as closely as possible for more efficiency:

- Labeling should be done in a column at the right-hand side of your page. Try to maintain an alignment to the best of your abilities.
- Always use a scale for drawing the lines used for labeling purposes, and it's more advisable to keep those lines parallel to one another.
- The lettering used for labeling should be kept in a horizontal alignment. Try to avoid vertical lettering unless you are specifically instructed or constrained to do so.
- Keep your lettering neat and intelligible such that the observer can understand it. For easier comprehensibility, it's more advisable to use block letters for lettering purposes, this isn't mandatory unless it's specifically instructed in the question paper.

- All biological drawings should be titled.
- Shading specific areas of a diagram might look aesthetic to the eye, but this practice is not acceptable in biology. Hence, the advice is to avoid at all cost.
- Try to draw the diagram on a single stroke of the pencil. Multiple strokes need to be avoided at all possible costs.
- Labeling intersections are not tolerated in biological diagrams.

2.10 Teaching Methods Used by Biology Teachers

The essence of teaching is to bring about a positive change in the behaviour, attitude and thinking of the learner. The teaching approach that the teacher adopts in order to bring about this positive change is very important. There are many different kinds of teaching methods as employ by teachers. Many studies have revealed that teaching activities are usually represented by teachers' teaching attitudes and their preferences regarding teaching methods (Wenning, 2002).

Teaching strategies are based on learning theories. These are techniques, sequence and methods used by teachers to enhance learning. It also involves multitudes of responsibilities given to the teacher during instruction (Hatfitt & Chan, 2017). These strategies are techniques that present information to the students in a manner that promotes learning such as exercises, demonstrations, tutorials, projects and producing biological models. A teacher may provide a variety of sensory experiences in the form of learning activities (Scaife, 2000). One important aspect in the study of the sciences and biology is the method used during impartation of knowledge to the students.

Recent studies advocate for a change in teaching methods so that students participate fully and understand difficult science concepts (Millar, 2010). Teaching methods such as learner design, reciprocal, inclusion, divergent and self-check could enhance the teaching of biology practical lessons (Capel et al., 2009). Ormrod (2000) insists that in science education, students are exposed to first-hand experience of the scientific inquiry process as well as constructing conceptual knowledge through a designed student-centered investigative method. Hence, the learning process is usually considered more important than the acquisition of factual knowledge in student-centered methods. Discovery learning as an inquiry-based learning method enables students to be actively

involved in investigating a topic or problem, obtaining appropriate information, interpreting causes and effects where necessary, and reaching the conclusions or solutions.

Aspbury-Miyanishi, (2021) stated that some teachers emphasize the use of question-and-answer techniques; others use a lot of programmed instruction. Still others utilize the lecture method in the science classroom and using overhead projectors a great deal. In a very real sense, each teacher uses a different teaching method. Root (2019) stated that programmed instruction is most effective at lower levels of learning, and that independent projects are appropriate at higher levels of learning, and these methods are flexible to the differences in learners. Field/clinical experience, laboratory experience, role playing, simulations and drill are the experiential learning methods. These methods require careful planning and precision at the secondary level.

Moreover, there is a traditional teacher-centered lecture (chalk-and-talk) approach, which emphasizes the transfer of knowledge and skills and rewards memorization. This is the predominant teaching format used in secondary schools (Tilya & Mafumiko, 2018). In this approach, the teacher talks most of the time, while student jots down notes mainly for the purpose of passing exams. This method does not allow for much critical analysis of issues but it makes students to duplicate the notes given back to the teacher. In this teaching approach, there is very little interaction between the teacher and the students or among the students themselves in the classroom. Students hardly ask any questions and the teacher rarely provoke students by asking critical questions.

Again, a study done on science teaching in Tanzania revealed that most teachers used transmission (chalk-and-talk) rather than interactive, learner-centered pedagogy (Osaki, 2000). Furthermore, teaching and learning approaches such as Behaviorism,

Cognitivism and Constructivism are also adopted by some science teachers during teaching and learning. Next is a thorough discussion on these three approaches/methods of teaching in science.

Constructivism

"Constructivism" means that students construct the knowledge; they do not receive it as it is but they re-form it again. They learn the new knowledge by adapting it to the existing knowledge and their own situations. A learner who comes across a new piece of knowledge uses the rules formed earlier to explain or forms new rules in order to explain better the knowledge perceived. In addition to this, a learner puts into practice the knowledge constructed, by bringing the already learnt knowledge and newly learnt knowledge together in order to solve the problems in life. In the constructivist approach, the aim is not to pre-determine what learners will do, but to provide individuals with the opportunity to direct their own learning process through tools and learning materials. According to Kahn et al., (2018) constructivism in general terms is based on:

1. the nature of reality: mental representation refers to "real" world
2. the nature of knowledge: knowledge is constructed in individuals" minds
3. the nature of human interaction: meanings are shared; that is, they are cooperative rather than being authoritative or manipulative
4. the nature of science: meaning is made after it passes through the individual's own filters.

Behaviorist Approach

Behaviorist theories that dominated the field of psychology during the first half of the 20th century is based on the philosophical views of Aristotle, Descartes, Lock and Rousseau on the nature of learning. These theories emphasize that by changing the

environment the desired behavior can be achieved. In the universe there is stable knowledge and the aim of education is to transfer this knowledge exactly to students and students are supposed to receive this knowledge without questioning. In addition to this, behaviorists see learning as an observable change in the behavior of the individual. Objectives are determined for students and they are expected to fulfill these objectives and organize their behaviors accordingly.

Cognitive Approach

The theorists of cognitive approach, in which Piaget, Bruner, Vygotsky and Guilford are pioneers, emphasize the complexity of human behavior and claim that the "action reaction" principle in the behaviorist approach is unsatisfactory in explaining learning.

According to the cognitivist, knowledge, which is perceived from outside environment through sensory organs is processed in the brain just like a computer processing data. The main knowledge processing are knowledge storages formed in the memory and the cognitive processes that help the knowledge to be transmitted to other memories (sensory, short-term and long-term) and that involve cognitive activities (Senemoğlu, 2010). The psychologists in favor of this opinion believe that learning is the result of our effort to give meaning to the events and situations around us and thus, we use all the mental tools we have, and adopted the following basic opinions below. Learner is not a passive receiver of external stimuli but he/she is the one who assimilates them and actively forms behaviors.

1. Learner is the one who takes the responsibility of his/her own learning, and he/she does not receive what is given as it is but discovers the meaning of what is given.

2. Learner is the person who chooses the suitable ones among the different pieces of knowledge and processes them.

Learner, even if it is a principle that is aimed to be acquired by him/her, has to give meaning to that principle by trying to find the meaning of it, relating it to other principles and associating it with the principles he/she have learnt before.

