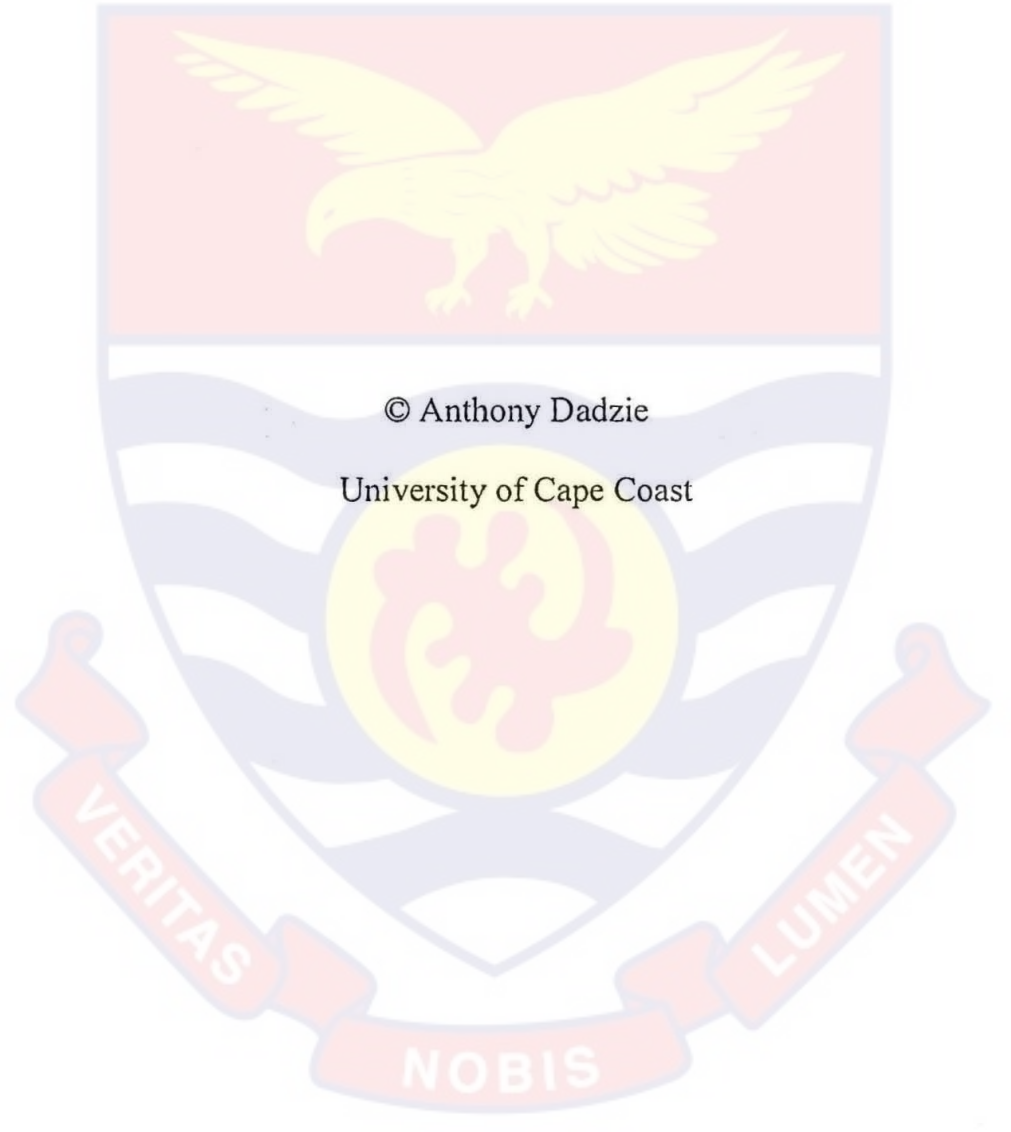

UNIVERSITY OF CAPE COAST

# STATE OF BIOLOGY TEACHING IN PUBLIC SENIOR HIGH SCHOOLS IN THE CAPE COAST METROPOLIS

BY

ANTHONY DADZIE

Thesis submitted to the Department of Science Education of the College of Education Studies, University of Cape Coast, in partial fulfilment of the requirements for the award of Doctor of Philosophy degree in Science Education



MARCH 2022

# DECLARATION

**Candidate's Declaration**

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature: ..... Date: 27-12-2022

Name: Anthony Dadzie

**Supervisors' Declaration**

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principals Supervisor's Signature: ..... Date: 27/12/2022

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Name: Dr. Kenneth Adu-Ayamfi

# ABSTRACT

The purpose of this study was to find out state of Biology teaching in public senior high schools in the Cape Coast Metropolis. The study sought insight into the difficulties both Biology teachers and students encounter in teaching and learning some Biology topics respectively, the teachers' specialised area of teaching and experience in the number of years of teaching, teaching methodologies employed, teaching and learning resources available, how Biology students are assessed and standard equipment in the classroom/laboratory. An explanatory sequential mixed methods design was used for the study. The purposive sampling technique was used to select 28 teachers teaching Biology and used a multistage sampling technique to select 281 senior high Biology school students from 6 schools. Quantitative data was analysed using descriptive statistical methods and inferential statistics. Classroom observations and interviews were used to support and explain the findings from the quantitative data. It was found out that over one-half of the teachers and students perceived Kreb's cycle as a difficult Biology topic to teach and learn respectively. Again, teachers and students perceived the Life cycle of insects and Ecology as easy or very easy to teach and easy or very easy to learn. Teachers combined more than one teaching method/strategy to teach. Effective teaching and learning strategies may help students to overcome their learning difficulties. It was, therefore, recommended that teachers teaching biology must update their knowledge on difficult biology topics and find more effective teaching strategies to teach it.

**KEY WORDS**

Difficult Biology topics

Teaching experience

Specialisation

Teaching methods

Resources

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## DEDICATION

To my wife, Veronica, children, my parents and friends.

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# CHAPTER ONE

# INTRODUCTION

This chapter describes the background to the study, statement of the problem, the purpose of the study, research questions, significance of the study, delimitation, limitations and organisation of the rest of the study.

## Background to the Study

School science is crucial to the advancement of every nation. The purpose of teaching school science, including Biology is to increase students' knowledge and comprehension of the world and to make sure students have the skills needed to do research on natural occurrences. In order to assist students accept the fundamental principles of science and understand the significance of applying the scientific method to their world-wide inquiries, a teacher must give the necessary learning that necessitates a protracted series of activities. To achieve this goal demands that a teacher should provide requisite learning that demands long series of events to help the students to embrace the underlying values of science and grasp the meaning embedded in the application of the scientific method in their investigations of the world.

It is generally accepted that national development is dependent and driven by science and technology. Ministry of Education in Ghana has emphasized the need to give special attention to science and technology education. To realise this set goal, it is expected that experiential teaching must be given prominence by all science teachers as learning by doing enhances students' understanding. By that, the students will be in the position to apply science concepts to solve scientific problems as well as constructing their knowledge and understanding.

Teaching is defined as the action of going through activities that provide students with experiences that can induce learning (National Research Council, 1997; Smith, 2007). Biology teaching is activity-based, so teaching only the theory for students to construct knowledge without application is not beneficial to society (Smith, 2007). Teaching activities are carried out specifically to facilitate learning so in a typical science classroom there must be a myriad of tasks that are to be fulfilled by the teachers together with the students. Some of these activities include asking thought-provoking questions, explaining concepts, acting as a moderator in discussions, going through assignments and marking them, demonstrating a piece of experiments for lack of adequate equipment and many others. This is more so with scientific knowledge which is human activity and hence subject to error and change.

In Ghana, Senior High School students continue to perform poorly in Biology which has raised a great concern to most especially teachers and learners (WAEC, 2017). Similar academic performance has been reported in the tertiary institutions in Ghana which has thus, been criticized by technocrats, parents, educators in science and the government (Anamuah-Mensah, Mereku, & Ghartey-Ampiah, 2009). A study by Anamuah-Mensah and Benneh, (2010) in Ghana shows that many students learn biology by rote without grasping the concepts and hence learners find it difficult to understand science concepts therefore, no meaningful learning takes place.

A study of the Biology curriculum was conducted in Turkey to focus on biology topics found difficult to learn by the biology students. It was found out in the study that students found it difficult to understand the biology concept. However, Çimer, (2012) found out that understanding of senior high

secondary school students' perceptions of Biology will assist stakeholders (policymakers, teachers, and teacher educators) to plan more effective strategies for teaching activities that can aid students to learn Biology better and have a more reassuring positive attitude towards learning the subject. Tekkaya, Özkan and Sungur (2001) have attributed possible difficulties students face in learning biology concepts to the nature of the high school biology curriculum and the teaching and learning strategies used by teachers.

The application of poor methods of teaching and learning of integrated science in Ghanaian schools which have resulted in the poor performance of Ghanaian SHS students in the West African Senior School Certificate Examination (WASSCE), preventing them from gaining admission into tertiary institutions for further studies (Anamuah-Mensah & Asabere-Ameyaw, 2011; Bello & Oke, 2011). Biology among other subjects has been given special recognition due to the educational values, and its benefits to living organisms. The biology curriculum of Ghana designed for senior high schools is to integrate science programmes, to provide advancement in knowledge and deeper understanding of the concepts that are learned.

Students should be motivated in the subject to stimulate interest in science among students and promote scientific literacy for functional living in the society. There are many reasons why students in science are taken through activities to learn much about science process skills. Chukwuemeka and Aneale (2008) describe the science process skills as a means of transferring the mental and physical skills required for acquiring concepts and broad principles that are used to get a logical conclusion. The teacher is responsible for the students' acquisition of these science process skills which is dependent

on the teacher to carefully guide the students and provide opportunities that will enable students to design and carry out scientific investigations. This will enable students to develop scientific skills and attitudes.

Elective Biology as a subject is one of the most important subjects in Ghana SHSs and is also famous with students with a high number of students offering the subject every year compared to physics and chemistry (WAEC, 2017). Biology is important science subject students should pass to qualify to do many of the science-related programmes in tertiary institutions. Candidates' results are however, not good despite the importance attached to this subject and the emphasis laid on elective biology. Candidates at senior high schools continue to perform poorly in the subject that has made technocrats, parents, educators in science, and the government criticise it (Anamuah-Mensah, Mereku, & Ampiah, 2009). Chief Examiners' Reports on Biology have consistently lamented the poor performance of biology students in the subject.

A research study in Nigeria by Egbunonu and Ugbaja, (2011) and Egbunonu, (2012) at a senior high level indicates that students achieve poorly in biology examinations. Statistics from the West African Examinations Council (WAEC) for the years 2006, 2007, 2008, 2009, 2011, 2012, 2013, 2014, 2016, 2017, 2018; 2019 and 2020 have consistently showed steady poor academic achievement of biology students in the WASSCE. Issues raised by Chief Examiners' reports included biology teachers' predominant use of ineffective teaching methods, candidates' lack of understanding of Biology concepts, candidates inability to spell scientific terms, the inability of candidates to write the name of every taxon starting with a capital letter. Some

candidates found it difficult to respond to the questions using the specimens, most of the candidates failed to obey the rubrics regarding biological drawings, and insufficient material resources required for effective delivery of Biology lessons. Chief Examiners' reports for Biology and Integrated Science in the Institute of Education University of Cape Coast have revealed similar findings at the Post-Secondary school level, indicating that these issues go beyond the SHS level (Anamuah-Mensah, Mireku, & Ghartey-Ampiah, 2009).

Bassey (2005) proposed that many problems are attributable to the conventional methods used in teaching and that has indirectly negatively affected academic performance of students. Akinfe, Olofinniyi and Fashiku (2012) have also stated that majority of untrained teachers' blame students when they realised that the students' academic performance was nothing to be written home about. The teachers shift the blame to the learners because they were unable to carry out the expected behaviour at the end of lessons or examinations rather than themselves. Agusibo (2008) has indicated that generally, many schools do not have the necessary facilities for teaching. The researcher, however, revealed that the teaching of theories in isolation will not help the learners know the fundamental facts of many science subjects with an emphasis on biology.

Çimer's (2012) study on secondary school science Biology curriculum in Turkey focused on the biology topics students have difficulty in learning. The lessons learnt from the study were the difficulties students encounter in learning biology, and shortfall of improving their effective ways in Biology learning. Tekkaya, Ozkan and Sungur (2001) have attributed the possible sources of students' difficulties in learning some Biology concepts to the

school biology curriculum perceived to be more or high itself and the strategies employed for teaching-learning by the teachers. Generally, the senior high school elective biology in Ghana is designed to build on the general science curriculum at the JHS level with the aim or idea of providing deeper advancement in knowledge and understanding of the biology concepts that are learned at the JHS. Emphasis is laid on the specialisation in elective biology at the SHS to stimulate interest in science among students and promoting scientific literacy for functional living in the society. Specifically, Biology is taught to fully prepare students to obtain requisite laboratory and field skills in the subject, have a deeper knowledge, apply the acquisition of scientific knowledge to daily life, and equip students with reasonable and functional scientific attitudes.

It is expected that if biology students are equipped with basic scientific skills such as inferential thinking skills, they can make meaningful observations based on their personal experiences. They can explain Biology concepts better when information is not directly stated and may improve their skills in making inferences. Students will be able to interpret, combine ideas or information perceived. They will also be able to use their cognitive schemes to make cognitive elaboration of the information obtained in the Biology concepts. Students should be taught to equip themselves with how to analyze, interpret data, discuss the data and state the difficulties encountered with the teacher. A society develops faster if its people are trained to be problem-solvers using scientific and critical thinking skills (Anamuah-Mensah & Benneh, 2010).

Rote learning which has been prominently adopted as a learning tool in the Ghanaian school system is not helping our students to be more creative thinkers (Anamuah-Mensah & Benneh, 2010). It is an ineffective procedure for training students who are supposed to be problem-solvers (Anamuah-Mensah & Benneh, 2010). Students need to be helped to use their minds to generate solutions to problems or tasks in education and life. They need to be supported and encouraged to understand facts, principles and concepts and know how to use them profitably in solving problems instead of relying on mere memorisation and recall of facts. In this situation, the teachers' methods of Biology teaching to resolve these difficulties encountered in teaching some Biology topics, and students learning some biology topics are very crucial. Akinfe, Olofinniyi and Fashiku (2012) see methods of teaching as the strategies or plans outlining the approach that teachers will like to use to achieve the desirable teaching objectives. It encompasses the methods teachers put together and use techniques of the subject, teaching equipment and teaching and learning resources to meet the teaching objectives.

Teachers have to practice what they should know and be able to teach in order to meet what the learners are required to study, to meet the expectation and the needs of their learners. This may require intensive teaching that will enable the teacher to have concrete evidence to show for his or her classroom practices. A more intensive collection of evidence, including frequent observations of this do include the use of artefacts such as lesson plans, the students' classroom and laboratory work done, marked with feedback to give a clearer picture of the teachers' performance in their respective classrooms. To improve this collection of evidence may include the

effort put in to represent more complex ideas of teaching as well as learning for teachers (Porter, Youngs & Odden, 2001) provision of all-embracing practice blueprint to serve as a guide to teacher initiation and coaching. This may help the teacher to improve the skills in teaching to overcome some difficulties encountered in teaching as well as learning some topics in Biology.

In Ghana, the SHS biology syllabus in the year 2010 specifically spells out the objectives of biology teaching at Senior high school. This includes equipping students to live effectively with scientific skills and the modern age of science and technology. The stature of science education was researched broadly in the 1970s (Helgeson, Blosser & Howe, 1997; Stake & Easley, 1978; Weiss, 1978). A notable theme that came up from the research was the principal function of textbooks needed for teaching the science subjects including Biology. The textbooks are the primary source of information for teaching Science Curriculum and learning by students, thereby serves as a primary seedbed of knowledge for learners (Weiss, 1978).

Since science textbooks play influential roles in how "science teachers organise the curriculum and how students perceive the scientific enterprise, science textbooks have long been an object of interest and concern" (Ampiah, 1999, p. 36). Several research studies have been carried out or conducted on science curricula of different education systems (Li & Shavelson, 2007). In each of these studies different aspects of the Biology curriculum were considered such as the quality of the curriculum; a stable knowledge acquisition, professional teaching community; the quality of classroom assessment that corresponds with the goals of the curriculum; and stability and

techniques for the transformation of curricula, and teachers developing their profession.

Teaching and learning are the most important activities that take place in the educational enterprise. Learners are enthusiastic and eager to learn under certain conditions such as what is of interest and relevance, what they feel can learn, and if the method of learning is attractive to the learner. Simkins (as cited in Adeyemi, 2008) described that the academic achievement is the on-the spot outcome that represents prompt results of the student activities. The researcher again, disclosed that the main students' academic outcomes in education are portrayed with regards to learning, changes in acquisition of knowledge, attitudes and skills exhibited by individual students in respect of their experiences.

This could be seen in the constructivist theory which states that constructivism is an ideology of learning established on the preface that, by reviewing and reflecting on our past experiences, we are able to reconstruct our understanding of our past and the world we reside in. The students create their own laid down mental principles to make sense of their individual experiences. In teaching together with learning, the main attention is rather on the learner than the teacher. Thus teachers are to allow students to work freely so that students would not be afraid of making mistakes, and also resolve their own mistakes in a congenial atmosphere created by the teacher. The students learn by doing therefore activity attracting the students' interest in experience-based learning is important because it enables the students to create unique meaning to learning.

Again, through assessment teachers have established that what students learn in the classroom does not correspond to the maximum effort the teachers put in during the teaching (Darling-Hammond & Baratz-Snowden, 2005). Therefore, at the moment the teacher is able to recognise the problems and difficulties student face in the instructional process, then this becomes the platform that the teacher uses for gathering information to resolve these difficulties students face in learning. The assessment is supposed to assist the teacher to collect information about the students' learning capabilities, behaviour and achievement level to make informed educational decisions.

Furthermore, the teacher is at liberty to use any suitable teaching method that may help the students to better understand the current knowledge they possess (Dietel, Herman & Knuth, 1991). Ferguson (1992) drew conclusion from his research study in Ghana that innovative teachers have recognisable teaching impacts on students' academic examination outcomes. However, Akinfe, Olofinniyi and Fashiku (2012) established that one factor affecting the academic achievement is the growing of students' population. And the difference depends on the effectiveness of the respective teachers to teach for better understanding. Assessment of students is the only means the professional teacher can know whether students are meeting the instructional expectations of the teacher as well as the objectives spelt out in the curriculum. For effective utilisation of assessment, a teacher must consider assessment as ongoing activity into the instructional process. That is to say before instruction, during instruction, and after instruction.

Elective biology is one of the requirements in many science-related disciplines. However, teachers and students' encounter some difficulties in

teaching as well as learning some topics in biology which prevents students from offering science-related courses. This incited or stimulated researchers to conduct investigations into why teachers and students face such difficulties and how to devise means to overcome them. It seems efforts by scientists to find solutions to students' and teachers' difficulties in learning and teaching some topics in Biology have not yielded the expected results. Facing a lot of difficulties in many Biology topics may negatively affect students' motivation and affect academic achievement (Zeidan, 2010).

Educational assessment is the process through which the students are taught to master knowledge acquisition and skills to make an informed decision (Black & Wiliam, 1998). It is a key constituent of teaching and learning because it complements the teachers' effort to modify their teaching methods and support students' learning. Teachers are given information concerning the students' academic performance abilities in the course of teaching and learning and use the data to reform teaching as well as learning (Atkin et al., 2001; Connor, 2013; Shepardson & Britsch, 2001). When students can see how they are doing in class, they can determine whether or not they understand the concepts of the subject. Students take time to research, write and revise to give them a better understanding of their learning. In teaching the biology subject affects many facets of education including students' learning grades, placement and instructional needs. If a student is aware of his/her performance either poorly or good he/she is motivated to work harder or to keep up the pace.

Teachers assessing students frequently in biology can see if their teaching has been effective. It ensures students are taken through the learning

process to master what they need to learn to meet the set objectives for learning. A teacher gathers evidence in a planned and systematic way about what students have learned over an instructional period to draw inferences about students' achievement and to provide a report that reflects each student learning (ARG, 2006; Harlen, 2001). The sole aim of teaching is to enhance learning, so every teacher expects that students put in much effort to grasp the concept. This is achieved through assessment by monitoring the progress students have made in learning, to diagnose students' comprehension, abilities and difficulties that may inform teaching for modification, given feedback to parents in the form of written reports on their wards' academic achievement, providing constructive feedback to students, informing teaching methods, and as a result try to improve the condition of teaching and learning.

**Statement of the Problem**

Chief Examiners' Reports on Biology for the years 2006 up to 2020 have revealed that some substantial number of senior high school biology students perform poorly in WASSCE Biology paper (WAEC, 2006; 2007; 2008; 2009; 2011; 2012; 2013; 2015; 2016; 2017; 2018; 2019; 2020). The reports mentioned have all pointed out some weaknesses shown by students in answering questions on some aspects of biology topics such as Genetics; Taxonomy of plants and animals; Ecology; Life cycle of insects; Photosynthesis; Kreb's Cycle; Circulation of blood; Hormones; DNA molecules; and Control and coordination.

Some of these aspects of the topics keep coming up every year and the same mistakes are committed by SHS biology students. Prominent amongst these aspects of the biology topics in respect of biology paper one and paper

two are Genetics, Taxonomy of plants and animals, Photosynthesis, Ecology, Life cycle of insects, Kreb's Cycle, Circulation of blood, Hormones, and DNA Molecules (WASSCE, 2006; 2007; 2008; 2009; 2011; 2012; 2013; 2015; 2016; 2017; 2018; 2019; 2020).

To confirm or to reject the Chief examiners' reports about the difficulties encountered by elective Biology students in answering some elective biology questions, some teachers teaching elective Biology were engaged in the form of interviewing by the researcher. The teachers mentioned genetics, taxonomy of plants and animals, Kreb's cycle, DNA molecules and hormones even though they mentioned some other elective biology topics, which confirmed the reports. But the aforementioned topics were very prominent in all the answers provided by the teachers.

Chief Examiners' Reports have also revealed that the students have consistently shown awful spelling mistakes of terminologies, failed to obey rubrics regarding biological drawings, most of the students exhibited a lack of in-depth knowledge of the subject matter and are also unable to answer biology questions involving application of knowledge (WASSCE, 2006; 2007; 2008; 2009; 2011; 2012; 2013; 2015; 2016; 2017; 2018; 2019; 2020). These reports showed that a high percentage of students had weak passes in biology; for example, in the year 2006, out of 15,938 candidates who wrote the Biology paper, 5,180 candidates representing 32.5% had very weak grades (D7, E8, and F9). The percentages recorded for weak passes with regards to the years 2007, 2008, 2009, and 2011 were 44.4%, 36.5%, 45.9%, and 26.1% respectively. In the year 2012, 29,482 candidates wrote the elective biology paper with 12,143 students representing 41.2% obtaining grades D7, E8, and

F9. This was not different in the year 2013 when 27,308 students representing 37.7% obtained weak grades. By inspection of these percentages trend of weak passes in elective biology; 32.5%, 44.4%, 36.5%, 45.9%, 47.9%, and 37.7% looks alarming and worrying because similar trends have occurred from 2014 up to 2020.

It is well judged to give an outline of students' academic performance in elective biology in Ghana over some years mentioned earlier and go ahead to give some feasible or probable explanations for the observations made on trend of Biology students' academic performance. The trend of candidates' results in the WASSCE elective biology examination from 2006 up to 2020 SHS shows a high percentage of grades obtained were below the prescribed grades of A1 to C6. For a student to be offered an admission into any tertiary institution or any public university in Ghana, the grades should be from A1 to C6 as recommended by the National Accreditation Board (NAB) and the Ghana Tertiary Education Commision (GTEC) of Ghana. Such students would therefore not be able to offer programmes in the university and other many tertiary institutions and colleges where elective biology is one of the compulsory requirements.

Measures such as teachers offering remedial classes for students, upgrading their knowledge in the subject through workshops and capacity building training, effective utilisation of teaching and learning materials, student's participation in the teaching together with learning have not yielded the expected results. These efforts put in by the teachers have not reflected on students' academic performance in the WASSCE compared to Chief Examiners' reports from 2006 up to 2020.

A study conducted by Zeidan, (2010) gave some reasons why students have difficulties in learning biology as teachers teaching methods and the abstract level of the concepts. One of the reasons reported by many researchers, for instance, in Turkey, is that due to the nature of biological sciences, students learn Biology by memorisation. Biology has a lot of abstract concepts, events, topics and facts students are expected to learn. This makes it very difficult for students to study (Çimer, 2004). Research has also shown that students who offer Biology encounter problems in the teaching of the elective biology concepts meaningfully and therefore resort to memorising them (Deakin, 2008).

However, a gap exists because the literature reviewed by the researcher in Ghana used quantitative investigations to describe difficulties teachers and students encounter in teaching and learning some difficult biology topics. The voices of the teachers together with the students were not included in the study with regards to difficulties encountered and also excluded classroom assessment. Therefore, the current study combined quantitative and qualitative results so that participants' voices could be heard and included classroom assessment,

The study of state of biology teaching in public SHSs in the Cape Coast Metropolis has become very necessary to be conducted because of the downward trend in WASSCE elective biology students' performance in biology (WAEC, 2013; 2014; 2015; 2016; 2017; 2018; 2019; 2020). Cape Coast Metropolis is the cradle of education so the study is conducted in the Metropolis to find out whether biology students aer also affected by the Chief Examiners Reports. Based on that, may enable the researcher to suggest ways

that could rectify the difficulties Biology students encounter in learning biology. The research may find out what is missing, what to do to improve the difficulties teachers as well as students encounter in teaching biology and learning Biology, Biology teachers teaching experience in years, methods employed for teaching, how classroom assessment is done and teaching and learning resources available to teachers and students in teaching and learning Senior High School Biology.

**Purpose of the Study**

The purpose of the study was to find out state of elective biology teaching in public senior high schools in the Cape Coast Metropolis. To achieve this, the teachers' difficulties in teaching and students' difficulties in learning some biology topics were examined. This was done to find out whether the poor performance of biology students in the WASSCE elective Biology papers could be attributed to teaching and students learning difficult Biology topics, experience in the number of years of teaching, the methodology used in teaching Biology, how students are assessed, availability of resources materials, and how Biology laboratories are furnished with standard equipment in the schools of study in the Ghanaian public SHSs in the Cape Coast Metropolis.

Additionally, an investigation was conducted to determine whether there was any difference between the teachers' level of demographics (teaching experience), teachers' specialised area of teaching and their views on difficult biology topics. The underlying basis for this hypothesis was to find out the degree to which the teaching experience affects the academic performance of the Biology students. Is it always true that a teacher who has

taught a specific subject for a considerable number of years has a positive effect on students learning? Furthermore, an exploration was made to find out teaching methods or strategies used by teachers, how students were assessed, and classroom practices to have a fair idea about what goes on and suggested some ways to improve the shortfalls observed.

**Research Questions/Hypotheses**

The study was guided by the following research questions/hypothesis:

1. (a) Which Biology topics do teachers find difficult to teach in senior high school?

   (b) $H_1$: Teachers who have taught biology for not more than 5 years will perceive Biology topics as difficult compared to teachers who have taught biology for more than 5 years.

   $H_{01}$: There is no difference in the perceived difficult biology topics between teachers who have taught biology for not more than 5 years and teachers who have taught Biology for more than 5 years.
2. Which biology topics do SHS biology students find difficult to learn?
3. What teaching methods or strategies do teachers use in teaching senior high school biology and what accounts for the choice of teaching methods?
4. How do teachers assess students during Biology lessons in senior high schools?
5. What teaching resources are available to teachers and students in teaching and learning senior high school Biology?

**Significance of the Study**

The study would be important to Biology curriculum developers, teachers and stakeholders because some hidden problems found with the Biology curriculum, teachers' and students' difficulties could be addressed. Curriculum developers will have information that could be used to revise or modify the SHS Biology curriculum to suit the needs of students. Teachers teaching SHS biology who are the implementers of the curriculum may have ideas about how to teach elective biology for the students to grasp the concepts to improve their academic performance.

The research found out what will improve the elective Biology teachers' teaching and students' performance in WASSCE. The study could form the basis to survey the actual classroom and laboratory teaching and learning strategies to have concrete affirmation about how teachers teach and students' learning of Biology take place.

The findings would also inform future policies about state of elective Biology teaching in the classrooms. It would serve as resource material for students or researchers who may want to conduct related or similar research in future.

**Delimitation**

There are a lot of dimensions in finding state of biology teaching in public SHSs in the Cape Coast Metropolis. These dimensions include students' performance, students' interest, number of students (male and female ratio), students' attitude toward learning biology, instructional methods, teaching and learning resources, human resources, standard of laboratory equipment, and classroom assessment strategies among others. However, in

this study the state of elective Biology teaching focusing on teachers' and students' difficulties they encounter in teaching and learning some Biology topics, their instructional methods, classroom assessment, teaching and learning resources used in the classroom/laboratory were considered.

**Limitations**

The study used schools in the Cape Coast Metropolis only and therefore the sample size of the teachers used in the study was too small for effective generalisation of the findings concerning teachers. This was due to the limited number of teachers teaching biology in the schools and financial and time constraints in bringing in more teachers outside the focused schools. However, the findings of the study concerning the teachers are credible but not generalisable to all senior high schools in Ghana except schools in the Cape Coast Metropolis.

Also, even though the teachers consented to take part in the study before classroom observations were made, my presence in the school and in the classroom may have influenced teacher behaviour during teaching.

**Definition of Terms**

Difficult Biology topics as used in this study, refers to an aspect of Biology topics perceived by teachers teaching Biology and Biology students as difficult to teach and learn respectively.

Teaching experience in this study could be explained as teachers who have taught Biology for more than five years.

Specialisation is explained as focusing on an area of expertise because the teacher has taught Biology for more than five years. Therefore, maximum benefit could be derived from the teacher in terms of delivery.

Teaching methods in this study refers to the strategies used by teachers teaching Biology.

Resources for teaching Biology in this thesis indicates human and material inputs required for realising goals of the concepts to be taught.

**Organisation of the Study**

The thesis has four more chapters, which are arranged to follow what have been raised as issues to be discussed and provide answers to the questions which were formulated.

Chapter Two is about the related literature review on issues related to the study such as elective biology teachers' difficulties in teaching some difficult biology topics, assessments strategies, and teaching/laboratory resources availability.

Chapter Three solely discusses the research methodology for the study. It describes and explains the type of study and adopted method and reasons for the method. The strength and weaknesses of the adopted method are also catered for. Matters concerning population and sampling, instruments, data collection procedures and data analysis are discussed in detail.

Results of the study on the research questions and major issues raised are discussed in Chapter Four. Chapter Five presented an overview of the research problem and methodology. Finally, the summary of the important findings and their meanings regarding the literature are shown. Implications and conclusions related to the findings are also discussed and pressing issues for future research work are presented, recommendations and areas that could be researched further are presented.

# CHAPTER TWO

# LITERATURE REVIEW

This study looked at state of Biology teaching in Ghanaian SHSs. The chapter reviews the related literature on the difficulties encountered by teachers in teaching Biology and students' difficulty in learning Biology, teachers' teaching experience in years and teaching methods or strategies used. How teachers assess students, the availability of teaching resource materials, and how the Biology laboratories are furnished with standard laboratory equipment will also be reviewed.

## Teaching Qualification

Students' achievement is said to be impacted by teacher factors including qualification and experience (Arzi & White, 2007; Khourey-Bowers & Fenk, 2009). This is because the qualified teacher has specialised knowledge in the subject he teaches. If s/he has taught for six years and more s/he is said to be more experienced than one who has taught for five years or less (Ezendu & Utazi, 2014). The experienced teacher also chooses appropriate methods, techniques and strategies for teaching to ensure students grasp concepts s/he teaches. This is because over the years s/he would have used various teaching methods, techniques and strategies and has seen the effects on students' learning. As such s/he knows which methods, techniques and strategies work best concerning perceived difficult or abstract topics.

Akinfe, Olofinniyi, and Fashiku (2012) defined teaching experience as all activities undertaken by the teachers in this pre and post teacher training exercise; it also includes teachers' participation in workshops and seminars to develop their knowledge. Studies in education have shown that for teachers to

teach effectively, improve the quality teaching and stay on the job there is the need to develop their knowledge and skills from time to time through workshops and seminars (Akinfe, Olofinniyi & Fashiku, 2012). According to Bucher (2010) teachers frequently face difficulties related to subject matter, new teaching strategies, technological advancement, altered rules and regulation, and students' learning requirements. As a result, teachers must be informed on new teaching techniques, skills, content, and curriculum or standard changes through the use of updated knowledge (Bucher, 2009).

Additionally, for productive teaching on the part of the teacher and learning on the part of the students to occur for students to perform well, the relevant teaching and learning resources must be available and used appropriately (Achimagu, 2006). According to Hartley (1998), providing activity-oriented learning brings about effective learning and understanding out of the learner. To reinforce learning, the student is supported with instructional materials to interact with in order to improve the scientific skills. The underpinning learning theories of this study upholds placing students at the center of teaching and learning. By this, students interact with learning materials and friends to construct their own knowledge and understanding with little or no supervision at all.

According to constructivist theory, the student is at the center of educational learning process so the teachers' attention is on the students (Henson, 2003; Spigner-Littles & Anderson, 1999). Students learn by doing; therefore, activity engaging students in experience-based learning is one key to the construction of new meaning (Merriam, Caffarella & Baumgartner, 2007). The students are encouraged by teachers to effectively work with their

peers to find solutions to some problems confronting them. The characteristics of real world situations with varying levels of difficulty to enable students to work with their peers in finding solutions to problems are experienced in the real world (Chandra & Watters, 2012).

The teacher is required again to be cognizant of the needs of individual learners when planning for curriculum delivery, looking at the curriculum from the learners' perspective and from its importance to the learner can promote learning experience that will have positive effect on students (Garmston, 1996; Spigner-Littles & Anderson, 1999). To facilitate all of the conditions needed by students for maximum construction of meaning, teachers have to create an enabling learning atmosphere where students will not be afraid of making mistakes during teaching and learning process because teachers will there to assist them, therefore, students may feel welcomed, comfortable, and respected (Henson, 2003; Spinger-Little & Anderson, 1999).

To be sure students are accomplishing the learning outcomes laid down, teachers must of necessity assess them constantly using both formative and summative assessment techniques. Assessments of learners aid the teacher in determining the strengths and weaknesses of the students. It also gives an approval to the teacher to gather data in a fair manner to have an idea of how the students are progressing. Armed with this information (that is, students' strengths and weaknesses), the teacher can provide the needed remediation to help improve students' achievement (Shavelson, 1995).

As a result, this study considered the difficulties encountered by Biology teachers in teaching some aspects of biology topics, the difficulties Biology students encountered in learning some aspects of biology topics, the

specialised area of teaching and experiences of elective biology teachers at the SHS. It also considered the methods the teachers used for the Biology lessons. The materials for teaching and learning that are available to teachers were also looked at. This included the availability of classroom/laboratory facilities, as well as equipment and materials. The assessment practices of the teachers were also given attention. All these were done to ascertain state of Biology teaching in SHS that is resulting in the students' poor academic achievement in elective biology at that level.