2.11 Challenges Faced in Teaching Biology Practical Lessons

The teaching of Biology practical lessons is not spared from drawbacks which inhibit the achievement of set goals. The factors such as unavailability of science teachers in schools, lack of materials, lack of funds and time have constrained the teaching of biology practical lessons. Consequently, many students fail to perform well in biology because of inadequacy of instructional materials such as laboratories, chemicals, models, apparatus, local specimens and shortage of textbooks all contribute to students' poor performance in biology. Also, Lack of allocated practical lesson time and irregularity of carrying out practical biology lessons by teachers affect student performance and understanding (Owino et al., 2014). Aloovi (2016) confirmed in his study that schools face challenges such as a lack of qualified teachers, a lack of experienced teachers, poor school infrastructure, a lack of practical work resources, overcrowded classrooms and timetable overload. Teachers in rural schools experienced the challenges more acutely because they reside far from resource centres. Therefore, there has been a communication barrier between teachers from various schools since they would have had very little opportunity to meet (Aloovi, 2016). Also, teachers had no platform in which to raise the problems that they endured with the implemented curriculum. He further pointed out that, teaching outside area of expertise offers considerable challenges and teachers express concern and apprehension when dealing

this situation. Teachers' lack of confidence when teaching topics outside their area of expertise is manifested in different ways including lesson plans, choosing or devising activities and analogies to aid students' learning, answering students' questions, setting up laboratory experiments, linking and applying various concepts and principles to everyday life situations, generating students' interest and passion for the science area. Teachers teaching outside their area of specialization face considerable challenges in lesson preparation and science teaching itself.

First of all, these teachers need to understand the structure and nature of the discipline and learn unfamiliar content knowledge, which is known as subject matter knowledge. Secondly, they need to transform the content knowledge into suitable activities, analogies, demonstrations or simulations and adapt them to the different students' abilities to help them learn, as described by Zakaria and Ahmad (2021) as pedagogical content knowledge. Inadequate background in the subject knowledge is one of the main factors that contributes to such challenges and will have an impact on the development of the teachers' pedagogical content knowledge as well as on the teachers' self-confidence and attitudes when teaching topics outside their area of expertise. The teachers' knowledge base strongly influences all aspects of teaching like preparation, planning and decision making regarding the choice of content to be taught (van Driel et al., 2001).

This implies that when teachers teach outside their area of expertise, they also need to develop different instructional strategies (one of the components of PCK). Having a limited knowledge of specific topics can negatively impact science instruction in senior high schools. Research studies about teachers teaching science topics within and outside their areas of specialization highlight important differences in the quality of

preparation and delivery of science lessons. Common challenges encountered by trainee or experienced teachers can be identified from different studies (Kind, 2009). Moreover, teachers teaching outside subject specialization, with lower background subject matter knowledge, followed the textbook structure quite closely, could not generate new activities and asked recall questions. They could not detect students' misconceptions and in some cases, they reinforced these ideas. In a study by Childs and McNicholl (2007) with novice and experienced teachers, lessons outside subject specialization were tightly controlled and included less discussions, open-ended questions, anecdotes, illustrations and analogies. A study in Australia by Goodrum (2000) claimed that large class size, limited resources, inadequate time for preparation, reflection and teachers' collaboration with colleagues limit the use of practical activities in teaching science in secondary schools.

It is worth noting that quality teaching and learning of science in schools cannot be achieved in a vacuum but requires adequate resources, improved teacher preparation, small class sizes, ongoing professional development for science teachers and the recognition of the importance of science education in society, among others. Improving the quality of teaching and students' achievement in science depends on the quality of initial teacher education, mentoring and induction programs provided for beginning teachers, opportunities for ongoing professional development provided for teachers, teaching resources in schools and community support among other factors. Literature in science education has continued to claim that teacher quality is the most important factor that inhibits the quality of science education.

Also lack of coordination in the nature of methods, courses, practicum experiences, and the role of placement of clinical experiences as the immediate problems facing science

teacher education that need to be addressed for quality science teaching. Kapting'ei and Rutto (2014) mentioned that learners should be able to develop different skills such as thinking skills and process skills. Adding to this, learners often have difficulties in achieving scientific skills because they lack the understanding of practical concepts. Because of this, they face the following challenges: lack of laboratories in schools, limited laboratory space, Lack of laboratory technicians, Inadequate laboratory equipment, limited time to spend on practical work, limited practical manuals, Lack of funds available for equipment repairs, Poor understanding and grasp of practical concepts by learners. Not having laboratories on school grounds puts the lives of learners at risk, because some practical work requires learners to use explosive chemicals that could harm learners, and he suggests that the risk of such experiments is diminished when done in a laboratory (Kasiyo, Denuga and Mukwambo, 2017). Having no laboratories makes it difficult for teachers to keep the limited apparatus safe, thus putting them at risk of damage, which will result in a reduction of the few that are available. Kapting'ei and Rutto (2014) mention that some schools appear to have quite limited laboratory space that cannot accommodate the number of learners in a class for the practical sessions, thereby reducing the productivity of the practical work learners must do. Teachers in some instances may be forced to divide learners into groups to fit into the laboratory and to have sufficient access to practical equipment. Working in shifts may be time-consuming, thus leaving practical work unfinished as per the syllabus requirement. Malathi and Rohini (2018) agree that inadequate time allocation for practical work is an obstruction, as is the unavailability of resources and a large number of learners per class, which makes it difficult for a teacher to give undivided attention to a single learner at a time. The authors add that teachers

are pressured to follow the assessment of theory activities, which erodes teaching time. These are contributing factors that hinder effective practical work. The absence of suitable venues, favourable environments, technical support and laboratory assistants are by far the most significant problems faced by teachers. Adding to the lack of sufficient equipment, Kapting'ei and Rutto (2014) state that some schools have very old and dysfunctional equipment and teachers claim that there is a lack of sufficient funds to replace the old equipment. Schools also face the challenge of a lack of trained laboratory technicians, who lack the necessary technical skills and professionalism. According to Kapting'ei and Rutto (2014) some schools do not have laboratory assistants at all, making it difficult for teachers as they are forced to do the work of a technician and waste the time required to teach and demonstrate practical.

2.12 Strategies Used by Science Teachers to Deal with Challenges in Practical Work.

When facing unfamiliar science content, teachers resort to a range of strategies to deal with these challenges (Childs & McNicholl, 2007; Kind, 2009). During the preparation stage, they mainly read textbooks, teachers' resource packs and outlines of work, which offer various ideas of lesson plans and activities; they also outline links between lessons across the theme. They also seek help and advice from school contemporaries who are subject specialists, especially about practical work and conduct trail experimentations. Support from the workplace was found to be the most popular strategy to help teachers deal with their weaknesses in subject matter.