**Biology Topics which are Difficult to Teach**

Many authors have reported on some aspects of biology topics that are difficult for biology teachers to teach at the secondary school level (Abimbola, 1998; Bahar, Hansell & Johnstone, 1999; Lazarowitz & Penso, 1992; Behar & Polat, 2007; Seymour & Longdon, 1991; Tekkaya, Özkan & Sungur, 2001). For instance, Abimbola (1998) used 32 teachers from 15 public and 5 private secondary schools in studying teachers' perceptions of important difficult Biology content in secondary schools in Kwara State in Nigeria. He identified ecology, chromosomes, respiration, growth and heredity as difficult Biology topics to teach. Similarly, a study conducted by Behar and Polat (2007) on science teachers' and students' perceptions about difficult Biology topics in the Integrated Science curriculum even at the lower secondary schools in Barbados reported on some difficult biology topics they teach.

The difficult biology topics reported by Behar and Polat (2007) were classification of living things, respiration in human beings, photosynthesis, mitosis and asexual reproduction, meiosis and sexual reproduction, ecosystem, the structure and replication of DNA, germination in plants, genetics,

circulatory systems in humans, and structure of the eye. Other biology topics perceived by teachers teaching Biology as difficult are, genetic manipulation, hormone regulation, nervous system, oxygen transport, cell division (mitosis and meiosis), and protein synthesis (Bahar, Johnstone & Hansell, 1999; Lazarowitz & Penso, 1992; Seymour & Longdon, 1991; Tekkaya, Özkan & Sungur, 2001).

Difficulties could be explained as a task or situation or things that are hard to deal with or understand. In much the same way, there are some difficulties teachers teaching Biology at the senior high schools are confronted with in teaching biology topics which may affect students' academic performance (Egolu & Igboewu, 2013). According to Abimbola (1998), genetics, hormones regulation, nervous system, and DNA molecules were difficult biology topics to teach. Again, genetics, ecology, respiration, photosynthesis, circulation of blood, reproduction, DNA molecules and circulatory systems of humans were found to be difficult biology topics to teach (Bahar, Johnstone & Hansell, 1999; Tekkaya, Özkan & Sungur, 2001). Furthermore, genetics, hormones regulation, nervous systems, cell division, and DNA molecules were also considered difficult biology topics for biology teachers to teach (Johnstone, 1998).

Some of these difficult biology topics are also associated with the teaching methods or strategies used in teaching them (Bybee, Tombridge & Powell, 2008), classroom/laboratory assessment (Tan, 2008; Tobin, 1986), teaching resources (Çimer, 2004; Durmaz, 2007; Egolu & Igboewu, 2013; Hornby, 2010; Özcan, 2003; Saka, 2006; & Zeidan, 2010), and students'

misconceptions (Aleixandre, 1994; Nehm, Kim & Sheppard, 2009; Nehm & Schonfield, 2008).

Many authors have suggested some teaching strategies, techniques or approaches for teaching concepts in Biology for understanding (American Association for the Advancement of Science, 2011; Bybee, Tombridge & Powell, 2008; Smith & Wood, 2016; Vickery, Rosploch, Rahmanian, Pilarz & Stains, 2015). Smith and Wood (2016) realised that genetics is taught in senior high school by the use of techniques based instruction on research in education that has been designed around principles of active learning and backward design. Thus, using a student- centred technique in teaching may enhance active participation by the students in the lesson as it has been found to sustain the interest of the students in learning (Smith & Wood, 2016; Vickery, Rosploch, Rahmanian, Pilarz & Stains, 2015).

The teaching methods/strategies employed for teaching that involves the teaching and learning resources have been expressed to be difficult for some Biology teachers (Egolu & Igboewu, 2013). This difficulty is due to inadequate or lack of teaching and learning resources such as bunsen burners, hand lenses, microscopes, video clips, mobile devices or computers, films and Biology textbooks (Çimer, 2004; Durmaz, 2007; Egolu & Igboewu, 2013; Hornby, 2010; Özcan, 2003; Saka, 2006; Zeidan, 2010). The teaching of a particular skill in Biology without using the teaching and learning resources could be unacceptable (Zeidan, 2010). For instance, teaching dissection of animals without dissecting materials will be difficult on the part of the teachers as well as the students. The learners may not have the opportunity to handle the materials for learning the skills involved in teaching and learning

dissection of animals because of insufficient teaching and learning materials (Çimer, 2004; Zeidan, 2010).

Some teachers including biology teachers in peculiar or remote areas have difficulty in accessing professional development workshops to upgrade their knowledge in teaching some Biology topics (Tytler, Symington, Darby, Malcolm & Kirkwood, 2011). This is because when teachers upgrade their knowledge through professional development workshops, may help to identify and find solutions by teaching students to grasp the concepts (Khourey-Bowers & Fenk, 2009). In the same way, having in-depth knowledge put teachers at an advantage to build and hold on to deeper knowledge on content for teaching (Arzi & White, 2007).

Research studies have disclosed that misconceptions prevail amongst teachers teaching Biology (Aleixandre, 1994; Nehm, Kim & Sheppard, 2009; Nehm & Schonfield, 2008). Also, some teachers including Biology teachers have difficulty in identifying students' alternative conceptions (Aleixandre, 1994). If Biology teachers have misconceptions with regards to biology topics, it will influence their explanation of those topics for students' understanding. Furthermore, research studies have shown that teachers teaching Biology also hold some misconceptions and different or strange conceptions on a range of Biology concepts as well as the nature of science (Bello, Bello & Abimbola, 2016; Modell, Michael & Wenderoth, 2005; Palmquist & Finley, 2007).

A research study conducted on teachers' perception of important and difficult Biology content by Abimbola (1998) revealed several reasons why teachers perceived some biology topics very difficult or difficult to teach. Some reasons enumerated were unavailability of instructional materials, poor

students' understanding of the topics, the complexity of topics, and insufficient time allocated to teaching Biology topics. Others were abstractness of biology topics, students lacking knowledge of the topics, misconceptions of some topics, poor strategies used in teaching and overloaded nature of biology curriculum.

Similar research conducted in Malaysia by Wan Mohamed Salleh, Che Ahmed, and Setyaningsih (2021) on difficult Biology topics from the viewpoint of the teachers also gave some reasons why the teachers perceived some Biology topics as not easy to teach. Some reasons given were on abstractness of Biology concepts, lack of teaching and learning resources, difficulty to understand some Biology concepts, and difficulty in understanding some terminologies in biology.

**Biology Topics which are Difficult to Learn**

Studies have reported on some aspects of biology topics that students perceived as difficult to learn (Bahar, Johnstone & Hansell, 1999; Çimer, 2004; Çimer, 2012; Durmaz, 2007; Hornby, 2010; Lazarowitz & Penso, 1992; Özkan, 2003; Özkan & Sungur 2001; Özkan, 2003; Saka, 2006; Seymour & Longdon, 1991; Zeidan, 2010). Topics such as respiration, photosynthesis, water transport in plants, protein synthesis, gaseous exchange, cell division (mitosis and meiosis), organs, physiological processes, hormonal regulation, Mendelian genetics, Kreb's cycle, circulation of blood in humans, and central nervous system can be recognised as difficult to study by quite many secondary school biology students (Bahar, Johnstone & Hansell, 1999; Lazarowitz & Penso, 1992; Seymour & Longdon, 1991).

For instance, the research studies conducted by Mumuni, Anthonia, Worlu Dike, and Uzoma-Nwogu (2017) on teaching trajectories of students' understanding of difficult concepts in Biology in Obio/Akpor Local Government Area used purposive sampling technique to sample 213 students from 2 co-educational schools in Obio/Akpor Local Area in River State. Quasi-experimental design was employed for the study and used Students Photosynthesis Achievement Test (SPAT) for data collection. The aspects of the topics were genetics, respiration in humans, cell division, photosynthesis, evolution, ecology, hormonal regulation and nervous coordination.

The rest of the topics are oxygen transport, Mendelian genetics, Kreb's cycle, circulation of blood in humans, and central nervous system can be recognized as not easy to study concept by many biology students (Bahar, Johnstone & Hansell, 1999; Lazarowitz & Penso, 1992; Seymour & Longdon, 1991). Tekkaya, Özkan and Sungur (2001) revealed in their study on difficulties Biology students face in learning some biology topics. Hormones, genes and chromosomes, mitosis and meiosis, the nervous system, and Mendelian genetics were among the aspect of the difficult Biology topics. Biology students of the study rated genetics, Kreb's cycle, circulation of blood in humans, photosynthesis, and nervous systems as difficult Biology topics to learn.

A study on students' difficulties in learning Biology gives some reasons given by students who are considered as difficult to learn (Lazarowitz & Penso, 1992). The students used in the study stated that Biology teachers did not use concrete materials to stimulate learning before proceeding to abstract information. The teaching of factors of photosynthesis for example

needs a lot of practical work for students to experience it. Other reasons given by the students were textbooks which were difficult to understand, overloaded curriculum (Chiappetta & Filman, 1998), learning by memorisation, styles and teaching methods used by the teachers which did not conform with the materials used in teaching (Zeidan, 2010).

Textbooks are used as reference materials to help to teach and learn so if teachers teach without reference materials, their content might not be rich enough which may affect student learning negatively (Tekkaya, Ozkan & Sangur, 2001). According to Tekkaya, Ozkan and Sangur (2001), students' difficulties in learning Biology may be caused by terminologies in Biology, teaching methodologies, textbooks, many topics in the curriculum, and abstractness of the concepts. Also, research conducted by Etobro and Fabinu (2017) revealed that teaching strategies and lack of learning resources were some of the students' difficulties in learning Biology. Çimer (2012) also gave some reasons why Biology was difficult to learn by Biology students. Some of the reasons given were the kind of the topics, the teachers' teaching styles, the students' ways of learning and lack of learning resources.

The concepts that are to be learned in biology must be aligned to things that are to be experienced by students in everyday life. The research study conducted about difficulties students face in learning biology by Cimer (2012) found that some topics that are studied in Biology cannot be understood by students. Many biology students come to the classroom with misconceptions or alternative conceptions which is one of the difficulties in learning Biology. Studies have shown that misconceptions prevail amongst Biology students (Aleixandre, 1994; Nehm, Kim & Sheppard, 2009; Nehm & Schonfield,

2008). Several examples of sources of students' alternative conceptions are found to be from traditional instruction, myths, curriculum, textbooks, everyday experiences, religious teachings, and students' own intuitive reasoning structures in learning similar or common concepts (Chiu; Gooding, Metz & Guest as cited in Adu-Gyamfi & Ampiah, 2019).

**Specialist and Non-Specialist Biology Teachers Teaching Biology**

Specialisation is explained as focusing on your area of expertise so that maximum benefit could be derived from the person in terms of delivery (Makhila, 2008). The indication is that subject specialisation incorporates competence and expertise with regard to a particular subject area. Generally, a teacher who has specialised in the same specific subject area is perceived to enhance students' academic achievement (Gerretson, Bosnick & Schonfield, 2008). The teachers can concentrate on students' learning difficulties and help students to overcome the difficulties. De Jong, Veal and Van Driel (2002) compared teachers who have not specialised in biology and teachers who have specialised in biology to know whether there was a difference between them in teaching some difficult Biology topics. The importance was to find out the effect of the two groups on Biology students' academic achievements to know whether it matters or not. This is because teachers who have specialised in teaching a particular subject are perceived to do better than teachers who have not specialised but teaching a particular subject (Arzi & White, 2007; Gerretson, Bosnick & Schonfield, 2008).

As it may be, the teachers will be expected to teach in their comfort zone or outside their area of specialisation (De Jong, Veal & Van Driel, 2002). Allowing teachers to concentrate on their strengths is the solution to

increasing their capacity of integrating principal practices and strategies as a guide to lesson planning and its execution (Gerretson, Bosnick & Schonfield, 2008). As matter of fact, teachers who are teaching outside their area of specialisation has their difficulties. The knowledge base of the specialised teacher have impacts on all the areas of teaching such as during advance preparation, planning, making decision and the choice of content to be learnt (De Jong, Veal & Van Driel, 2002). It is required that teachers who have specialised in content areas are to teach them well to their students. The reason is that teachers who are teaching their area of specialisation have the advantage to build up and hold on to good content knowledge compared to teachers who have not specialised in the same area (Arzi &White, 2007).

Additionally, teachers teaching their areas of specialisation may have deeper knowledge to teach students for better understanding (Khourey-Bowers & Fenk, 2009). These teachers may have teaching strategies enabling students to grasp concepts for application to solve daily and scientific problems confronting them (Whitehurst, 2002). Senior high secondary teachers who have specialised in their fields of teaching improve students' academic achievement as compared to teachers teaching out of their field, despite the socioeconomic background of the students (Whitehurst, 2002). That is also not always so provided all the necessary structures in teaching and learning are put in place. This may make it certain for students to acquire good background information concerning the current issues in science (Arzi & White, 2007; Khourey-Bowers & Fenk, 2009).

According to OECD, (n. d.), the characteristics of specialised teachers comprise pedagogical content knowledge, adaptation of teaching methods to

cater for the needs of different learners, better problem-solving strategies, have total control over classroom events, make better decision, have absolute control over the subject and have greater respect for students. It is, therefore, important that teachers who have specialised in some subjects are made to teach the same subjects. It gives teacher's sense of professionalism by enhancing or improving their effectiveness and proficiency in teaching (Ojo, Akintomide & Ethindero, 2012).

The teachers' in depth knowledge on the subject matter has an influence on before, during and after teaching and learning processes which improves the knowledge they impart to students in an effective way (Jadama, 2014). Thus, deep subject matter knowledge shown by teachers during teaching is directly related to students' achievement (Metzler & Woessman, 2012). That notwithstanding, Kind (2009) put forward that holding high academic performance in specialist subjects is not a panacea to good teaching unless all the necessary teaching resources are put in place. Subject specialists are likely to teach in a way that could not be understood by students (Kind, 2009). Again, when the specialist teachers are also not comfortable in a subject area could affect their effectiveness.

Once teachers teach content in areas which they are not familiar or comfortable with, their exhibition of skills and abilities in their specialist subject becomes a difficulty regardless of their capabilities (Loughran, Berry & Mulhall, 2012). Teachers who are lacking knowledge in the content delivery of the subject matter may impact negatively on students learning. It affects teachers' inability to clarify students' misconceptions and cannot respond appropriately to the answers demanded by the learners on questions they are

probing (OFSTED, 2009). For that matter, the higher attaining learners who seek more challenges become disappointed (OFSTED, 2009) and also not able to intervene with low students' achievers (Erskine, 2010).

According to Peace (2012), misconceptions with regards to mathematics and science can lead to students' poor academic achievements. Research has shown that science and mathematics are among the most studied subjects that require specialist teachers with deeper content knowledge (Peace, 2012). High content knowledge in the content to be delivered is brought to classroom teaching by the specialist teacher (Makhila, 2008). Furthermore, Honnessy (2000) asserts specialist teachers exhibit several important dimensions in teaching and learning. Specialised subject teachers exhibit greater enthusiasm for teaching their specialised subjects (Fromyhr, 1995), because they highly value their subjects (DeCorby, Halas, Dixon, Wintrup & Janzen, 2005). According to Ndawi (2002), subject specialisation promotes better teaching, improves learners' academic performance and enhances teacher preparation. More years are spent by the teachers to learn and deepen their knowledge in a field of study on the content to equip the students with scientific skills to improve the worth of their work (Wilson, Macdonald, Byrne, Ewing & Sheridan, 2008).

Finally, allowing teachers to concentrate on their subject area may help the teachers to have a deeper understanding of his/her teaching. They can guide students to overcome their learning difficulties (Gerretson, Bosnick & Schonfield, 2008). Thus, in classroom teaching, proficient teachers can deal with students' learning problems and give remediation to enhance academic achievement (Ojo, Akintomide & Ethindero, 2012).

**Teaching Experience of Biology Teachers**

Classroom management is a skill acquired through training and a lot of experiences teachers go through in terms of years in the field (Bosch, 2006). Teachers who have taught for many years have the chance to upgrade their knowledge leading to understanding of new strategies of teaching. Experience teachers who may be competent or proficient and willing to improve upon quality teaching to stay in the teaching field, from time to time upgrade and deepen their knowledge and skills through development of their profession (Akinfe, Olofinniyi & Fashiku, 2012). They can use effective strategies of teaching that pleases students to modify the way they learn biology (Phoenix, 2000).

An experienced teacher may have developed techniques that could be applied to teach difficult topics for students to understand (Arzi & White, 2007; Khourey-Bowers & Fenk, 2009). Long serving teachers in the field of teaching are recognized to be good managers and more competent. This is because these experienced teachers have taught for so many years in schools and have been found to improve academic achievement by some researchers (Akinleye, 2001; Ogundare, 2002; Commeyras, 2003).

These teachers are regarded as competent to have taught for many years in the teaching service and acquisition of classroom management skills and techniques. They can prioritise tasks and carefully select several important classroom issues (Hagger & McIntyre, 2000). Furthermore, these teachers can command the lively nature of the classroom environment and effectively rectify the most important area of unpredicted classroom matters (Doyle, 2006). Experienced teachers tend to be less uncertain than their beginning teachers

(Cater, Cushing, Sabers, Stein & Berliner, 1988) and are also more workable and could adapt to classroom issues (Kerrins & Cushing, 2000).

Experience teachers are competent and very proficient in teaching because they have taught for more than five years (Carter & Doyle, 1995; Gonzalez & Carter, 1996; Varrella, 2000). The number of years in teaching brings about teachers' proficiency and competency in managing instruction. This includes life in the classroom, the establishment of the daily procedures, material allocations and being able to monitor independent work of students (Martin & Sass, 2010). Experienced teachers can set rules, establish a reward structure, and provide enabling atmosphere for students to comment (Martin & Sass, 2010).

Furthermore, some researchers have argued that experienced teachers can identify the complex concepts they have to teach, and support students to overcome their learning difficulties to improve students' academic performance. The reason for the arguments was that experience teachers' upgrade or polish up teaching skills for teaching and learning. (Al-Methen, 1993; Waiching, 1994; Ijaiya, 2000). Thus, learners pick up in the hands of teachers who have tutored them for a considerable number of years (Ijaiya, 2000). Experience teachers are more effective in using of a particular instructional strategy to enhance students' learning. Teachers may therefore be able to pinpoint the essential components if teaching approaches are examined in the environment in which they are used. As a result, experienced teachers will be able to modify a generalised educational technique for a particular subject matter or novel circumstances.

Teachers who have gained experience in terms of years of teaching are able to strategise his/her methodology to suit all the levels of his/her students which is consistence for better understanding of concepts. MacDermott and Shaffer (2000) suggested, among other things, that experienced teachers study each subject in a manner that is congruent with how they are expected to teach that content. Additionally they emphasised that in order to increase their own learning and become aware of potential student issues, teachers must be given the chance to confront and address their own conceptual and logical problems.

In contrast to the experienced teacher who is underprepared, who may feel unsure about how to instruct their students, the experienced teacher who is well-prepared may be able to handle obstacles faced by students, teach them at a high level, and make a difference in their lives. According to Akinfe et al. (2012), there is a direct link between teachers' experience and student achievement. Studies have shown that teachers with these years of teaching experience, particularly in the sciences, help students perform better academically. This is a result of the teachers' background in pedagogy and instructional technology.

Although, teachers who have taught for a considerable number of years have more knowledge in teaching but still encounter some difficulties in teaching some aspect of Biology topics. Common difficulties faced by experienced teachers were identified (Childs & McNicholl, 2007; Hasweh, 1987; Kind, 2009; Kind & Kind, 2011; Sanders, Borkos & Lockard, 1993). Some teachers who are experienced and teaching in secondary schools prepare lessons in the area of their expertise and outside portrayed some vast distinction in planning, responses given to questions students posed, and prior

subject matter knowledge (Hasweh, 1987). However, studies have revealed that teachers including experienced teachers have difficulties in teaching many biological concepts (Aleixandre, 1994; Nehm, Kim & Sheppard, 2009; Nehm & Schonfield, 2008; Bello, Bello & Abimbola, 2006; Modell, Michael & Wenderoth, 2005; Palmquist & Finley, 2007).

**Teaching Methods and Strategies Used by Biology Teachers**

Methodology and strategies used by teachers teaching Biology are very important as being used to carry out instructions in the classroom/laboratory. Methods and strategies could be contributing to biology students' difficulties they encounter in learning biology. In Ghana the teacher is always at the receiving end of students' performance. All the stakeholders and the government in most cases perceive the teacher to be the cause of the poor performance of students generally and elective biology cannot be excluded.

To some extent, the assumption that teachers are the cause of the poor performance in school could be buttressed by the conclusion drawn by Kimani, Kara and Arain (2010) when they concluded from their study that how students are taught contribute to their academic achievement. According to these researchers teachers are to devise means of making positive impact on student academic outcomes. The researchers lamented on the fact that learners' academic outcomes to some extent depends on the teachers.

It is difficult to downplay the importance of instructors or their influence on students' academic success across all subject areas in schools. According to Kimani, Kara and Njaji (2013), it has been demonstrated that teachers have a significant impact on their students' academic progress. During interactions with students, the teacher must translate policy into principles

based on experience. Students under the instructor's instruction will make insufficient academic progress if the teacher is unsuccessful at instructing using the appropriate methodology (Kimani et al., 2013). This holds true regardless of how similar or dissimilar the individuals' particular academic potential may be.

Different authors have suggested some teaching strategies for teaching (Akinoglu & Tandogan, 2007; Bigge & Shemis, 1998; Hartly, 1998; Henson, 2003; Kaselman, 2003).To attain the goals set in the teaching the teacher should apply productive teaching methods in teaching. The methods which appeal to learners' active involvement and motivation must be carefully discovered and used. It should look at the knowledge, environment and set learning goals for the students before using particular methods. Research has disclosed that productive teaching takes place only when variety of methods, strategies and techniques are adopted very well in the course of the teaching (Teddlie & Reynolds, 2000).

As a result of using different methods in teaching, a teacher who knows the students well chooses a teaching methodology which may help students to efficiently learn and benefit more from teaching (Maryellen, 2009). Stanislav (2012) asserts that using a student centred instructional method improves students learning. Teaching methods employed by teachers are very crucial in students' academic achievement. Practically oriented teaching methods that incorporate pictures, chart, models and videos could be one of the worthwhile methods that facilitate students' academic performance and retain what have been taught (Onwioduokit & Akinbobola, 2005).

Using guided discovery, group discussion, and demonstrations as practical teaching methods are fruitful in enhancing students' academic performance in science (Omwirhiren, 2002; Akinbobola, 2006). Many teachers use discussions in teaching senior high schools (Akinye, Olufunmin, Akinbobola & Afolabi, 2009). Students remember 10% of what they read, hear 20% of talking, 30% of what they see, and 90% of what they use their hands to manipulate (Vaselinovska, 2011). The application of different teaching methods in a lesson may cater for individual needs of students' learning. In this way, the students improve academic performance by applying diverse methods teachers use in teaching (Archibald, 2006; Darling-Hammond & Baratz-Snowden, 2005; Golla, de Guzman, Ogena, & Brawner, 1998; Hake, 1998). Finding and using effective methods of teaching biology that pleases students is one option that could be applied to enhance the feature of biology learnt in schools. Teaching methods and teaching styles that are suitable as claimed by Phoenix (2000) can motivate students to modify the way they learn Biology.

Many topics in Biology need strategies that can encourage how problem is experimentally solved and process-based skills (Kaselman, 2003). The application of active learning in solving scientific problem positively enhances students' academic performance and their attitudes toward science education (Akinoglu & Tandogan, 2007). Implementation of group investigation and problem-based learning motivates students to critically think through problems and questions, plan, arguments, and find solutions to scientific problems confronting them (Asyari, Al Muhdhar & Ibrohim, 2016).

Teaching methods that make use of hands-on activities support students who learn by toying with concrete materials so attention must be given to it in teaching and learning Biology. It is important because it integrates concrete experiences, emotions, values and interests (Bogner, 1998). Experiencing learning in both classrooms and outside the classroom with concrete materials are very significant components connecting the interest students have in learning Biology (Uitto, Juuti, Lavonen & Maisalo, 2006). Students attain quality learning outcomes when they acquire first-hand knowledge from original natural learning environment (Broody, 2005; Lavie Alon & Tal, 2015; Palmer & Suggate, 1996; Bogeholz, 2006).

The discussion method, for example, give teachers the opportunity to put in much effort and make sure students have attained the needed creative and critical thinking capabilities for learning which may prepare them to face challenges of life (Archibald, 2006). The teachers' ability to use teaching methods to create a conducive atmosphere for learning cannot be underrated (Darling-Hammond & Baratz-Snowden, 2005). Thus, the kinds of classroom knowledge transfer produced by teachers and the type of answers to questions they apply to organise the teaching play very important role in promoting thinking skills utilised by learners, information that are relevant to be covered and the application of skills in thinking they may learn (Darling-Hammond & Baratz-Snowden, 2005; Smart & Marshall, 2012).

The traditional approaches to teacher education have been denounced for its restricted correlation to the students' and the teachers' need (Cochran-Smith, 2005; Darling-Hammond et al., 2002; Korthagen et al., 2006; McDermott, 2001; McDermott & Shaffer, 2000). Even though traditional

method of teaching has been criticised immensely but it cannot be totally ignored in teaching. The reason is that it is the method used to impart knowledge when it is employed appropriately. However, the cognitive apprenticeship guide posits that students must be taught with the teaching method which will give them the opportunity to invent, observe, engage in, or discover strategies found in context (Berryman, 1991; Collins, Brown & Holum, 1991).

As maintained by Berryman (1991) the methods applied in teaching must motivate learners to comprehensively make exploration and learn independently. Berryman emphasised that teachers provide guidance and feedback to students in the course of learning new tasks that is difficult and beyond their reasoning levels. The environment needed for learning by students should motivate and allow them to learn what they have to experience in learning. Therefore students learn among themselves to find reliable answers to problems as encountered in the real-life situation in the world (Berryman, 1991). Hewson and Kerby (1993) remarked that teachers are expected to choose and use instructional strategies that are associated with goals set for teaching. That being so teachers' ideas learnt in teaching should have a correlation with the teaching strategies. Koballa et al. (2005) however, argued that teachers' understanding of ideas about teaching can be applied on the spot to serve as a reference to know much about the teaching approaches used.

The teacher is required again to be conscious of the requirements of every learner when preparing and planning for classroom instruction, looking at the content in the curriculum and bringing it down to students' level to

facilitate learning experience that will have a positive impact on academic performance (Garmston, 1996). Several studies, Hattie (2013), Thoran, Sarah and Burleson (2014), and Mutodi and Ngirande (2014) showed that 80% or more of secondary school students have now reached a concrete operational stage. Therefore Biology lessons must be tailored to suit their level to encourage the students to learn the subject with less difficulty.

**How Biology Students are Assessed in the Classroom/Laboratory**

A student's achievement in relation to certain curriculum expectations can be determined through a systematic procedure called assessment. After the assessment, the students improve their knowledge and skills level, feel good about their performance, and alter their attitudes (Kirkpatrick, 1994). After a class of students has been taught, the teacher will want to assess how successfully the goals stated were accomplished. It should not be assumed that learning has occurred once the students are seated in the classroom. The majority of the time, teachers have discovered that the amount of work put into the teaching process does not match what the pupils actually learn in the classroom.

The profile dimension in the Biology teaching syllabus has described the underlying behavior for evaluation in the classroom (MOE, 2010). The idea of profile dimensions, which need to serve as the foundation for training and evaluation, is a key component of this syllabus or curriculum. Through learning, a student may pick up some knowledge and be able to apply it in a different setting. The primary focus of teaching and learning in schools should be on the dimension of application of knowledge (Farrant, 1990). This type of evaluation is designed to help students go from rote memorization and didactic

knowledge acquisition to a position where they can apply their knowledge, develop critical thinking abilities, make plans, and come up with new ideas

Three profile dimensions have been established for evaluating teaching, learning, and assessment in Biology. Knowledge and comprehension have been given a 30% weighting, knowledge application a 40% weighting, and practical and experimental skills a 30% weighting (MOE, 2010). The assessment should be guided by the percentage weights that have been assigned to each of the dimensions. The percentages demonstrate the appropriate priority that should be placed by the teacher on assessment throughout the teaching, learning, and testing processes. Finding any gaps or omissions between what was taught and what students really learnt is the process of assessment.

The platform for the teacher to gather information to address these issues arises when the teacher is able to pinpoint the issues and challenges the student encountered during the instructional process. The assessment could assist the teacher in gathering information about the academic performance and learning style of the students. It comprises all techniques used to assess a student's present knowledge (Dietel, Herman & Knuth, 1991), or any actions teachers and students engage in to gather data that can be used to diagnose and change teaching and learning (Black & William, 1998).

The only way for the teacher to determine whether the students are understanding or meeting the instructional expectations is through assessment. The teacher could conduct an assessment during earlier instruction to determine how much information students have contributed and how prepared

they are for fresh learning. The method of gathering this data is known as a diagnostic test or test of entry behaviors (Gallagher, 1991).

According to Hirvonen and Viiri (2000), studying practical skills and scientific learning methods increases students' motivation and gives teachers the chance to assess their students' knowledge. It provides diagnostic information to improve learning, formative and summative data about students' learning and achievement, information to help with instructional planning by giving teachers enlightened feedback, information to help determine the efficacy of approaches and methods, and communication tools. Students learn about desired learning outcomes, the type of performance they need to succeed, and where they need to put effort through the feedback (Elliot, 2000).

The students are assessed during instruction and learning in the classroom to identify what they have studied with regards to the activities conducted in the classroom (Black & Wiliam, 1998; Luxia, 2007; Paige, 2006; Stobart, 2008). Assessment has to do with every activity which teachers together with students handle to collect data about teaching and learning. Biology students are assessed for learning which seeks and interprets evidence of learning applied by students and teachers to determine the learners' academic achievement or their level of attainment in learning.

This assessment dealt with class exercises, quizzes, written class tests, oral tests, practical tests and assignments. Assessment for learning is also one of the strategies used by teachers for improving what learners have learnt and raising standards (Black & Wiliam, 1998). The teachers teaching biology go through rigorous activities together with the students to produce information to

be utilised as for given feedback for modification in teaching and learning (Black & Wiliam, 1998; Stobart, 2008). In this way, students are motivated because they can monitor their learning (Biggs, 2003).

Therefore, assessment for learning in biology provides students with timely good feedback to ensure students are helped during teaching and learning (Nicol, 2009; Nicol & Macfarlane-Dick, 2006). Teachers use various strategies and questioning techniques to measure the learning that has taken place. It is applied as a continuous process that comes about at every stage in the instructional process to monitor the progress of the students and to give appropriate good feedback (Nicol, 2009; Nicol & Macfarlane-Dick, 2006). The teacher and the student are often in collaboration to enhance learning. There is an interaction between the teacher and the student about the learning response (Laurillard, 2002).

However, Nicol and Macfarlane-Dick (2006) assert that satisfactory feedback as a practice is not only about producing useful information that supports students to enhance their learning but also provides reliable information that could be relied upon by teachers. Thereby, teachers can modify teaching to meet learning objectives to help students' learning. There are so many ways to assess the quality of students to find out whether they are performing well academically (World Bank, 2008). Students are to be fully assessed to find their shortcomings in learning so that teachers provide remediation to improve students' academic performance (Shavelson, 1995).

The concept of formative assessment in Biology is very important in a sense of guiding teaching strategies that support students learning in research assessment in science (Atkins & Coffey, 2001; Black & William, 1998). This

provides feedback to teachers and enables teachers to judge how well students are learning (Dunn & Mulvenon, 2009). Biology teachers respond to students' work and give appropriate feedback on students' current level of performance and learnng (Nicol, 2009; Nicol & Macfarlane-Dick, 2006).

The students are also assessed in skills, knowledge, and application on what have been taught. Activities and testing Biology students about what have been taught develops knowledge, skills and application that the test required learners to exhibit. In this case, the test may produce a positive effect on students' learning. Again, this may help the teachers to modify their teaching to enhance students understanding and knowledge of concepts to promote teaching and learning (Dietel, Herman & Knuth, 1991). Consequently, biology students are assessed to help the Biology teachers to discover how well the students are studying to meet the expectations in the instructional delivery (Black & Wiliam, 1998). Biology students could be assessed prior or during instruction by the teachers to find out what knowledge students have acquired already and brought into the current learning situation and the learners' readiness for new learning (Gallagher, 1991).

It could be done during instruction to help students to learn more and also find out how they are progressing in the process of instructing and learning (Gallagher, 1991). Formative assessment in Biology learning is there to evaluate the comprehension of the students during and after the lesson. The learners are given chance also to assess themselves in how they are performing academically. Thus, assessment as learning supports students' sense of ownership about their learning through reflective practices (Pryor & Crossouard, 2008).

Biology teachers apply several assessment methods to gather information about the students. For example, information such as portfolios, journal entries, project work, checklists and questionnaires, are gathered by the teachers to make informed decisions about students' learning (Kuhs, 1998). According to Kuhs (1998), a portfolio is an assessment used to collect different information about students' progress in their engagement in tasks and also determine the competencies and skills in their achievement.

The Biology students are again assessed in higher-order thinking so that they can work independently. Higher-order level thinking activities or thought-provoking activities such as scientific problem solving, project work, and practical work are given to biology students to stimulate their thinking. Some studies in assessment utilised summative rating scales to measure student participation levels for their self-report. Students' portfolios, projects, exhibitions, performances, and learning journals or logs could serve as a proof of higher-order problem solving and metaconscious learning techniques (Royer, Cisero & Carlo, 1993; Wolf, Bixby, Glenn & Gardner, 1990).

A summative assessment enables Biology teachers to gather information about the students in a well-ordered way about what students have learned over an instructional period (ARG, 2006; Harlen, 2001) so that inferences could be drawn about students' achievement, and to provide a report that reflects each student learning (ARG, 2006; Harlen, 2001). Summative assessment comes about at the end of teaching a course to find out the students' level of academic achievement or how well learners have performed. It is also described as assessment of learning which often takes the

form of external examinations, end of term examinations, and end of year examinations.

Biology students are also assessed in the school laboratory to know how they could use scientific equipment to support learned theories. Teachers and educators in science currently admit that laboratory experiment is needed to enhance understanding to learn science (Ottander & Grelsson, 2006; Tan, 2008). Laboratory experiments or activities well planned by teachers engage learners at all levels to sharpen their observational, manipulative, and reasoning skills. Laboratory assessment or work in science education has been given the attention it deserves because researchers, teachers, and policymakers are reassured about its usefulness for understanding science (Psillo & Niedderer, 2002). Thus, laboratory activities keep students busy to discover how and learning through first-hand experiences.

As stated by Collete and Chiappetta (1989), activities that are carried out in the laboratory allow learners to plan and to engage in exploration or to get involved in the activities that help enhance their skill in manipulation of learning materials. In the laboratory assessments, some variables must be prominently emphasised. Variables that are to be taken into consideration are objectives set in learning, the type of instructions delivered by the teachers and the laboratory guide, materials and equipment needed and obtainable for utilization in the laboratory research (Lunetta, Hofstein & Clough, 2007).