Teachers also read textbooks for more knowledge especially trainee teachers in their areas of specialization, hence, produce more successful lessons. Some studies have also

tried to find a correlation between teachers' self-confidence to teach the different sciences and the level of content knowledge (Kind et al., 2011). Fitzgerald (2020) found that teachers gained more confidence not only when they experienced success in learning science content but also when they experienced how the subject is taught after undergoing a science method course.

Planning and preparation on how to carry out practical activities safely can be found in practical teaching guides and practical workbooks. Practical teacher's resources, lesson observation and peer support can all help if you're struggling to plan practical sessions. For inexperienced students, practical workbooks can provide helpful support and save time, with step-by-step instructions, diagrams identifying scientific equipment and detailing procedure, and helpful health and safety advice.

Provision of appropriate equipment and guidance is also an effective way of addressing the challenges faced in teaching biology practical in schools. Using a practical activity can help structure a lesson and improve engagement and knowledge retention.

2.13 Chapter Summary

This chapter dealt with literature review related to the study. The literature was discussed under the sub-headings: theoretical framework, The history of practical work in science, meaning of practical work in science and nature of biology practical work, Also present in this chapter were concept of biological drawing/work, role of practical work in teaching and learning of biology, biology practical work in secondary schools, teaching methods used by biology teachers, state of facilities (science laboratory, equipment etc.)materials/resources available to biology teachers. It also dealt with of teaching methods used by biology teachers, state of facilities (science laboratory, equipment etc.) materials/resources available to biology teachers, effects of practical

work/ activities on the academic performance of students. The chapter also focused on challenges faced by biology teachers in schools, and using practical activities and strategies to solve /deal with such challenges faced, and finally, chapter summary.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter describes the research methods used in conducting the study. These include the research design, research instruments, population size and the study sample. Also presented are the validity and reliability of the instruments, data collection procedures as well as the data analysis method utilised.

3.1 Study Area

This study was conducted in the Bawku-East district in the Upper-East Region of Ghana. According to Ghana Statistical Service and Ghana Housing and Population Census (2021), the population of the area is about four hundred and thirty-five thousand, four hundred and thirty-seven (435,437) inhabitants. Farming and trading are the major economic activities in the district. There are eight (8) SHS in the district which comprised six public and two (2) private SHS. The public SHS are Tempane Senior High School, Garu Community Senior High School, Bawku Senior High School, Bawku Senior High Technical School, Binduri Senior High School. The private schools are Saniti Senior High School, and Azoka Memorial Senior High School.

3.2 Research Design

A research design is a detailed plan of how a research study is to be conducted by operationalising variables to be measured, selecting samples of interest, and data collection procedure to answer research questions, test hypothesis, test analysis of data (Creswell, 2008). Though, there are several types of research designs, this study adopted mixed method approach, by using the descriptive survey design.

Mixed method approach involves collecting, analyzing and integrating quantitative (e.g., experiments, surveys) and qualitative (e.g., observation, focus groups, interviews) in research (Creswell, 2003). This approach uses the strength of both methods to provide a broader perspective about the issue under investigation. Mixed method approach is used when the researcher needs to converge or validate results from different methods. The approach can also be used when the researcher wants to elaborate, enhance or further clarify the results of a method. The advantages with this method are that: It provides strengths that offset the weaknesses of both qualitative and quantitative approaches. It also provides a more complete and comprehensive understanding of the research problem than either quantitative or qualitative. Creswell and Clark (2007) regard a research design as the philosophical assumptions of the study framework which are linked to the methods to be used in conducting the study. The research design is known to play a role in an investigative or assessment study for an obvious reason: it provides an outline of the route that will be followed in order to conduct the study.

Though, there are many mixed method designs, this study employed the sequential explanatory design to explain and offer insights into the performance of senior high school students in biology practical work. Sequential explanatory design involves the collection and analysis of quantitative data followed by the collection and analysis of qualitative data where the qualitative results is used to interpret and further explain the findings from the quantitative results. In this case, the significance is given to the quantitative data and the findings are integrated during the interpretation phase of the study. The strength of a sequential explanatory design is that it is easy to implement because the steps fall into clear separate stages. Also, the design is easy to describe as well as in reporting its results (Bryman, 2004).

3.3 The Target Population

Population is a well-defined group of individuals and entities having similar characteristics (Castillo, 2009). The target population consisted of eight Senior High Schools in the district.

Out of the total number of eight (8) senior high schools in the district, the researcher employed the purposive sampling technique/procedure to select three schools for the study due to the fact that elective biology is only offered in these schools. The purposive sampling technique was used because some of the schools in the district do not offer general science as a programme. The sampled schools were Labeled A, B and C for easy identification and handling.

3.4 The Accessible Population

The accessible population consisted of all the two hundred and fifty (250) SHS 3 biology students in the three selected senior high schools within the Bawku-East district in the Upper-East region of Ghana. The three schools are Bawku SHS, Bawku SHTS and Garu Community SHS.

3.5 Sample for the Study

A sample is a small part of anything which is intended to represent the whole (Wellington, 2003). The sample of the study consisted of one-hundred and sixty (160) students selected from the three senior high schools in the Bawku -East district. The sample consisted of 35 males and 25 females from school A, 30 males and 25 females from school B and 25 males and 20 females from school C. In all, the sample size consisted of 90 males and 70 females' students.

The students from each biology class in each school were selected using the stratified random sampling technique. According to Yeboah (2010), random sampling is one where each item in the universe has an equal or known opportunity of being selected. The researcher used stratified random sampling because it increases precision and representativeness of the study sample. In each school, students were grouped into two strata namely, males and females. Simple balloting was then used to select the proportion of males and females to form the sample of the study.

3.6 Instruments for Data Collection

Two instruments were used in this study. One questionnaire with open and close-ended items was used to collect the data in the study. Another instrument used included a laboratory checklist of equipment available.

The Questionnaires

A questionnaire according to Patton (2002) is a self-report data collection instrument that each research participant fills out as part of a research study. A questionnaire is a written document in survey research that has a set of questions given to respondents or used by an interviewer to ask questions and record the answers (Neuman, 2003).

The questionnaires were developed by the researcher in consultation with the supervisor. The questionnaire was structured in accordance with the research objectives, so as to achieve the anticipated results. The questionnaire was selected because all the participants were literate and could respond to the items in the instrument. The questionnaire comprised of three sections: section A, B and C. Section A comprised items on biodata of students and B on the students' attitude and C on students' views of their teachers' attitude towards laboratory practical work. from the

three schools under study. Participants were given ample time to respond to the questionnaires.