The motive and concepts behind teaching the activities carried out in the laboratory in science education to assess students is to give conceptual and theoretical knowledge underlying the scientific concepts, through the application of scientific methods that will help the students to comprehend the

nature of science (Lazarowitz & Tamir, 1994; Lunetta, 1998). Besides, laboratory practical activities should motivate students to develop their analytical and critical thinking skills and uplift interest students have in science (Lunetta, 1998). Despite the attempts to improve assessment done on laboratory activities in science education, investigations have proven that teachers perceived laboratory experiment as difficult (Tan, 2008; Tobin, 1986).

Assessment could also be done in the laboratory to determine how the learners are performing per what the teacher expects them to do. As claimed by Wiggins (1990), assessment is meant to involve students in productive tasks and problem-solving activities that command them to use requisite effective knowledge and creativity. Stiggins (1987) observes authentic assessment as one that demands the learner to exhibit specific skills and proficiencies. For instance, the learners benefit from the process skills during their learning process and when doing scientific investigations (Harlen, 2001).

The comprehensive account and effectiveness and value of authentic assessments hinge on formulation of suitable structured tasks, checklists, and rubrics for scoring (Hart, 1994). Rubrics put in place, set an obvious criteria by which work will be scored (Radford, Ramsey, & Deese, 1995). To pass judgement on the application of higher-order skills in thinking of the students' portfolios, rubrics may have the criteria that will serve as a proof of problem-solving, planning, and self-evaluation in the activities. Several informal and formal protocols used to assess students' learning strategies also include the parts that hinge on metaconscious skills (Pintrich & De Groot, 1990; Ward & Traweek, 1993).

The metaconscious knowledge for monitoring assessment (Tobias, Everson & Laitusis, 1999) and assessment of cognitive monitoring effectiveness (Osborne, 2000) are kinds of assessments which are regarded more appropriate for the classroom situation. These instruments have also shown resound psychometric qualities in testing and evaluating of activities (Osborne & Collins, 2001). The use of checklists is to ensure that the type of skills designed in the laboratory work is achieved by the students when teachers go round to tick when desirable skills have been portrayed by students. The one who is assessing should reveal clearly the goals and objectives during the development of rubrics for scoring, administration, interpreting and making good use of the results. These rubrics developed guide the classroom assessment process planning (Moskal, 2000a). Thus, this particular assessment helps teachers to see live what the learners are doing right and or wrong to assists those in difficulty.

Given reliable feedback to students is a vital aspect of assessment to maximize students learning. By that, students are given reliable information on the level of their learning, showing how well they are meeting what the teachers expect from them. Feedback helps students focus and plan their learning so that they will be well-guided for performing self-appraisals of their learning, which increases learning and retention (Enerson, Plank & Johnson, 1994; Gredler, 1999; Hargreaves, 2001; Smith, 2007; Tierney & Charland, 2007). Positive reinforcement encourages students to work harder on a task.

More often than not, teachers have been using written tests to assess the performance of their students' academics. Several senior high schools are now using hands-on as a means for assessing the degree to which their

students portray basic scientific skills. This type of method of teaching and learning also suits the nature of science education that includes the frequently changing occurrences and active studies (Atkin, Black & Coffey, 2001). The strength of the hands-on assessment lies on the utilisation of graded, authentic task which is needed to address problems based on real-life circumstances. It comes up with giving an opportunity for students to independently attain the expected level of study (Baker, 1996).

It requires students to participate fully in the activities with acquired knowledge, and give them opportunities to learn and realize their challenges and correct them (Mabry, 1999). The students manipulate learning materials to execute the tasks given them. Therefore, the materials provided for utilisation in such tasks should guide the assessor to assess the degree to which the students exhibit their skills, and thus, provide reliable information about the level of knowledge students have attained (Roberts & Gott, 2004).

Without assessment it will be very difficult on the part of the teacher to know whether his/her practical method is effective or not. For instance, Johnson (2010) submits science is delivered through practical methods; students are expected to investigate with strategies to test hypotheses being formulated about the characteristics of the learning resources to examining and to build into concepts, generalisations and theories. German and Aram (1996) suggested that the ability of students to exhibit the science process skills efficiently during an experimental enquiry is dependent on the student's knowledge and skills. Thus, teachers must use effective practical assessment technique for students to equip themselves with the necessary skills.

Several reasons outlined for assessing students' performance in laboratory work including skill development, discovery and creativity have been explained in clear terms (Kober, 1993; Raizen & Kaser, 1989; Meng & Doran 1993). The assessment has been designed to measure some specific learning outcomes as well as for assisting students, teachers, and parents to keep an eye on learning. Assessment should be dependent on the context in which it has been explained, give consideration to the kind of the subject matter and hold forth to the distinctive cultural considerations of class, the school, and the community among the culturally different population (Tippins & Dana, 1992).

Assessing a sizeable number of students will not enable teachers to pay attention to individual challenges (Nzabihimana, 2010). In the classroom teaching activities and laboratory practical assessment, the teacher's role cannot be overruled as he/she should initiate a conducive environment for students to learn without or minimised difficulty. Teachers need to inquire about students' understanding before they start to teach, and explanations given to students bring about better understanding and improve the skill of materials already taught (Shavelson, 1995).

**Resources for Teaching Biology**

Anything that may be used to further the aims and purposes of institutions or organizations is a resource. Awolola (2000) defined teaching and learning resources as the human and material inputs required for realising the goals of the concepts to be taught. Everything that is directly or indirectly used for educational instruction to support or encourage the acquisition of knowledge, competence, skill, and know-how is included in this category.

Resources, instructional tools, or items used in the context of learning are many and are used to make teaching and learning easier for understanding. Some examples of the instructional and learning resources are textbooks, skeleton, chalkboard, slide projectors. Computers, library, charts, models, measuring cylinders, and top scale pan balance (Adobe, 1998).

Inadequate teaching and learning resources may be one of the difficulties Biology teachers face in teaching. The human resource in education cannot be overlooked because it is the first point of reference in terms of teaching including learning elective Biology. In the light of this, Wobbman (2004) describes that a teacher is an important person or important factor in the provision of education and consequently affects the feature of education significantly. As claimed by Oludipe and Lasis (2006), the equipping and application of resources have an effect on the effective teaching and learning of science.

Classroom, laboratories, chemicals, equipment, and audiovisual resources were categorised by Achimagu (2006). Gbamanja (2002) on the other hand believes that using resources in the classroom can make learning more practical, useful, and meaningful. The researcher went on to say that resource materials are items that provide a concrete foundation for learners, to make learning more permanent in the learners' mind; have a high degree of interest for learners. Resources for teaching-learning offer a reality of experience that stimulates participation in the activities learners are engaged in, develop continuity of thought; contribute to the growth of meaning and thus to vocabulary development. Furthermore, resources provide experiences no one else has had before.

It has been determined that the availability and utilisation of teaching-learning materials as well as the type of school have a direct impact on students' performance. (Oguntuase, Awe & Ajavi, 2013). Further availability, sufficiency and right use of teaching-learning resources according to Oguntuase et al. (2013) improve school effectiveness because these are the basic aspects that might trigger good academic achievement in students. Academic performance development requires access to variety of information sources, teaching and learning aids, according to Wanjala, Khaemba and Sindabi (2010).

The relevance of the use resources in the instruction or teaching and learning process is well acknowledged in the research on the school effectiveness (Barrett et al., 2007; Musasia et al., 2012; Owoeye & Yara, 2011; Onderi & Makori, 2013; Pule, 2007; World Bank, 2008). According to Yadar (2007), without some sort of practical work, no education in science or mathematics can be considered complete. People should complete the practical work in laboratories or in mathematics classes. Yadar (2007) went on to say that a handled object makes a more lasting imprint on the mind than one that is simply viewed in a sketch or from a distance.

Material school inputs are linked to academic progress in the Third World according to Fuller (2009). After accounting for the effect of students' background, empirical study reveals that school institution has a bigger influence on accomplishment in developing countries according to Fuller. Among these schools, factors are the resources, human and non-human, available for teaching the subjects in the schools. Fuller (2009) further emphasised that in developing countries, simple resource inputs especially

those directly related to the instructional process such as textbooks availability in classrooms, teacher quality, appropriate and serene environment resources are consistently associated with achievement. The availability of proper structures ensures the safety of the learners as well as concentration on what is being taught (Fuller, 2009).

In the research on the relationship between educational resources and students, Idiagbe (2004) found out that, teachers' qualifications and suitable facilities were factors of assessing students' academic achievement in secondary schools. Inadequate teaching-learning resources have been identified as one of the important indications in studies of factors impacting students' low performance in test (Kitheka, 2005). According to a study on factors affecting effective library usage in secondary schools (Ashiola, 2012) found out that, libraries were not a priority in secondary schools and continued to be overlooked as an important part of the educational system.

The importance of teaching-learning resources in the teaching and learning process was also stressed (Barrett et al., 2007; Musasia et al., 2012; Owoeye & Yara, 2011; Onderi & Makori, 2013; Pule, 2007; World Bank, (2008). Owoeye & Yara (2011) opined that teachers and students benefit from materials that make teaching and learning easier. Because teachers and students handle resource materials to achieve the objectives set. Yadar (2007) furthermore asserted that, it is common knowledge that handling an object has a bigger mental impact than viewing it merely from a distance or in a sketch.

The Science laboratory is a valuable resource that has a huge impact on teaching science and enhancing students' academic achievement (Dahar, 2011). Well and furnished science laboratories have a positive impact on

advancing the scientific world. Some researchers have suggested that when students work in science laboratory their learning improves (Hofstein & Lunetta, 2004; Hofstein, 2004). Because of its unique function in science teaching and learning, the science laboratory should be fully equipped and resourced. The benefits derived by students in terms of manipulative skills come as a result of going through activities in the laboratory (Hosfstein & Lunetta, 2003).

Despite that, the resources and facilities in senior high schools for science teaching are inadequate (Dahar, 2011). The senior high school serves as a basis for learners preparing for science education. This is the level where students are exposed to laboratory facilities, equipment, resources and precautionary roles in the laboratory (Dahar, 2011). A senior high school laboratory should have standard facilities and equipment for conducting experiments (Tesfamariam, Lykkenes & Kvittingen, 2014). To make good use of the facilities and equipment by the students, they are to be fully guided. Therefore students can have full laboratory experience when they have a competent laboratory assistant (Tenaw, 2015).

If students are deprived of laboratory experiences, it may impede the benefits that could be derived from science laboratories (Hunde & Tegegne, 2010). Students understand better when they acquire practical experiences in experimentation to develop an interest in Biology (Watts, 2013). Knowledge and skills learnt from laboratories help countries to find solutions to their scientific experimental problems (Teshome, 2007). Learners should be provided opportunity to practice practical learning with the use of appropriate

science apparatus. If there is no practice in all that has been learnt, knowledge acquisition becomes dormant (Jonassen, 1991).

Some teaching and learning classroom/science laboratories lack some basic facilities that may support classroom/science practical work. Tesfamariam, et al. (2014) have found out that most laboratories in secondary schools were not built for laboratory purposes and lacked some basic facilities such as the source of electricity, working tables, stools, running water, and sinks for washing apparatus. Thus, teachers are forced to teach theories only without practical work or experiments for verification. Sam (2009) put forward that, practical activities as a strategy could make the teachers' teaching more real to the students by using instructional materials or equipment. Students are able to recall what they see and touch more than what they hear as a result of teaching and learning science at the laboratory to improve academic achievement (Farounbi, 1998).

The laboratory is regarded as an indispensable element of teaching and learning science where practical or experimental studies are conducted (Nzewi, 2008; Aina, 2012). A Science laboratory is an instructional facility utilised by the teachers to assist students to learn science through investigating the world around them (Ude & Unah, 2017). Biology is a science-based on experimentation that should be taught through an activity-based approach in the laboratory that is well equipped. Laboratories are essential in developing students' interest, curiosity, creativity and problem-solving in science to improve their understanding of science concepts and scientific processes (Azizoglu & Uzuntiryaki, 2006).

Well and equipped science laboratory may help students to benefit from how the apparatus work and how to be handled for practical work. Classroom/laboratory teaching and learning benefits students as it makes learning concrete to form the basis of science education at all levels (Hunde & Tegegne, 2010). Science laboratories that are not well equipped with equipment cannot expose learners to design and conduct research, use scientific reasoning, operate equipment, manipulate apparatus, record and generate data for analysis (Ude & Unah, 2017).

Kibirige and Tsamago (2013) endorsed the use of practical strategies or methods to improve the development of science process abilities of the students. National Academy of Science (2010) suggested that practical work has been found to improve academic achievement than non-practical in Biology. Knowledge acquisition of biology by students in secondary school, motivate them in the practical and theoretical aspect to solve some basic problems of life (Ude, 2011). Some students learn better and improve their understanding when they are confronted with the activity-based investigation through experimentation (Hunde & Tegegne, 2010).

Researchers (Ikeobi, 1996; Adeyegbe, 1997; Adeyemi, 2008; Arokogu & Ugonwa, 2012) have disclosed that lack of adequate laboratory facilities, students' attitude towards learning science, teacher-centred and ineffective methods of teaching science contribute to students' poor academic performance. Adeyemi (2008) suggested that many secondary schools lacked the necessary laboratory space and equipment for science.

Science laboratory is very important in its distinctive role in science teaching and learning so it should be well furnished and resourced. This is

because the benefits derived by students come as a result of going through activities in the laboratory (Hosfstein & Lunetta, 2003). Despite that, the resources or the facilities used to teach science are subpar in senior high schools (Dahar, 2011).

Students are exposed to laboratory facilities, equipment, resources and precautionary roles in the laboratory (Dahar, 2011). A senior high school laboratory should have standard facilities and equipment for conducting experiments (Tesfamariam, Lykkenes & Kvittingen, 2014). If students are deprived of laboratory experiences, it may impede the benefits that could be derived from science laboratories (Hunde & Tegegne, 2010). Moreover, students understand better when they acquire practical experiences in experimentation to develop an interest in biology (Watts, 2013). Knowledge and skills learnt from laboratories help countries to find solutions to their scientific experimental problems (Teshome, 2007).

Tesfamariam, et al. (2014) have found out that most laboratories in secondary schools were not built for laboratory purposes and lacked some basic facilities such as the source of electricity, working tables, stools, running water, and sinks for washing apparatus. Thus, teachers are forced to teach theories only without practical work or experiments for verification. The laboratory is regarded as an indispensable element of teaching and learning science where practical or experimental studies are conducted (Nzewi, 2008; Aina, 2012).

Teachers use science laboratories as learning spaces to help their students learn science through investigating the world around them (Ude & Unah, 2017). Biology should be taught using an activity-based method

because it is a subject that depends on experimentation in a well equipped science laboratory. Researchers (Ikeobi, 1996; Adeyegbe, 1997; Adeyemi, 2008; Arokogu &Ugonwa, 2012) have disclosed that lack of adequate laboratory facilities and ineffective methods of teaching science contribute to students' poor academic performance.

**Summary of Findings in the Literature Review**

The researcher reviewed literature that helped to answer the research questions. It looked at teachers' experience with regards to the number of years of teaching, difficult Biology topics to teach, and difficult Biology topics to learn by students. Others were methods used by teachers teaching Biology, how the classroom assessment is done, and resources that are available to teaching and learning Biology.

1. In order to promote learning experiences that will have the greatest impact on students, teachers must be aware of the needs of individual learners while preparing curriculum delivery. By examining the curriculum from the learners' perspective and considering its relevance to the learner (Garmston, 1996; Spigner-Littles & Anderson, 1999). Teachers must establish a secure learning atmosphere where individuals are free from fear and open to constructive learning, where learners feel welcomed, at ease, and respected in order to support all the circumstances students require for the maximal production of meaning (Henson, 2003; Spinger-Little & Anderson, 1999).
2. According to Abimbola (1998), genetics, hormones regulation, nervous system, and DNA Molecules were difficult Biology topics to teach. Again, genetics, ecology, respiration, photosynthesis, circulation of

blood, reproduction, DNA molecules and circulatory systems of humans were found to be difficult Biology topics to teach (Bahar, Johnstone & Hansell, 1999; Tekkaya, Özkan & Sungur, 2001). Furthermore, genetics, hormones regulation, nervous systems, cell division, and DNA molecules were also considered difficult biology topics for biology teachers to teach (Johnstone, 1998).

3. Studies have reported on some aspects of Biology topics that students perceived as difficult to learn (Bahar, Johnstone & Hansell, 1999; Çimer, 2004; Çimer, 2012; Durmaz, 2007; Hornby, 2010; Lazarowitz & Penso, 1992; Özkan, 2003; Özkan & Sungur 2001; Özkan, 2003; Saka, 2006; Seymour & Longdon, 1991; Zeidan, 2010). Topics such as respiration, photosynthesis, water transport in plants, protein synthesis, gaseous exchange, cell division (mitosis and meiosis), organs, physiological processes, hormonal regulation, Mendelian genetics, Kreb's Cycle, Circulation of blood in humans, and central nervous system can be recognised as difficult to study by quite many secondary school biology students (Bahar, Johnstone & Hansell, 1999; Lazarowitz & Penso, 1992; Seymour & Longdon, 1991).
4. The methods which appeal to learners' active involvement and motivation must be carefully discovered and used. It should look at the knowledge, environment and set learning goals for the students before using particular methods. Research has disclosed that productive teaching takes place only when variety of methods, strategies and techniques are adopted very well in the course of the teaching (Teddlie & Reynolds, 2000).