Checklist

A checklist was used to look at and record equipment that could be found in biology laboratories of the three selected Senior High Schools under study within the Bawku - East district. A checklist is an assessment tool that lists the specific criteria for the skills, behaviours or attitudes that participants should demonstrate to show successful learning from training. Checklists usually feature statements or questions about the participants' performance of each criterion. It is a list of all the things that you need to do, information that you want to find out, or things that you take somewhere, which you make in order to ensure that you do not forget anything. It is important that your checklists should be clearly written, and it may include all information that you can need during the development of your tasks. Checklists have the objective of overseeing tasks or projects and ensuring and nothing important is forgotten during execution. This way, you don't omit anything that might end up compromising your results. Additionally, they ensure activities are completed in orderly and organised manner. A checklist is a document that enumerates items or tasks to be accomplished. Checklists are one of the most common, versatile, and widely-used forms. Checklists, Control Lists or Verification Lists are formats designed to perform repetitive activities, to verify a list of requirements or to collect data in an orderly and systematic manner. They are used to make systematic checks of activities or products ensuring that the worker or inspector does not forget anything important. A checklist is a comprehensive list of crucial tasks to be completed in a specified order; this ensures no important step is forgotten**.** The use of a checklist can help improve efficiency by minimizing mistakes. Checklists also provide a written trail detailing what was done at every step of a project.

The ideal checklist should be precise, efficient, easy to use in any situation and straight to the point. All the items on a good checklist should be actionable and grouped by category.

3.7 Validity of Instrument

The quality of a research instrument or a scientific measurement is determined by both its validity and reliability (Kimberlin & Winterstein, 2008). An instrument is considered valid when there is confidence that it measures what it is intended to measure in a given situation (Punch, 2005). Whiston (2012) defined validity as obtaining data that is appropriate for the intended use of the measuring instruments. In this case, validity tests, which determine whether the expressions in the scale make suitable measurements according to the purpose of the research, come to the fore.

In order to ensure the content and face validity of the items, the questionnaire was given to a senior biology teacher and my supervisor to vet the items. The items were vetted in terms of their relevance to the subject matter, coverage of content area, appropriateness of language usage and clarity of purpose. They made necessary corrections on the items and their input were incorporated in the final draft of the instrument. The final copy of the instrument after the validation, was used for data collection.

Pilot Test

The questionnaire was piloted in the Garu Senior High School to obtain a standardised data. The result of the pilot test was subjected to SPSS analysis to obtain the reliability coefficient value. The pilot study was used to restructure the items on the questionnaire in order to elicit correct responses. Cargan (2007) explained that a pilot study is a good means of ensuring that the questionnaire would provide data that is accurate and

standardised as well as guarantee successful administration in the main study. The instrument was also tested to establish its internal consistency, reliability and validity. It was meant to identify ambiguous and difficult questions based on the analysis of data from the pilot test, hence, some modifications were made in the questionnaire.

3.8 Reliability of Instrument

Sharpe (2012) refers to reliability as "the extent to which a test or procedure produces similar results under a constant condition on all occasions. To test the reliability of the instrument used in this study, a pilot test was conducted by using the questionnaire in Garu SHS. Reliability is a measure of the accuracy of a test or measuring instrument obtained by measuring the same individuals twice and computing the correlation of the two sets of measures. Reliability refers to the consistency or stability of a measurement. A test or instrument with good reliability means that the respondent will obtain the same score on repeated testing as long as no other extraneous factors affect the score. In actuality, a respondent will rarely obtain the exact same score over repeated testing because repeated assessments of any phenomenon will likely be affected by chance errors. Thus, the goal of testing is to minimize chance errors and maximize the reliability of the measurement with the recognition that a perfectly reliable measure is rarely attainable Reliability is extremely important because evidence of reliability is necessarily the first step in establishing the scientific acceptance and usefulness of a test. Indeed, good reliability is a prerequisite for validity of a test, which is defined as the extent to which a test accurately measures the construct that it purports to measure. In quantitative research, reliability alludes to the degree to which research findings could be duplicated if the study were to be repeated, with the aim of creating cause and impact relationship among factors (Creswell, 2012)

The main statistical measure to determine reliability of the questionnaires was the use of Cronbach's alpha coefficient estimate. The Cronbach's alpha reliability coefficient was calculated to be 0.80 after the pilot study, hence, the instrument was reliable since according to Amin (2005), Cronbach's alpha value of 0.7 and above is considered reliable. Pilot testing of the instruments reduced ambiguity of items and therefore enhances their reliability (Meriwether, 2001).

3.9 Data Collection Procedure

The researcher used a day to visit each participating school to meet the respondents. The visits were meant to enable me establish rapport with all the respondents and to explain the purpose of the study to them and to elicit their maximum co-operation so that the objective of the study could be achieved. A date was set with the respondents for the administration of the questionnaire. The second visit was used to administer the questionnaire on the agreed dates. The researcher personally administered the questionnaire to the respondents. The researcher was there to further explain and clarify any part of the questionnaire that might be ambiguous to the respondents. All the respondents were assured that any information collected from them would be kept confidential.

Each respondent was given enough time to complete the questionnaire. The questionnaire was completed and collected the same day and all were returned.

One practical lesson each was observed using the observation checklist. The observation was to cross check and identify discrepancies between respondents' competence, attitudes and practices based on the data gathered. During the practical lesson, every observable behaviour (verbal and nonverbal) of the teachers were noted down. Notes were also taken during the lesson to get relevant issues not covered by

the observation schedule, such as the topic and objectives for the lesson, list of materials and equipment used in each observed lesson. Notes were taken on the nature of laboratory activities and the involvement of students in these activities.

The teachers were interviewed immediately after the lesson observation to clarify issues that affects their competence, attitude and practices during the observation. The researcher used semi-structured interview to collect qualitative data from the respondents because, it allows the researcher to obtained new ideas during the interview as a result of what the respondents say.

Also, Various curriculum materials and students practical note books and Chief Examiners' report was examined. These helped to explain some of the information collected through observation and interview. This was also to enable the researcher to ascertain whether respondents paid attention to the WAEC Chief Examiners' reports on biology practical work/activities.

3.10 Ethical Issues

In research, ethical matters are the principles of right and wrong, accepted by a particular group at a particular time (Bogdan & Biklen, 2007). According to Banu (2011), ethical codes represent desire and efforts to show respect to others' rights, execute responsibilities, avoid harm, and supplement benefits to the subjects. To ensure participation of the respondents and their respective institutions, the researcher ensured confidentiality of their data taken and anonymity. This was done by instructing respondents not to write their names nor indicate their schools on the questionnaire in their responses.

3.11 Data Analysis

Data analysis is the ordering and breaking down of data into constituent parts and performing statistical calculations on the raw data to provide answers to the questions guiding the research (Osuala, 2001).

Quantitative data collected was analysed using descriptive statistical tools such as frequencies percentages, means and standard deviations. Statistical Packages for Social Sciences (SPSS) version 21 was employed to analyse the data and the results was presented in tables. On the other hand, the qualitative data were analysed using content (text) analysis. Content analysis is a research tool or technique used to determine the presence of certain words, themes, concepts within some given qualitative data. It can also be used to identify patterns in recorded communications. Content analysis was done through collection of written text in books, newspapers, magazines, visual, oral/ written speeches and interviews. After which, the presence, meanings and relationships of certain words, themes or concepts were quantified and analysed. However, personal identification details were left out to ensure the anonymity of the respondents.

3.12 Chapter Summary

This study was conducted in the Bawku -East district. Mixed method approach with sequential explanatory approach was employed to collect the data. One hundred and sixty (160) participants, were selected through stratified sampling techniques. The main instrument for data collection was questionnaire and checklist. Descriptive statistical tools (frequencies and percentages) were used to analyse the quantitative data whereas content analysis was used to analyse the qualitative data (open-ended items). Finally, ethical concerns and chapter summary were discussed in this chapter.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter presents and discusses the response to the data collected in relation to the performance of senior high school biology students in practical work.

This study was conducted in the Bawku East District in some three selected SHSs to investigate students' views of their teachers and their own attitude towards biology laboratory work. The chapter specifically considers and explains both the students and teachers' attitude in performance in biology at SHSs in Bawku-East District, Ghana, more particularly the achievements in biology practical, acquisition of science process skills, attitude change towards biology, scheme for evaluating practical work in secondary schools in biology. Results discussed in this section were obtained from a sample of 160 elective biology students selected from three senior high schools within the Bawku East district of the Upper East Region of Ghana. The study was guided by three research questions.

Research Question One

What are the resources available in the laboratories for practical work in Schools in the Bawku East District?

4.1. Available Laboratory Equipment in each School

Research question one was meant to investigate the laboratory resources available and their sufficiency and functionality in each school for practical work in the Bawku East District. Laboratory tools are very essential in biology laboratories and their sufficiency and function is a matter of significance to teaching and learning of biology practical in secondary schools. The laboratory equipment in the three selected schools is indicated in Table 1.

Table 1: Availability of laboratory equipment in each of the three schools

	SCHOOL A	SCHOOL B	SCHOOL C
What laboratory equipment or tools is available in your school laboratory?	Safety Apparatus, Dissecting Tool Kit, Electronic Balance, Beakers, Conical Flasks, Evaporating Disk, Graduated Cylinders	Inoculating Loops and Petri Dishes, Spatulas and Scoular, Electronic Balance, Thermometer, Litmus and Filter Papers Conical Flasks, Evaporating Disk, Graduated Cylinders	Forceps, Beakers, Conical Flasks, Evaporating Disk, Funnels, Graduated Cylinders, Droppers and Pipettes Safety Apparatus, Dissecting Tool Kit, Hot Plate, Electronic Balance

Table 1 shows the available of laboratory equipment in each of the schools under the study. The results suggested that none of the schools has all the laboratory required equipment in their schools. Science laboratory equipment allows students to interact directly with the data gathered. They get a first-hand learning experience by performing various experiments on their own. From the results obtained, it was concluded that teaching and learning practical work in the absence of well-equipped science

laboratories possibly hinder learning to occur as well as teaching process also fail. Laboratory equipment play key roles when performing laboratory work with biology students but insufficiency of the equipment would not help the students achieve what is expected of them. Even though, all the three schools under study have laboratories, they were not well equipped with laboratory tools to do practical work in their respective schools and could result in students not performing well. Without proper science equipment for schools, student's engagement and information retention would not be possible. Outlander and Grelesson (2006), showed that, the role of practical work is to help teachers to work together with students so that to build the connection between theory and practice in real life situation and therefore increase motivation to the side of students. Absence of the laboratories and laboratory equipment hinders the students and teachers to work together in practical session and therefore students fail to connect the theory of what they learn in the classroom with the practical, and then they are de-motivated.

4.2. Functionality of Laboratory tools

Table 2 shows the functionality and sufficiency of the laboratory tools in each school under study.

Table: 2 The functionality and sufficiency of the laboratory tools in the schools.

		School A		School B		School C	
	Responses	Respondents	Percent	Respondents	Percent	Respondents	Percent
Does your school have a laboratory?	Yes	30	100.00%	70	100.00%	60	100.00%
	Total	30	100.00%	70	100.00%	60	100.00%
Are the laboratory equipment in this school sufficient for practical work?	Yes	8	26.67%	19	27.14%	21	35.00%
	No	22	73.33%	51	72.86%	39	65.00%
	Total	30	100.00%	70	100.00%	60	100.00%
Are the laboratory equipment good for use in the laboratory?	Yes	7	23.33%	33	47.14%	29	48.33%
	No	23	76.67%	37	52.86%	31	51.67%
	Total	30	100.00%	70	100.00%	60	100.00%

Source: Field Survey, 2022

In Table 2, all the respondents indicated that, the three schools had laboratories to carry out laboratory work. An availability of science laboratories allows students to actually perform experiments rather than just read about them. Instead of taking monotonous notes, they would observe and complete exciting experiments. However, about 73.33% of the respondents in school A said the laboratory equipment were not sufficient for practical work, 72.86% of the respondents in school B said the laboratory equipment were not sufficient whereas, 65.00% of the respondents in school C said the laboratory equipment were insufficient for use. It was noted that, many schools depend on neighbor schools for their students to do practical which is not enough for students, to acquire all practical skills and knowledge. Teachers perform practical and demonstrations when the school has laboratories, equipment, chemicals and reagents.

If the laboratories, equipment, chemicals and reagents are not present biology teachers prefer lecture method.

About 76.67%, 52.86% and 51.67% in school A, B and C said the laboratory equipment are not good for use. The results suggested that, there were laboratories in the various schools, but the available equipment were not enough to carry laboratory experiments efficiently in their schools and this could affect their understanding of laboratory work. Even, an observation made by the researcher himself had indicated that, some of the tools were faulty in the laboratories and could not be used for any laboratory work.

Dinah (2013) found that, inadequate availability of text books, laboratory apparatus and other learning resources contribute significantly to the poor performance of students in biology examination. Also, Mamalanga and Awelani (2014), noted that the possible factors responsible for the poor performance in biology practical included lack of financial support, lack of equipped libraries, lack of laboratories and biology textbooks, method of teaching and accessing biology. According to Owino et al., (2014), inability of a school to provide adequate teaching and learning resources such as chemicals, charts, apparatus, models, local specimens, laboratories lead to poor performance of students in biology.

These results suggested that the laboratory equipment were generally not good for use among the various schools and would definitely affect student's performance negatively. According to SCORE (2008), the problem with understanding the true purpose of practical work within science education is still an issue. This unclear focus led to different approaches of practical work that potentially influence the learning outcomes for the students. Also, it was observed by WAEC Chief Examiner (2013) that academic performance of candidates in biology fell below expectation. The chief

examiner lamented that "there were many candidates who could not answer correctly a single question in biology practical, in most instances; they have to guess unrelated answers that were sometimes not biological.