5. Once the teacher has figured out the issues and difficulties encountered by the student in the instructional process, then this provides the platform for the teacher to gather information to address these difficulties. The assessment may help the teacher to collect data on students' learning behaviour and achievement level. It includes any method used to better understand the current knowledge that a student possesses (Dietel, Herman & Knuth, 1991), or all activities that a teacher and students undertake to get information that can be used diagnostically to alter teaching and learning (Black & William, 1998).
6. One of these issues could be inadequate teaching and learning resources Biology teachers face in teaching. The human resource in education cannot be overlooked because it is the first point of reference in terms of teaching including learning elective Biology. In the light of this, Wobbman (2004) describes that a teacher is an important person or important factor in the provision of education and consequently affects the feature of education significantly. As claimed by Oludipe and Lasis (2006), the equipping and application of resources have an effect on the effective teaching and learning of science.

# CHAPTER THREE

# RESEARCH METHODS

This chapter describes how the study was carried out. It highlighted the research design, population, sample and sampling procedure, instruments, data collection procedure, and data analysis.

## Research Design

The research design used for this research was the explanatory sequential mixed methods. This involved quantitative and qualitative methods (Cohen & Manion, 2000; Cresswell & Plano Clark, 2018; Creswell, 2003; Cresswell, 2012). The explanatory sequential design was employed in two strands. The first strand involved collecting and analysing quantitative data. To further understand the quantitative results, the researcher implemented the qualitative strand to help explain some of the quantitative results. This is because quantitative and qualitative methods supplement each other and ensures for more complete analysis (Tashakkori & Teddie, 1998).

The explanatory design was chosen for this study because the research problem was more quantitative oriented. The researcher had access to quantitative instruments as well as the ability to go back to participants for the second collection of qualitative data (Cresswell & Plano Clark, 2018) on the state of teaching Biology in the selected public senior high school. It was easy to implement, and the study was reported for the quantitative and qualitative phases for the reader. It can give better understanding of the problem and gives more evidence. Using triangulation strengthens the findings. One of the disadvantages of using the explanatory sequential mixed methods is that if the researcher is not adept in using it, had to call on someone for assistance which

may increase the cost. It is also time consuming in collecting and analyzing both quantitative and qualitative data. This explanatory sequential mixed method for the study is presented in Figure 1 and has been adapted from Creswell and Plano Clark (2018).

**Quantitative Strand**

In the first phase of the explanatory sequential mixed methods design, the research questions on teachers' and students' difficulties with biology teaching and teacher specialisation and teaching experience were formulated. The teachers and students involved in quantitative data collection were identified and selected through a multistage sampling procedure. Quantitative data were then collected using questionnaires on difficulties teachers and students encounter in teaching and learning some aspects of biology topics, and teachers' experience in teaching. This was achieved through cross-sectional survey of the selected schools.

Analysis of quantitative data was done using descriptive and inferential statistics. This gave an insight into how to formulate research questions for collecting the qualitative data. The analysis of the data led to the determination of the significance of the quantitative results. It was then used to select the participants for the second phase where observations and interview guides were used for qualitative data collection.

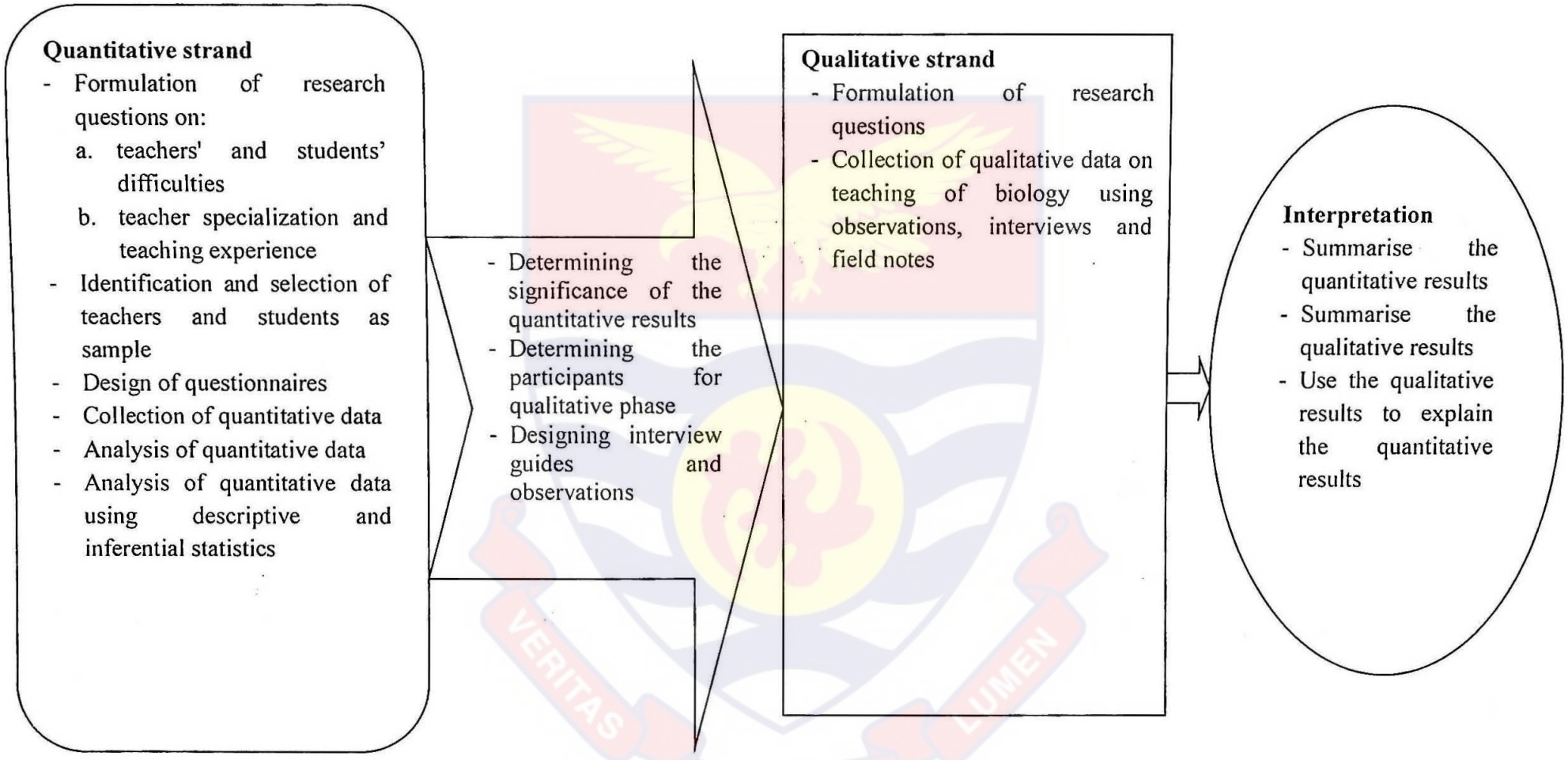


*Figure 1*- Explanatory sequential mixed method design adapted for investigating the state of biology teaching.
**Source:** Creswell and Plano Clark (2018)

### Quantitative Strand

In the first phase of the explanatory sequential mixed methods design, the research questions on teachers' and students' difficulties with biology teaching and teacher specialisation and teaching experience were formulated. The teachers and students involved in quantitative data collection were identified and selected through a multistage sampling procedure. Quantitative data were then collected using questionnaires on difficulties teachers and students encounter in teaching and learning some aspects of biology topics, and teachers' experience in teaching. This was achieved through cross-sectional survey of the selected schools.

Analysis of quantitative data was done using descriptive and inferential statistics. This gave an insight into how to formulate research questions for collecting the qualitative data. The analysis of the data led to the determination of the significance of the quantitative results. It was then used to select the participants for the second phase where observations and interview guides were used for qualitative data collection.

### Qualitative Strand

In the second phase, observations and interviews were used to collect data from the students and teachers on teachers' teaching methods employed, teaching available resources, how students were assessed and how the Biology classroom/laboratories were furnished with standard equipment. It was used as a follow-up to the quantitative strand in the first stage of data collection. This was achieved in a case study where some selected teachers' and students' responses given in the questionnaires were triangulated to find out whether there were some inconsistencies to be rectified. Five out of the 28 teachers

willingly accepted to be observed whilst teaching and were also interviewed to probe further issues as they emerged, and informal discussion was held with them. Twenty-four students availed themselves to be interviewed.

**Interpretation**

At this stage of the explanatory sequential mixed methods design, the quantitative and qualitative results were summarised separately to determine the priority areas of the results to be given more attention. The qualitative areas on teachers' methods of teaching, how students were assessed, and availability of resources/equipment were used to explain the quantitative results. This helped to establish state of teaching biology in the public senior high schools in the Cape Coast Metropolis.

**Study Area**

The Cape Coast Metropolis in Ghana's Central Region served as the site of the study. The Gulf of Guinea, Komenda Edina Eguafo Abirem Municipal District, Abura Asebu Kwamankese District, and Twifo Heman Lower Denkyira District all lie alongside the Cape Coast Metropolitan Assembly to the south, west, east, and north, respectively. With 169,894 inhabitants, the Cape Coast Metropolis represents 7.7% of Ghana's Central Region's overall population (Ghana Statistical Service, 2010). Fante is the locals' language in Cape Coast. Oguaa and Kotokuraba, which respectively mean "River of Crabs" and "Village of Crabs," are the city's more ancient traditional names.

The location was given the name Cabo Corso (which translates to "short cape") by the Portuguese explorers Joao de Santarem and Pedro Escobar who passed through Oguaa in the year 1471. The terrain is mostly

undulating with steep hills and is dominated by batholithic rock. Between the hills, there are valleys with a variety of streams, the largest of which is Kakum. Fetu Afahye, an annual festival celebrated by the chiefs and residents of Cape Coast, is one of Ghana's most well-known tourist destinations.

As the home to some of Ghana's oldest and most successful institutions, Cape Coast Metropolis is known as the birthplace of the country's educational system. It has numerous schools, from elementary to tertiary institutions, spread out over the entire Metropolis. People who are interested in pursuing various levels of academic and professional education come to the schools from all around the nation and the West African subregion. The Metropolis features 12 public senior high schools in addition to one university, one polytechnic (formerly known as a technical university), one public nursing and midwifery training college, and one public college of education.

**Population**

There are 12 public senior high schools in the Cape Coast Metropolis. Out of these 12 schools, two were girls, three boys and seven mixed or coeducational schools. I was interested in all the categories of school types so that the actual state of Biology teaching in all the schools could be unravelled. The target population for the study was teachers teaching Biology and biology students. However, the accessible population was teachers teaching Biology in SHS 2 and SHS 2 Biology students. This was because the form 3 students were preparing for WASSCE and the form 1 students had not covered many Biology topics during the data collection stage of the study. The average ages of the accessible population comprising teachers and students in the study were 30 years and 16 years with standard deviations of 0.52 and 0.50

respectively. Also, 20 of the teachers were first-degree bachelor of education holders and 8 of the teachers were second-degree holders.

**Sampling Procedure**

Before data collection, the 12 schools were stratified into single-sex (two females, three males), and seven mixed or coeducational schools. The two female schools were selected purposively, and a simple random sampling technique was used to select two each from males and mixed or coeducational schools. This was done because there were only two female schools in Cape Coast Metropolis so both were selected. During the quantitative strand, a multistage sampling technique was used to select the participants from year 2. This was done because the year 3 students were preparing for WASSCE and the year 1 group had then not covered enough topics in biology to participate. In each school the science class was grouped into more than one intact class. In school 'A' there were 3 intact science classes, school 'B' had 4, school 'C' had 5, school 'D' had 3, school 'E' had 5 and school 'F' had 6. Of these intact classes of each school, one intact class was randomly selected for the study. The total number of students in each intact class were; school A (n=46), school B (n=47), school C (n=47), school D (n=47), school E (n=46), and school F (n=48). Therefore, 281 students were selected from the six schools to participate in the study. Thereafter the teachers teaching Biology in SHS 2 were selected using the purposive sampling technique. This was because in each of the schools, there were Biology teachers also teaching year 1 and year 3 students but I was interested in the Biology teachers teaching year 2. The number of Biology teachers teaching in year 2 in school 'A' was 4, school 'B'

had 4, school 'C' had 5, school 'D' had 4, school 'E' had 5 and school 'F' had 6. All the 28 teachers and 281 students participated in the study.

In the qualitative strand, two schools (A and B) were simple randomly selected from the 6 schools for the classroom observations and semi-structured interviews. This was done to get more insight into the difficulties teachers and students encounter in teaching and learning Biology. A total of 5 teachers in the two schools availed themselves to be observed whilst teaching and also interviewed. Two of the teachers were from school A and 3 from school B. In all, four lessons were observed in each of the two schools. Twenty-four students were conveniently selected because they were willing to be interviewed. Ten of the students were from school A and 14 were from school B.

**Data Collection Instruments**

The research instruments that were developed for the research were:

1. Teachers' questionnaire on difficult Biology topics [TQDBT]
2. Students' questionnaire on difficult Biology topics [SQDBT]
3. Observation checklist on Biology equipment [OCBE]
4. Observation checklist on classroom practices [OCCP]
5. Teachers' interview guide [TIG]
6. Students' interview guide [SIG]

**Teacher Questionnaire on Difficult Biology Topics [TQDBT]**

TQDBT was constructed by the researcher consisted of closed-ended items with four main sections. The purpose of the TQDBT was to gather information about state of teaching biology in the senior high schools in the Cape Coast Metropolis. Section 1 had 8 items starting from 1 to 8 containing

background information of teachers including teachers' sex, age, professional qualification, rank, duration of teaching, how long teachers have taught biology, number of in-service training attended, area of specialisation and teachers' experience in a number of years of teaching.

Section 2 had 10 items from 9 to 18 on perceived difficult biology topics on a 4-point Likert scale. The instruments were ranked using 1 (very difficult), 2 (difficult), 3 (easy) and 4 (very easy). The purpose of the items in section 1 was used to determine the difficulties teachers teaching Biology encounter in teaching Biology students. This was used to collect data to answer research question 1 (see Appendix A).

Section 3 had 4 items from 19 to 22 and Section 4 had 1 item consisting of different teaching methods. These two sections of TQDBT were constructed using open-ended items. These items were on methods teachers used to teach Biology students and how students were assessed. It was used to collect data to help answer research questions 3 and 4 (see Appendix A).

**Reliability and validity of TQDBT:** In constructing the instrument, the difficult Biology topics were selected based on WAEC Chief Examiners' report (WAEC, 2006; 2007; 2008; 2009; 2011; 2012; 2013; 2015; 2016; 2017; 2018; 2019; 2020). Some Biology teachers teaching biology in senior high schools outside Cape Coast schools were contacted to suggest some biology topics they considered difficult to teach. This ensured that participants of the actual study did not have any idea about the questionnaires before administration. The topics were then put together for the construction of the instrument. To further ensure content validity, the literature consulted also

revealed some difficult biology topics which were added to the topics on the instrument.

The face validity was ensured by my experts' supervisors who have in-depth knowledge in the study. Final corrections were made based on the comments and suggestions passed by my supervisors before the instrument was pilot tested. Two schools outside Cape Coast Metropolis were selected for the pilot testing. This was done to make sure participants did not have foreknowledge about the questionnaires in the schools of the study. The reliability coefficient of TQDBT was committed to identifying the scale's internal consistency. Cronbach's alpha reliability coefficient was used to compute this, and the result was an alpha value of 0.8. According to a widely established guideline, an alpha value between 0.67 and 0.7 denotes a passable degree of reliability and one of 0.8 or more, a very good one. Acceptable Cronbach's alpha values range from 0.6 to 0.8. (Wim, Katrien, Patrick, & Patrick, 2008). This demonstrated the validity of the study's TQDBT instrument.

**Students' Questionnaire on Difficult Biology Topics [SQDBT]**

SQDBT constructed by the researcher, consisted of closed-ended items with two sections. The purpose of the SQDBT was to gather information about the state of learning Biology in the senior high schools in the Cape Coast Metropolis. Section 1 contained three items which were background information of students including sex, age, and type of school either females only or males only or coeducational schools. It was used to determine the average age of students who were the participants of the study.

Section 2 of the SQDBT contained 10 items from 4 to 13 perceived as difficult biology topics by students on a 4-point Likert scale. This section of the instruments was ranked using 1 (very difficult), 2 (difficult) 3 (easy) and 4 (very easy). The purpose of the items in section two was used to collect data on difficulties students encounter in learning some biology topics. It was used to collect data to answer research question 2 (see Appendix B).

**Reliability and validity of SQDBT:** In constructing the instrument, the difficult Biology topics were selected based on WAEC Chief Examiners' report (WAEC, 2006; 2007; 2008; 2009; 2011; 2012; 2013; 2015; 2016; 2017; 2018; 2019; 2020). I contacted some Biology students offering biology in senior high schools outside Cape Coast to give me some Biology topics they considered difficult to learn. The topics were then put together for the construction of the instrument. To further ensure content validity, the reviewed literature showed some difficult biology topics students find difficult to study which were added to the topics on the instrument.

The face validity was ensured by my experts' supervisors who have in-depth knowledge in the study. Final corrections were made based on the comments and suggestions passed by my supervisors before the instrument was pilot tested. Sixty students were selected from two schools outside Cape Coast Metropolis for the pilot testing. This was done to prevent students of the main study from having access to the questionnaires. The reliability coefficient of SQDBT was determined to find the internal consistency of the scale. This was calculated using Cronbach's alpha reliability coefficient which gave an alpha value of 0.7. As stated earlier a value of Cronbach's alpha

between 0.6 and 0.8 is acceptable (Wim, Katrien, Patrick, & Patrick, 2008). This indicated that the instrument SQDBT was reliable for the study.

**Observation Checklists on Biology Equipment [OCBE]**

The OCBE developed by the researcher, consisted of 24 items which were the teaching and learning resources for the laboratories and classrooms. The purpose was to establish how the biology classrooms/laboratories were furnished with standard equipment for an experiment, teaching, and learning. The items constructed were for how teachers made use of the resources and also to explain issues that needed more explanations for understanding.