According to Amichebe (2007) practical laboratory experiences are unique to biology in that it allows students to gain hands-on experience in the subject matter. It clearly provides students with the opportunity to become highly engaged in the process of learning and promote academic performance of students.

Eze and Ezemagu (2018) observed that schools, which are involved in practical classes, perform better in SSCE than those that neglect practical work. Teachers should be encouraged to assess' learners regularly on practical skills. Perhaps, lessons that are more practical should be availed and documented so that teachers would plan for them and regular inspection to ensure the actual order is adhered to (Wabuke & Mukhwan, 2013).

4.3. Attendance at biology practical work

Research Question Two

What is the attitude of students towards the use of practical work in learning biology?

Research question two was meant to investigate the attitude of students towards the use of practical work in learning biology.

Table 3: Attendance and organization of biology practical in the three schools

Reponses		School A		School B		School C	
		Respondents	Percent	Respondents	Percent	Respondents	Percent
Do you attend biology practical lessons regularly?	Yes	16	53.33%	66	94.29%	45	75.00%
	No	14	46.67%	4	5.71%	15	25.00%
	Total	30	100.00%	70	100.00%	60	100.00%
In Biology class, does your teacher use practical work to illustrate concepts that have been introduced?	Yes	11	36.67%	41	58.57%	24	40.00%
	No	19	63.33%	29	41.43%	36	60.00%
	Total	30	100.00%	70	100.00%	60	100.00%
If yes, do you use the equipment during practical work in the laboratory?	Yes	25	83.33%	56	80.00%	39	65.00%
	No	5	16.67%	14	20.00%	21	35.00%
	Total	30	100.00%	70	100.00%	60	100.00%

Source: *Field Survey, 2022.*

Table 3 indicated that 53.33 %, 94.29 % and 75.00 % of the respondents in school A, B and C respectively, said they did attend biology practical lessons regularly, representing the majority of the respondents. This actually portrayed students' attitudes towards biology practical attendance in their schools.

Majority of the respondents in school A (83.33%) said they used the equipment during practical work in the laboratory, 80.00% in school B said they used the equipment during practical work in the laboratory and 65.00% in school C said they used the equipment during practical work in the laboratory. This concludes that, school A will perform better, follow by B and C respectively, because of the proper use of the apparatuses in their schools. Also, about 63.33% in school A and 60.00% in school C said their biology teachers did not use practical to support concepts that have been

introduced and this would not aid them in their retention of useful information purposely for laboratory work. This was contrary to students in school B, as about 58.5% said that their teacher used practical to illustrate concepts that have been in the laboratory and this would enable them recalled information appropriately. Also, about 83.33 %, 80.00 % and 65.00 % of the respondents in A, B, and C respectively, said that their teachers allowed them to manipulate with the available laboratory tools in their schools for better understanding and knowledge retention.

In practical work, the need for the learners to participate actively in the practical activities is very key to learner's most especially secondary school students. It gives the students the opportunity to have their hands on the use of the laboratory tools which enhances their experience and knowledge in the practical works. Millar (2004)) argued that it is also important to distinguish, and keep in mind that, the school science curriculum in most countries has two distinct purposes. First, it aims to provide every young person with sufficient understanding of science to participate positively and effectively in the modern world, with a 'scientific literacy'. Second, advanced societies require a steady supply of new recruits to jobs requiring more detailed scientific knowledge and expertise; school science provides the foundations for more advanced study leading to such jobs.

The attitudes of students towards a subject also plays an important role in the performance of those students. This section evaluates the behaviour and students' attitude towards learning, class attendance and note taking of biology during and after class ours. Table 4 captures attitude of respondents.

Table 4: Students' attitude towards biology practical work

Responses		SCHOOL A Respondents	SCHOOL A Percent	SCHOOL B Respondents	SCHOOL B Percent	SCHOOL C Respondents	SCHOOL C Percent
Do you have biology study groups?	Yes	26	86.7%	62	88.6%	48	80.0%
	No	4	13.3%	8	11.4%	12	20.0%
	Total	30	100.0%	70	100.0%	60	100.0%
Is biology your favourite subject?	Yes	25	83.3%	53	75.7%	44	73.3%
	No	5	16.7%	17	24.3%	16	26.7%
	Total	30	100.0%	70	100.0%	60	100.0%
Do you attend biology practical lessons regularly?	Yes	16	53.3%	66	94.3%	45	75.0%
	No	14	46.7%	4	5.7%	15	25.0%
	Total	30	100.0%	70	100.0%	60	100.0%
Do you have biology practical book?	Yes	12	40.0%	40	57.1%	34	56.7%
	No	18	60.0%	30	42.9%	26	43.3%
	Total	30	100.0%	70	100.0%	60	100.0%
if yes, do you take note?	Yes	12	92.3%	43	87.8%	34	91.9%
	No	1	7.7%	6	12.2%	3	8.1%
	Total	13	100.0%	49	100.0%	37	100.0%

Source: *Field Survey, 2022.*

Table 4 presented the results on students' attitudes towards biology practical, it was discovered that 86.70% of the students did have biology study groups in school A, 88.6% of the respondents in school B said they had biology study groups and 80.0% of them in school C did say they have biology study groups. This would encourage students to think creatively and build strong communication skills which would also help in refining understanding of the materials. It was proven that those who participated in group studies felled more confident and comfortable about reaching their academic goals. Effective study groups could help students learned course materials in a deeper, more concrete way and generate positive energy, encourage active participation, instill discipline, and require commitments from students, which are certainly important for learning.

About 83.3% exhibited the habit of liking biology in school A, 75.7% say biology was their favourite subject in school B and 73.3% say biology is their favourite subject a student having interest in a particular subject area would be able to do well in it. This constitutes majority of the respondents in the three schools. This shows that student's attitude is good, and may translate to better performance in their schools.

According to Kuren et al., (2015), many students expressed their interest and enthusiasm in practical exercise hence, students who enjoy practical do well in science. The study revealed that about 53.3%, 94.3%, 75.0% of the respondents attend biology lesson regularly in schools A, B and C respectively. This would enable students to apply and extent their understanding and knowledge of biology in novel investigative situations, which could aid learning and memory, and stimulate interest. When students are regular in class, they understood whatever is been taught and would increase knowledge and retention in laboratory work. They constitute the majority of the respondents. About 60.0% of the respondents did not have biology practical books in school A, but in school B, 57.1% say they have biology practical books and 56.7% of the respondents in school C say they have biology practical books. They majority of the respondents came from school B and school C saying they have gotten biology practical books, and this could enhance their performance in biology practical work.