Six columns created had headings such as equipment/material, number, present, absent, condition good and condition bad. The columns were ticked under the appropriate headings depending on the state and availability of the equipment. The instrument was used to collect data for research question 5 (see Appendix C).

**Reliability and validity of OCBE:** The content validity was ensured by my experts' supervisors who have in-depth knowledge in the study. To establish credibility, the laboratory resource materials were collected from all the six schools. I again crosschecked my items with what the laboratory assistants provided to be sure and followed it up to observe what resources the six schools have in their biology classrooms/laboratories.

**Observation Checklist on Classroom Practices [OCCP]**

The OCCP was developed by the researcher on classroom observation to find out the teaching and learning activities that occurred in the classroom. Five out of 28 teachers availed themselves to be observed. The observations were guided by a table with five columns. Titles for the columns were

teaching and learning activities always, most of the time, never and use of resources. The purpose was to compare the responses given by the teachers in TQDBT and what they did in the classroom (see Appendix D).

**Reliability and Validity of OCCP:** The content validity was ensured by my experts' supervisors who have in-depth knowledge in the study. To establish credibility, teachers' lesson plans were collected and observed. This was done to find out some of the teaching and learning activities written which were observed in the classroom. Some of the concerns raised by the teachers in the classrooms were more consistent across the majority of them. Field notes were taken on some activities that could not be captured on the checklists but teachers portrayed them.

**Teachers' Interview Guide [TIG]**

The TIG was a semi-structured interview guide developed by the researcher. The purpose of conducting the interview was to find the consistency in the teachers' responses in the teachers' questionnaire. Five teachers willingly accepted to be interviewed. There were four items on teaching methods from 1 to 4 on how important those methods were to the teachers, the importance of the methods to the students, whether there were any method/s apart from the methods used, and why those methods were not used (see Appendix E).

**Reliability and validity of TIG:** The content validity was ensured by my experts' supervisors who have in-depth knowledge in the study. To establish credibility, teachers' responses in the interview were cross-checked with the additional teaching method/s they used and the reason why some method/s were not used. The teacher's concerns raised were common and

consistent with all of them. Field notes were taken on some methods used which were not captured by teachers for discussion.

**Students' Interview Guide [SIG]**

The SIG was a semi-structured interview guide developed by the researcher. The purpose was to interview students to freely express themselves with regards to learning difficult Biology topics for a deeper understanding of the study. Twenty-four students willingly accepted to be interviewed. There were five items on the preferred subject area, perceptions about teaching Biology in their respective schools, listing difficult biology topics, difficulties encountered when Biology teachers were teaching, and their suggestions that could reduce their difficulties in teaching and learning Biology (see Appendix F).

**Reliability and Validity of Students' Interview Guide [SIG]:** The content validity was ensured by my experts' supervisors who have in-depth knowledge in the study. To establish the authenticity of the responses given by the students on the 4-point Likert scale, they were made to mention the difficult Biology topics again for confirmation. Students freely suggested what could be done to reduce the difficulties in teaching and learning some Biology topics so that their voices could be heard.

**Data Collection Procedures**

Before the quantitative strand phase of data collection, my Department gave me a letter of introduction to the selected schools. Familiarisation was done for the formal self-introduction of the researcher to the headmasters or headmistresses of the selected schools. The survey was done within two weeks moving from one school to other on different dates. The 28 selected teachers

were first to be given the TQDBT before 281 selected students were given SQDBT in all the six schools. Both the teachers and the students were assured of the confidentiality of their participation in the study and that no names were required on the questionnaires.

The teachers responded to the TQDBT on the same day but some could not finish and the collection was made the following day. The researcher was there to monitor the collection of students' SQDBT to clarify anything beyond the comprehension of the students on the spot. Data collected were coded and analysed to inform the qualitative strand which was the second stage.

**Qualitative Strand**

The qualitative strand which was the case study was completed in 4 weeks. Data were collected through observations, TIG, and SIG. The 5 teachers and 24 students from schools A and B who participated were purposively selected because they expressed interest in the observations and interviews. The interviews granted enabled the researcher to probe further issues as they emerged from the quantitative strand of the study. There was also an informal discussion with the teachers and the students after the observations and semi-structured interviews to tell where they were satisfied or otherwise. This was done by the use of researchers' field notes.

Schools A and B were visited on 4 different occasions and a total of five Biology teachers were observed by the researcher in their various classrooms teaching elective biology. Six elective Biology practical works were also observed in all the six schools for the study. Five teachers and 24 students availed themselves to be interviewed after the lessons. The interview data were all recorded by writing and the completion of the data collection

took 4 weeks because of changing schedules of the selected schools. Data was analysed based on the themes.

**Data Processing and Analysis**

The study used both quantitative and qualitative methods of data analysis. For the quantitative data of research questions 1 and 2, basic data checks were done to find out whether some could negatively affect the accuracy of the results. In preparing for coding, data were grouped and assigned values to responses from the survey. Responses were coded and ranked using 1 (very difficult), 2 (difficult), 3 (easy), and 4 (very easy). Descriptive statistics, such as frequencies, percentages means, standard deviations and inferential statistics were used for the analysis. The frequencies and the percentages were used to find the proportions of teachers and students who agreed or disagreed with the statements. Also, the calculated mean of less than 1.5 was interpreted as very difficult, greater than 1.5 and less than 2.5 as difficult, greater than 2.5 and less than 3.5 as easy, and greater than 3.5 as very easy. The average mean of 2 was interpreted as difficult and that of 3 was interpreted as easy.

Research questions 3 and 4 were analysed using frequency counts, percentages and bar charts, whilst frequencies and percentages were used to analysed research question 5. During the qualitative data of research questions 3, 4, and 5, I read the data collected severally to be familiar and looked for patterns. This helped to identify common concepts, common phrases and assign codes to themes. For the classroom observations and semi-structured interviews, open coding and constant comparison were done to arrive at the

themes for analysis. Themes were used to determine areas for more exploration and used narrative analyses and interpretations.

The research hypothesis was answered using an independent sample t-test to determine whether there was a difference in the perceived difficult elective Biology topics between experienced teachers who have taught from 1-5 years and teachers who have taught for more than 5 years on difficult Biology topics.

# CHAPTER FOUR

# RESULTS AND DISCUSSION

This chapter focuses on the results of the analyses of the data and discussion of findings from the TQDBT, SQDBT, OCBE, OCCP, TIG, and SIG enquiring into the state of elective biology teaching in some selected public SHSs in the Cape Coast Metropolis. These are presented with regards to research questions that were formulated to guide the study. The findings are reported for the quantitative and qualitative strands and how the qualitative data helps to understand the quantitative data in the whole process is emphasised.

## Biology Topics Perceived to be Difficult for Teachers Teaching Senior High School Biology to Teach

Research question 1(a) sought to find out the Biology topics which were perceived to be difficult to teach by the selected teachers. To achieve this, teachers' responses on Items 9 to 18 on TQDBT were used. The mean and percentage responses are presented in Table 1. The Table shows that generally, teachers teaching Biology in SHS in the sampled schools found it easy to teach Biology (M=3.0, SD=0.99). However, about 40% and above of teachers found 5 out of the 10 topics difficult or very difficult to teach. The topics were Genetics= (42.9%), Kreb's cycle= (53.6%), Hormones= (42.8%), DNA molecules= (46.5%) and Control and coordination= (53.6%).

**Table 1: Teachers' Responses on Difficult Biology Topics (N=28)**

| | Very Difficult | | Difficult | | Sub Total | | Easy | | Very easy | | Sub Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ITEM | N | % | n | % | n | % | n | % | n | % | n | % | M | SD |
| Genetics | 5 | 17.9 | 7 | 25.0 | 12 | 42.9 | 6 | 21.4 | 10 | 35.7 | 16 | 57.1 | 2.9 | 1.21 |
| Taxonomy of plants and animals | 2 | 7.1 | 5 | 17.9 | 7 | 25.0 | 5 | 17.9 | 16 | 57.1 | 21 | 75.0 | 3.3 | 1.06 |
| Photosynthesis | 1 | 3.6 | 10 | 35.6 | 11 | 39.2 | 5 | 17.9 | 12 | 42.9 | 17 | 60.8 | 3 | 0.98 |
| Life cycle of insects | 1 | 3.6 | 4 | 14.2 | 5 | 17.8 | 11 | 39.3 | 12 | 42.9 | 23 | 82.2 | 3.2 | 0.83 |
| Ecology | 1 | 3.6 | 6 | 21.4 | 7 | 25.0 | 12 | 42.9 | 9 | 32.1 | 21 | 75.0 | 3 | 0.84 |
| Kreb's cycle | 1 | 3.6 | 14 | 50.0 | 15 | 53.6 | 3 | 10.7 | 10 | 35.7 | 13 | 46.4 | 2.8 | 1.00 |
| Circulation of blood | 0 | 0 | 9 | 32.1 | 9 | 32.1 | 6 | 21.4 | 13 | 46.4 | 19 | 67.8 | 3.1 | 0.89 |
| Hormones | 1 | 3.6 | 11 | 39.2 | 12 | 42.8 | 4 | 14.3 | 12 | 42.9 | 16 | 57.2 | 3 | 1.00 |
| DNA molecules | 1 | 3.6 | 12 | 42.9 | 13 | 46.5 | 5 | 17.9 | 10 | 35.7 | 15 | 53.6 | 2.9 | 0.97 |
| Control and coordination | 3 | 10.7 | 12 | 42.9 | 15 | 53.6 | 2 | 7.1 | 11 | 39.3 | 13 | 46.4 | 2.8 | 1.11 |
| Average | | | | | | | | | | | | | 3.0 | 0.99 |

**Source:** Field data (Dadzie, 2020) maximum score=4; minimum score=1

More than one-half of the teachers (53.6%) reported finding it more difficult or difficult to teach Control and Coordination (M=2.8, SD=1.11) and Kreb's Cycle (M=2.8, SD=1.00). However, 75% or more of teachers found 3 of the topics very easy or easy to teach (Life cycle of insects = 82.2%, Taxonomy of plants and animals = 75.0%, and Ecology = 75.0%).

**Teaching Experience and Perceived Difficult Biology Topics**

The study also sought to find out whether teachers who have taught biology for not more than 5 years will perceive Biology topics as very difficult or difficult to teach as compared to teachers who have taught Biology for more than 5 years. Generally, Table 2 shows a very close average score between teachers who had taught for more than 5 years (M=3.1, SD = 0.96) and those who had taught for 5 years or less (M=2.9, SD =1.01), with teachers who had taught for more than 5 years being slightly higher. However, the details in Table 2 also show that about one-third or more of the teachers who had taught Biology for more than 5 years rather found 7 (Genetics, Taxonomy of plants and animals, Photosynthesis, Ecology, Krebs's Cycle, DNA Molecules, and Control and Coordination) out of the 10 topics more difficult to teach compared to about one-fifth of teachers who had taught for 5 years or less.

**Table 2: Teaching Experience and Perceived Difficult Biology Topics**

| | 1-5 years (N= 11) | | | | | | Above 5 years (N=17) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | VD/D | | VE/E | | | | VD/D | | VE/E | | | |
| ITEM | n | % | N | % | M | SD | n | % | n | % | M | SD |
| Genetics | 3 | 10.7 | 8 | 28.6 | 2.9 | 1.14 | 8 | 28.6 | 9 | 32.2 | 2.8 | 1.29 |
| Taxonomy of plants and animals | 2 | 7.2 | 9 | 32.1 | 3.4 | 1.02 | 5 | 17.9 | 12 | 42.8 | 3.3 | 1.11 |
| Photosynthesis | 3 | 10.7 | 8 | 28.6 | 3.3 | 1.1 | 8 | 28.6 | 9 | 32.2 | 2.8 | 0.88 |
| Life Cycle of insects | 5 | 17.9 | 6 | 21.5 | 2.7 | 1.01 | 0 | 0.0 | 17 | 60.7 | 3.5 | 0.51 |
| Ecology | 3 | 10.7 | 8 | 28.6 | 2.9 | 0.94 | 4 | 14.3 | 13 | 46.4 | 3.1 | 0.78 |
| Kreb's Cycle | 6 | 21.5 | 5 | 17.9 | 2.7 | 1.1 | 9 | 32.1 | 8 | 28.5 | 2.8 | 0.95 |
| Circulation of Blood | 5 | 17.9 | 6 | 21.4 | 2.8 | 0.87 | 4 | 14.3 | 13 | 46.4 | 3.4 | 0.86 |
| Hormones | 6 | 21.5 | 5 | 17.8 | 2.7 | 0.91 | 6 | 21.5 | 11 | 39.2 | 3.1 | 1.05 |
| DNA Molecules | 5 | 17.9 | 6 | 21.5 | 2.7 | 0.79 | 8 | 28.6 | 9 | 32.2 | 2.9 | 1.09 |
| Control and Coordination | 6 | 21.5 | 5 | 17.9 | 2.8 | 1.17 | 9 | 32.1 | 8 | 28.5 | 2.7 | 1.11 |
| Average | | | | | 2.9 | 1.01 | | | | | 3.1 | 0.96 |

**Source:** Field data (Dadzie, 2020) maximum score=4; minimum score=1

More than one-half of the teachers who had taught Biology for more than 5 years indicated that they found it difficult to teach Kreb's Cycle, and Control and Coordination whilst two out of five teachers who had taught Biology for less than 5 years found Genetics, DNA Molecules, Ecology, Photosynthesis, and Hormones difficult to teach.

However, 5 (17.9%) of teachers who had taught for 5 years or less found Life cycle of insects very difficult or difficult to teach compared with none (0%) from those who had taught for more than 5 years. All the 17 teachers who had taught for more than 5 years indicated that they found it easy to teach Life cycle of insects compared to 5 (17.9%) of teachers who had taught for less than 5 years. In the case of Circulation of blood 5 (17.9%) teachers who had taught for 5 years or less found it more difficult or difficult to teach compared with 4 (14.3%) of teachers who had taught for more than 5 years. There was virtually no difference between the two groups of teachers on the difficulty of teaching Hormones.

As can be seen from Table 2, while there is a difference in the mean scores of teachers who have taught biology for 5 years or more (M=3.1, S.D=0.98) and those who have taught Biology for 5 years or less (M=2.9, SD=1.01) but these results are not statistically significant. Therefore, from Table 3, no evidence was found of a mean score difference between teachers who have taught biology for 5 years or less and those who have taught biology for more than 5 years on their perceptions of difficult Biology topics (p=0.496, t=-0.553, df=26). However, the differences exist in terms of the proportion of teachers who found the Biology topics difficult as already indicated.

**Table 3: Independent-samples t-test Results on Teaching Experience and Perceived Difficult Biology Topics**

| Teaching Experience | N | Mean | SD | t | df | p |
|---|---|---|---|---|---|---|
| 1-5years | 11 | 2.9 | 0.48 | -0.553 | 26 | 0.496 |
| > 5years | 17 | 3.1 | 0.63 | | | |

Significant at $p < 0.05$

The results show that some Biology teachers have difficulty teaching some of the biology topics at the SHS level, especially those who were considered to be experienced teachers and have taught for more than 5 years. This resonates with what WAEC Chief Examiners have been reporting over the years. This study is also consistent with studies that have been conducted and reported on Biology topics and concepts that are perceived as difficult to teach (Bahar, Hansell & Johnstone, 1998; Lazarowitz & Penso, 1992; Seymour & Longdon, 1991; Tekkaya, Özkan & Sungur, 2001).

However, in this study, the majority of the Biology topics reported in WAEC Chief Examiner's WASSCE reports as difficult to teach and study, what some teachers teaching biology perceived as difficult topics and findings of this thesis confirms this. Biology topics such as genetics, Kreb's Cycle, Control and coordination, DNA molecules and hormones were reported constantly as very difficult to teach (Bahar, Johnstone & Hansell, 1999; Lazarowitz & Penso, 1992; Seymour & Longdon, 1991) were perceived by more than 40% of teachers as difficult to teach. The finding suggests that

teachers must update their knowledge on these topics and find more effective teaching strategies to teach these topics. If particular biology topics are difficult to teach by a good number of teachers, then it shows that not much is being done about it to change the situation.

It has been found out that experience in the number of years of teaching Biology does not seem to positively influence teachers' perception of Biology topics which they found to be difficult to teach. This finding is not in sink with that found by Ladd (2008) that teachers with more years of teaching experience were more competent than teachers who have the least number of teaching experience. Besides, the study is not consistent with the assertion by Ezendu and Utazi (2014) that teaching experience in years had a remarkable effect on teachers' competency level. The finding again did not corroborate with the study conducted by (Carter & Doyle, 1995; Gonzalez & Carter, 1996; Varrella, 2000) that it takes between four to seven years of experience for a teacher to become competent in teaching as teachers who have taught biology for not more than 5 years have not been able to master the topics they found difficult to teach over the years.

**Biology Topics which are Difficult for SHS Biology Students to Learn**

Research question 2 sought to find out the Biology topics students perceived to be difficult to learn in senior high school. To achieve this, students' responses on Items 4 to 13 on SQDBT were used. The topics used were those mentioned in the Chief Examiners' report as difficult for students to learn. The topics given to the students were the same topics given to teachers in research question one. The mean and percentage responses are presented in Table 4.