Majority of the respondents in the schools take notes with 92.3%, 87.8% and 91.9% in school A, B and C respectively. This shows that majority of the respondents take notes during biology lessons. This means that students were often involved actively in class and could easily get reference or information from their notes when needed.

A study by Ruffato (2012) in United States of America showed that when students were using hands-on methods of learning biological processes, they were more

engaged than with previously used methods like lecture and following drawings on the board and performed well in short term assessments of knowledge. Also, Rafi et al., (2019) found a positive relationship existing between the independent variables of laboratory facilities, recommended text books, number of science books in the library and teachers' qualifications and the dependent variable, academic performance of students in biology, chemistry and physics.

Research Question Three

What is the attitude of teachers towards practical work in teaching biology?

4.4. Attitudes of biology teachers towards practical work

Research question three was meant to investigate the attitude of biology teachers towards the use of practical work in teaching and learning of biology, and examine how actively the teacher allows students to practice during practical lessons. In the teaching field, the attitude of the teacher plays a very critical role in the performance of the students. The interest of students in a particular subject depends on the teachers' attitudes and effectiveness towards the teaching of the subject. Below is the illustration of the teachers' attitudes during delivering in class. Results of teachers' attitude towards the use of practical work are shown in Table 5.

Table 5: Biology teachers' attitudes towards the teaching of biology practical work

Responses		SCHOOL A		SCHOOL B		SCHOOL C	
		Respondents	Percent	Respondents	Percent	Respondents	Percent
Is the teaching and learning of biology interactive enough?	Yes	18	60.0%	51	72.9%	34	56.7%
	No	12	40.0%	19	27.1%	26	43.3%
	Total	30	100.0%	70	100.0%	60	100.0%
Does your biology teacher introduce hands-on activities in the teaching and learning of the subject?	Yes	19	63.3%	41	58.6%	28	46.7%
	No	11	36.7%	29	41.4%	32	53.3%
	Total	30	100.0%	70	100.0%	60	100.0%
Does your teacher always demonstrate to you before giving you the opportunity to work on your own during biology lessons?	Yes	19	63.3%	55	78.6%	35	58.3%
	No	11	36.7%	15	21.4%	25	41.7%
	Total	30	100.0%	70	100.0%	60	100.0%
Does your biology teacher allow you to work on your own while he/she serves as a facilitator during lessons?	Yes	22	73.3%	46	65.7%	30	50.0%
	No	8	26.7%	24	34.3%	30	50.0%
	Total	30	100.0%	70	100.0%	60	100.0%
Does s/he permit you to use your own judgment in solving problems during biology lessons?	Yes	21	70.0%	38	54.3%	29	48.3%
	No	9	30.0%	32	45.7%	31	51.7%
	Total	30	100.0%	70	100.0%	60	100.0%
If yes, do you use the equipment during practical work in the laboratory?	Yes	25	83.3%	56	80.0%	39	65.0%
	No	5	16.7%	14	20.0%	21	35.0%
	Total	30	100.0%	70	100.0%	60	100.0%

Source: *Field Survey, 2022.*

From Table 5, about 60.00% of the respondents in school A agreed teaching and learning of biology is interactive, about 72.90% in the B agreed teaching and learning is interactive and about 56.70% agreed the teaching and learning is interactive. This could draw students closer to their biology teachers and students would understand concepts well during lesson delivery in the laboratory. Obviously indicating that the

majority of the respondents in the all the schools agreed that teaching and learning is interactive in their schools. Cohen et al., (2007), put it that "directly or indirectly classroom interactions are controlled by the teacher, it is he who promotes particular learning situation through his choice of objective, organization of experience, selection of materials and methods in order to facilitates the students' academic performance.

School A and School B have the majority of the respondents accepting that teachers introduce hands-on activities in the teaching and learning of the subject with about 63.30% and 58.60% respectively. School C having the majority of the respondents saying their teachers did not introduce hands-on activities in their schools in teaching and learning of the subject with about 53.30%, and could seriously affect their understanding in the subject negatively.

About 63.30%, 78.60% and 58.30% of the respondents said the teachers always demonstrate to them before giving them the opportunity to work on their own during biology lessons in school A, school B and school C respectively. This represented the majority of the respondents in the three schools. Demonstrations attract and hold student's attention, thereby increasing their interest in the practical as it normally presented the subject matter in a way that can be understood easily and take out their doubts.

The majority of the respondents in school A, school B and school C said their teachers allowed them to work on their own while they serve as the facilitators with about 73.30%, 65.70% and 50.00% responses and could boost their confidence level. School C had about 50.00% of the respondents disagreeing that the teachers allow them to work on their own while they served as facilitators. School A and B had the majority

of the respondents saying their teachers allowed them practice while they observed but school C had equal numbers on both sides of the responses.

Schools A and B had the majority of the respondents saying the teachers permit them to use their own judgment in solving problems during biology lessons with about 70.00% and 54.30% respectively. Schools C with about 48.30% agreeing to the claim and about 51.70% disagreeing with the claim.

All the respondents in the three schools agreed that they use the equipment during practical work in the laboratory with about 83.30%, 80.00% and 65.00% in school A, B and C respectively. This could allow them involved the various senses to make learning permanent in them. It would develop interest in the learners and motivates them for their active participation. By providing students with practical laboratory lessons, that are academically stimulated, students are more engage meaningfully with tasks and subsequently achieve higher assessment grades (Karental et al., 2015).

Many studies have revealed that teaching activities are usually represented by teachers' teaching attitudes and their preferences regarding teaching methods (Wenning, 2002).

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This chapter presents the summary of the findings, conclusions and recommendations based on the conclusions.

5.1 Summary of Work

The study was conducted to explore students' views of their teachers and their own attitude towards biology laboratory work at SHSs in Bawku-East district, in the upper east region of Ghana. A total 160 students were randomly selected from three senior high schools within the district. In the study, the mixed method approach was employed. The instruments for data collection were checklist of laboratory equipment and a questionnaire which developed by the researcher himself and validated by senior biology tutors and the supervisor before they were used. The questionnaire was pilot tested and a reliability co-efficient of 0.80 was obtained. Teaching and learning practical work in the absence of well-equipped science laboratories hinder learning to occur as well as teaching process. Laboratory equipment play key roles when performing laboratory work with biology students but insufficiency of the equipment would not help the students achieve what is expected of them. It was noted that, many schools depend on neighbor schools for their students to do practical which is not enough for students, to acquire all practical skills and knowledge. Also, during practical lessons, it was interactive between teachers and students which encouraged the students to actively involved in class. This could draw students closer to their biology teachers and students would understand concepts well during lesson delivery in the laboratory.

5.2 Conclusion

The study has shown that, biology students within the Bawku East district exhibited positive attitudes towards biology laboratory work. This would enhance them to do well in their examination.

Participated schools lack the necessary apparatus and equipment for conducting effective biology laboratory work. This could not help students to have in-depth knowledge in the various topics from which the specimens could be taken from, hence their inability to perform well. Poor performance of students in biology laboratory tasks could be due to the fact that students did not often understand or get knowledge of biological specimens during their biology practical lessons.

From the researcher observation, students also found it difficult to pronounce the scientific terms correctly causing them to spell the terms wrongly. This study has provided insights into some factors that affected students' performance in biology practical work. These included the; type of specimens and equipment provided during the practical work, the selection of topics from which the practical questions were selected for the students and the type of task given to students during practical activity. The study concluded that while teachers have positive attitudes, few had exhibited negative attitudes.

Even though, all the three schools under study had laboratories, the study showed that, the various laboratories equipment in their schools were not enough for practical work by students in the Bawku East district.

5.3 Recommendations

Following the above conclusions, it is recommended that:

a) School administrators and the Boards of Management should construct well equipped biology laboratories since the practical approach to teaching the subject demands such facilities.

b) Biology teachers should incorporate a lot of laboratory activities such as demonstrations, projects and field trips into their teaching to help enhance students' performance in practical work.

c) Biology teachers should prepare their students holistically on all the aspects of practical work rather than being selective of the syllabus for SHSs students.

d) The West Africa Examination Council (WAEC) has also not been ignored. The study recommends piloting of the prototype marking scheme for evaluating acquisition of students' science process skills in biology.

5.4 Suggestions for Further Research

This research work can serve as the foundation for other researchers who wish to investigate further into other factors that affect students' performance in biology practical work. Some studies can look at challenges that face teachers in the use of laboratory for teaching biology.

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APPENDENCES

UNIVERSITY OF EDUCATION, WINNEBA

APPENDIX A

QUESTIONNAIRE FOR STUDENTS

Dear Student,

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

This questionnaire seeks your opinions and concerns about the use of practical work in the teaching and learning of Biology at SHS in the Bawku East District in Upper East. There is no right or wrong answer to each question. Information from this questionnaire will be used to improve the teaching and learning of Biology practical in SHS in Ghana. The information will be aggregated and summarised for inclusion in research reports. No person or school will be identified in any reports.

SECTION A

Basic information (Tick only one Bracket or fill the blank space where appropriate)

1. Age of student. i. 11-14 years [ ] ii. 15-18 years [ ] iii. 19 years + [ ]

2. Sex: i. Male [ ] ii.Female [ ]

3. Number on roll: School. i. School A [ ] ii. School B [ ] iii. School C [ ]

4. Number of Biology periods per week: i. 3 [ ] ii. 4 [ ] iii. 5 [ ]

5. Are you punctual during biology lessons? i.Yes [ ] ii.No [ ]

6.If yes, how many times in a week? i. 3 times [ ] ii. 4 times [ ] iii. 5 times [ ]

SECTION B

Student's attitudes towards biology practical

7. Do you have biology study groups? i. Yes [ ] ii. No [ ]

8. If yes, do you belong to any of the groups? i. Yes [ ] ii. No [ ]

9. If yes, how many are you in the group?

i. 2-3 member [ ] ii. 4-6 members [ ] iii. more than 6 members [ ]

10. How many hours do you spend anytime you meet?

i. 1-2 hours [ ] ii .2-3 [ ] iii.3-4 hours [ ]

11. how many times do you meet in a week? i. 1-2 [ ] ii. 3-4 [ ]

12. Is biology your favourite subject? i.Yes [ ] ii. No [ ]

13. If yes, why is biology your favourite? .....

14. How would you describe your motivation towards the study of biology?

i. Highly motivated [ ] ii.Motivated [ ] iii.Not motivated [ ]

15. Is the teaching and learning of biology interactive enough. i.Yes [ ] ii.No [ ]

16. Do you attend biology practical lessons regularly? i. Yes [ ] ii.No [ ]

17. If yes, do you normally actively participate in class during biology practical work?

i. Yes[ ] ii.No [ ]

18. If no, state your reasons for not actively participating during biology practical lesson (s)

a……

b……

c……

19. do you have biology practical book? i.Yes [ ] ii. No [ ]

20. if yes, do you take note? i. Yes[ ] ii.No [ ]

21. How would you rate your performance in biology practical test?

i. below average [ ]ii Average [ ] iii. Above average [ ]

22. Would you recommend biology practical lessons' periods per week be increased?

i. Yes[ ] ii. No [ ]

23. If yes/ no, state your reason(s)

a……

b……

c……

SECTION C

Students and teachers practices during biology practical work

24. In Biology class, does your teacher use practical work to illustrate concepts that have been introduced? i. Yes [ ] ii. No [ ]
25. Does your biology teacher introduce hands-on activities in the teaching and learning of the subject? i. Yes [ ] ii. No [ ]
26. Does your teacher use enough teaching and learning materials in the delivery of biology lessons? i. Yes [ ] ii..No [ ]
27. Does your teacher always demonstrate to you before giving you the opportunity to work on your own during biology lessons? i. Yes [ ] ii. No [ ]
28. Does your biology teacher allow you to work on your own while he/she serves as a facilitator during lessons? i. Yes [ ] ii.No [ ]
29. Does s/he permit you to use your own judgment in solving problems during biology lessons? i.Yes [ ] ii. No [ ]
30. Do you think your biology teacher is experienced enough in teaching the subject? i. Yes [ ] ii. No [ ]
31. Do you think your biology teacher delivers well? i. Yes [ ] ii. No [ ]

Use of laboratory and its equipment

32. Does your school have a laboratory? i.Yes [ ] ii. No [ ]

33. If no, where do you normally go for laboratory practical work?.....

34. Are the laboratory equipment in this school sufficient for practical work?

    i.Yes [ ] ii. No [ ]

35. If yes, do you use the equipment during practical work in the laboratory?

    i.Yes [ ] ii.No [ ]

36. Are the laboratory equipment good for use in the laboratory? i.Yes [ ] ii. No [ ]

Thank you for your participation in this study.

APPENDIX B

Checklist of Laboratory Equipment

Safety Apparatus, Dissecting Tool Kit, Electronic Balance, Filter Papers	Inoculating Loops and Petri Dishes, Spatulas and Scoular, Thermometer, Litmus and	Forceps, Beakers, Conical Flasks, Evaporating Disk, Funnels, Graduated Cylinders, Droppers and Pipettes Dissecting Tool Kit,

APPENDIX C

Demographic Character of Respondents

Gender	Count	Percent	Cumulative Percent
Male	95	59.4	59.4
Female	65	40.6	40.6
Total	160	100.0	100.0

APPENDIX D

Age Distribution of Respondents

Ages	Count	Percent	Cumulative Percent
11-14 years	4	2.5	2.5
15-18 years	87	54.4	56.9
19 years+	69	43.1	43.1
Total	160	100.0	100.0