**Table 4: Students' Responses on Difficult Biology Topics (N=281)**

| | VD/D Sub Total | | VE/E Sub Total | | | |
|---|---|---|---|---|---|---|
| ITEM | n | % | n | % | M | SD |
| Genetics | 66 | 23.4 | 215 | 76.6 | 3.2 | 0.92 |
| Taxonomy of plants and animals | 86 | 30.6 | 195 | 69.4 | 3.1 | 0.98 |
| Photosynthesis | 48 | 17.1 | 233 | 82.9 | 3.3 | 0.77 |
| Life cycle of insects | 27 | 9.7 | 254 | 90.4 | 3.4 | 0.70 |
| Ecology | 22 | 7.9 | 259 | 92.2 | 3.4 | 0.65 |
| Kreb's cycle | 153 | 54.5 | 128 | 45.5 | 2.5 | 1.00 |
| Circulation of blood | 58 | 20.6 | 233 | 79.4 | 3.3 | 0.82 |
| Hormones | 104 | 37.0 | 177 | 63.0 | 3.0 | 0.90 |
| DNA molecules | 177 | 63.0 | 104 | 37.0 | 2.5 | 1.02 |
| Control and coordination | 114 | 40.5 | 167 | 59.7 | 2.9 | 0.95 |
| Average | | | | | 3.1 | 0.87 |

**Source:** Field data (Dadzie, 2020)

Table 4 shows that generally, majority of the students perceived 8 out of 10 Biology topics as very easy or easy to learn. More than one-half of the students perceived Kreb's Cycle (54.5%) and DNA molecules (63.0%) as very difficult or difficult to learn. What was very easy or easy to learn were Ecology (92.2%) and the Life cycle of insects (90.4%). Thus, students agreed with the teachers that Kreb's Cycle was very difficult or difficult. Also, about one-half of students and teachers perceived DNA molecules as difficult Biology topics to learn or teach.

However, students perceived Life cycles of insects (90.4%) and Ecology (92.2%) as very easy or easy to learn. Teachers also perceived these topics as very easy or easy to teach. More than two-thirds of teachers and two-thirds of students found Control and coordination very difficult or difficult to teach or

learn respectively. There were, therefore, some similarities between students' and teachers' perceptions of difficult topics.

Twenty-four SHS biology students were interviewed on the difficult Biology topics as perceived by the students as very difficult or difficult to learn. Using the students' Interview Guide (SIG)(Appendix F) students were asked about their preferred science area, how they perceived Biology teaching in their schools, difficulties encountered in understanding biology concepts, and what could be done to reduce the impact of difficulties students have identified.

Eight of the students offering biology were in the Vocational Skills programme in schools A and B. According to these students,

> "Because Biology or chemistry was compulsory for us, we have to choose one. Even Biology was forced on us when the teacher found out that our knowledge in chemistry was very weak." (Ama from School A and Akos from School B).

> "We do not do Biology practical work at all and we are about to go to form three without knowing anything in Biology." (students Ama and Akos, from Schools A and B respectively).

The finding here suggests that the Home Economics students' background of this study may be weak, thus contributing to their finding Biology very difficult or difficult to understand.

## Teaching Methods and Strategies used in Teaching Biology

Research question 3 sought to find out Biology teachers' responses to the methods or strategies they used in teaching Biology. To do this, teachers' responses on the TQDBT Section 4 item 23 were used. It required teachers to tick or indicate the method(s)/strategies they used in teaching Biology. The results on the frequency count and percentages of the number of ticks of each method are presented in Table 5

**Table 5: Methods Teachers Used in Biology Teaching (N=23)**

| Methods/Strategies | N | % |
|---|---|---|
| Lecture | 14 | 60.9 |
| Inquiry | 5 | 21.7 |
| Problem solving | 4 | 17.4 |

**Source:** Field data (Dadzie, 2020)

Table 5 shows the teaching methods used by the teachers in the sample for this study. The table shows that teachers teaching biology preferred the lecture method (60.9%) compared to the inquiry method (21.7%) and problem-solving (17.4%). Only 5 out of the 23 teachers who responded to the item indicated that they used the inquiry method to teach. The inquiry method enables students to be engaged and supported to learn science by doing (Keene & Zimmerman, 1997; Bullough & Gitlin, 2001).

## Other Methods/Strategies Teachers used in Biology Teaching

Table 6 shows other methods/strategies teachers teaching biology added to the methods already discussed. The table shows that teachers also

relied on the use of discussion (34.4%) and group presentation methods/strategies for teaching biology.

**Table 6: Additional Methods/Strategies Used in Biology Teaching (N=61)**

| Methods/Strategies | N | % |
|---|---|---|
| Discussion | 21 | 34.4 |
| Group presentation | 9 | 14.8 |
| Practical work | 6 | 9.8 |
| Discovery | 5 | 8.2 |
| Whole class | 3 | 4.9 |
| Hands-on activities | 3 | 4.9 |
| PowerPoint presentation | 3 | 4.9 |
| Activity-based | 3 | 4.9 |
| Peer teaching | 3 | 4.9 |
| Brainstorming | 2 | 3.3 |
| Co-operative | 1 | 1.6 |
| Learner activities | 1 | 1.6 |
| Delivery | 1 | 1.6 |

**Source:** Field data (Dadzie, 2020)

Table 6 also shows that teachers teaching Biology combined more than one teaching method/strategy to teach Biology.

The methods such as inquiry, discussion, and discovery may create avenues for students to learn effectively to improve their understanding of topics, especially those they find difficult to understand. For instance, the study's material, which mostly focuses on process techniques, is informed by the inquiry method on two different levels: first, the instructor models inquiry for students while also engaging in it herself or himself (Ancess, 2003; Lambert, 2003).

Classroom observation and interviews were carried out to obtain data to explain the results of the quantitative strand of the study concerning the

qualitative strand. The classroom observations were guided by (OCCP) observation checklists on classroom practices (see Appendix D). This was achieved using 9 items constructed by ticking if an activity occurred always, most of the time, never, as well as the use of resources. In schools A and B, none of the teachers introduced the lesson by asking thought provoking questions related to students' previous knowledge.

The lessons were mostly centered on the teachers and were not summarised at the end of the teaching. The resources for teaching and learning were not adequate but surprisingly the little available were not in full use. The teachers preferred doing whiteboard illustrations without referring to the resources available in the classroom. Except for teacher Ato from school A, the remaining four teachers wrote the topics on the board before introducing the lesson. Teacher 'Ato' who used a chart pasted it before the lesson began. Classroom observations were made to find out whether the teachers were using the teaching methods indicated.

The findings indicated that the elective Biology teachers' classroom teaching did not use inquiry-based and activity methods of teaching and learning. The quantitative results which showed that teachers used mostly lecture methods to teach were therefore true. According to the cognitive apprenticeship model (CAM), which states that students should be exposed to teaching methods that give them the chance to observe, participate in, invent, or discover expert strategies in context, the classroom observations also suggest that teachers were not instructing in accordance with this model (Berryman, 1991; Collins et al., 1991). According to the cognitive apprenticeship model, teachers should only coach, "offering hints, feedback,

and reminders; providing scaffolding support for students as they learn to carry out tasks; and fading gradually, handing over control of the learning process to the student." Teaching strategies should systematically encourage students to explore and be able to work independently (Berryman, 1991, p. 5). However, this did not occur in the four teachers' classrooms that were under observation.

The observations showed that students were largely inactive during the teaching and learning processes and that, teachers controlled what took place in the classrooms. This kind of instruction appears to be poor for increasing students' comprehension of scientific ideas and gives the erroneous impression of how scientific knowledge and understanding grow. The results are comparable to those of (Angell, Guttersrud, Henriksen & Isnes, 2004; Hackling, Goodrum & Rennie, 2001; Masika, 2011; Sunal, Sunal, Dantzler, Turner, Harell, Stephens & Aggarwal, 2015; Vosniadous, 2007).

The interviews that followed were guided by the teachers' interview guide (TIG). The items were on methods teachers used in teaching, its importance to teachers and students, whether there could be any other method(s) aside from what the teachers normally use, and why such methods were not used by the teacher (see Appendix E). Teachers interviewed seemed to know what methods they were to use in teaching but other compounding factors such as overloaded biology curriculum and the unavailability of resources to use other methods made them resort to methods that were easy or more convenient to use. This is supported by these excepts from teachers interviewed;

"I use lecture method and discussion method. These methods help me to cover more topics. Students cover a lot of topics in the syllabus. Field trip method is time-consuming and expensive." (Teacher Ato, school A)

"I use discussion method and discovery methods. These methods involve students in the teaching and learning process and it enhances understanding. The methods help students to understand whatever is being taught very well. Yes, the use of computer-assisted instruction to teach some challenging topics but lack of funds and it is time-consuming." (Teacher Kobina, school A).

Also, the interview revealed that some students perceive Biology as difficult because of how some teachers teach it. Students are not able to connect biology concepts to everyday life so questions involving reasoning and application are difficult for the students and this is attributed to the way lessons are delivered.

Even when there are teaching materials they are not adequate for the students to use. So instead of students performing hands-on activities, teachers resort to the use of demonstration methods to save time. This is exemplified by teacher Kwamina who said:

"the teaching and learning materials are not adequate for all students to use so most of the time demonstration is carried out by me and that might also be a contributory factor why students are having learning difficulties of the subject." (Teacher Kwamina, school B)

Four of the teachers stressed on lack of time, lack of teaching resources, and the numerical strength of the students as major factors contributing to why teaching practical activities were not used in teaching.

Even though, practical teaching methods such as guided discovery, group discussion, and demonstrations are effective in enhancing students' academic performance in science (Omwirhiren, 2002; Akinbobola, 2006), these were missing in teachers' classroom practices during the observations made in the course of this study.

**Time Factor**

The teachers mentioned the lack of time as one of the difficulties they encounter when teaching because it was not adequate for them to complete their lessons. Time is very important in teaching and learning because concepts need enough time to achieve the objectives set. Some teachers may need more time to teach difficult concepts, others may need lesser time to do the same thing but all in all it should help students to surmount their difficulties in learning. When they were to experiment with anything it was done hurriedly. From my observations of classroom teaching during this study, I observed that teaching and learning resources were rarely used in the classroom and laboratory by teachers and students. As stated by Teacher Coffey:

> "we could not make use of the resources because of the limited time and so the easiest way was to do illustrations on the whiteboard." (Teacher Coffey, School B)

This outcome of the study is supported by other studies (Reinaldo, 2014; Deshmukh, 2013) that time is not enough to complete the topics stipulated to be taught in the term to help students to achieve their target.

**Large Class Sizes**

The large number of elective biology students makes it difficult for teachers to give and mark adequate exercises promptly for discussions in the classroom. Naturally teachers give more exercises, more assignments and have to sit down and mark if the class size is not large. The teachers can attend to all the students and address the challenges they face in the classroom. The reverse were observed because the class size was very large such that teachers found it difficult to attend to individual problems, and were not able to give more exercises to address difficulties students encountered in learning. This confirms Nzabihimana's (2010) study that in assessing sizeable number of students will not enable teachers to pay attention to individual challenges.

Students also had something to say about the mode of teaching used by their biology teachers during interviews with a sample of 24 of the students from six schools. The issues that emerged during interview of students centered around teachers' teaching style, students' learning and studying habits, students' negative feelings towards the topic, lack of teaching and learning resources, and the nature of some topics. Student from school A 'Frema' said:

> the nature of the topic itself is my reason for my difficulty in learning Biology. Biology has a lot of concepts, some biological events cannot be practicalised and seen by the naked eye, some concepts are too abstract, and that there are a lot of

> Latin words difficult to memorise them. I struggle to learn biology because some of the textbooks do not have illustrations to be understood. Few examples are given so if you do not have other textbooks you cannot add to any of the examples so you only have to hold on the few examples in the textbook. (Ama, School A)

Five students from school B added to the problems with Biology topics and summarised by Akos, Kwansima, Frema and Amokoh:

> the nature of biology forces some of us to memorise biological facts to learn them. We don't do practical work at all because of lack of specimens but our lessons are also done in the Biology laboratory. (Akos, School B)

Thus, memorisation of learning strategy was common to many of the students interviewed. A few of the students said that:

> "teachers' lack of mastery in Biology teaching negatively affected their learning." (Kwansima, School B)

Some students reported that even though teaching of Biology was done in the laboratories they did not have adequate teaching and learning materials to carry out biology practical activities as they expected. According to the students,

> we could not conduct enough biological experiments in the laboratories. (Franca, School B)

> time for teaching biology was insufficient because Biology needs more time for both practical work and classroom activities. (Amokoh, School B)

All the 24 students interviewed indicated that they preferred more student-centered approaches tailored to their needs than the lecture methods and other methods used in teaching them. According to the students

> our interest in elective biology will be more enhanced if Biology lessons were designed to focus more on the students where practical questions were given them with time to discuss among themselves. (Franca, school B)

The students who were interviewed stated that they want instructional strategies that encouraged engagement. They demanded hands-on activities, more learner interactions, group discussions, and cooperative learning with some guidance from the teachers to boost their confidence in the learning of the subject. They further suggested that there should be enough provision for teaching and learning materials, introduction of videos and projectors for teaching, go for excursions to experience real-life situations. They also wanted better explanation of concepts for better understanding, and that there should be a reduction of the number of biology topics because it was too voluminous.

The responsibility lies with the teacher to create a hospitable atmosphere in their teaching that will provide more student participation to increase and sustains their interest in the subject. The observation was that creating a supportive environment for students to learn well involves listening to their thoughts about what they want to learn. Additionally, it has been found

by research studies by Darling-Hammond and Baratz-Snowden (2005) and Smart and Marshall (2012) that the type of classroom practices used by the teacher and, consequently, the learning experiences they afford, have a significant impact on the range of information and thinking skills that students may learn.

Students must be aided in learning through pedagogies emphasizing full interaction, group reflection, and the formation of consensus knowledge because how students interact in the classroom has a significant impact on their ability to learn (Conner, 2014b; Darling-Hammond & Baratz-Snowden, 2005; Smart & Marshall, 2012). Biology teachers need to tailor their teaching methods/strategies to suit the students understanding, focus more on the students, and measure their success based on students' academic performance.

Students therefore made the following suggestions as possible means of reducing the impact of difficulties they encounter in learning Biology.

i. They wanted a reduction in the number of topics to be learnt in the Biology syllables, there must be more excursions and regular practical work.

ii. More practical work so that we will not be afraid during WASSCE, and some of our apparatus must be replaced.

iii. Because of the large population of Biology students, practical activities in the Biology laboratories must be done frequently so that every student will have enough practical work experience before the term comes to a close.

iv. The use of multimedia in teaching such as projectors to display images of what is being taught and more excursions to see real things.

v. Teachers should allocate enough time for Biology practical work than concentrating more on the theory.

**How Students are Assessed in Biology Lessons**

Research question 4 sought to find out how Biology students were assessed. To do this, the teacher's responses on the TQDBT section 3 items 19 to 22 were used (see Appendix A). The results on the frequency count and percentages on profile dimensions considered are presented in Figure 2.

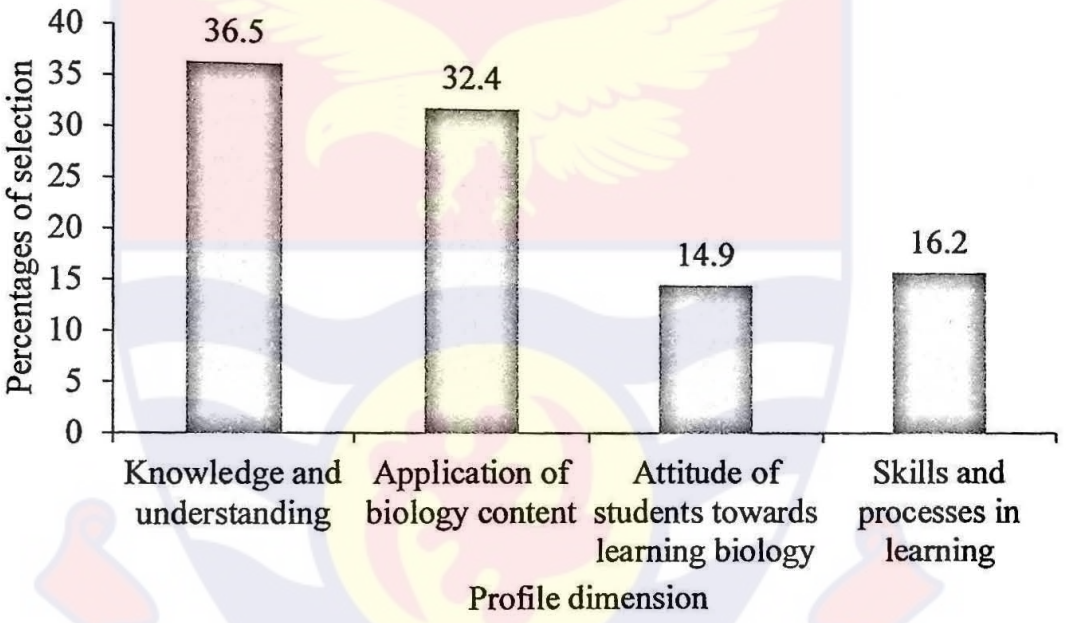


*Figure 2*: Profile dimensions considered by teachers for assessing biology *students (N = 74).*

**Source:** Field data (Dadzie, 2020)

As can be seen in Figure 2, out of the four areas of profile dimensions that guided teaching and assessment of students, majority of the teachers most of the time assessed students on knowledge and understanding of biology content, and application of knowledge. About 12 (16.2%) assessed biology students on skills and processes in learning. Only 11 (14.9%) of teachers indicated that they assessed the attitude of students towards learning biology.

For teaching, learning, and testing in Biology, the three profile dimensions that have been established are: knowledge and comprehension (30%), application of knowledge (40%) and practical and experimental skills (30%). The results show that teachers were applying knowledge and understanding in their teaching per the standard set. But application of knowledge and skills fell short with 32.4% and 16.2% respectively instead of 40% and 30%.

**Number of Times Students were Assessed**

The total number of times Biology teachers assessed Biology students in a week, month, at the end of the term, and after each topic were computed in percentages. The results are presented in Figure 3.

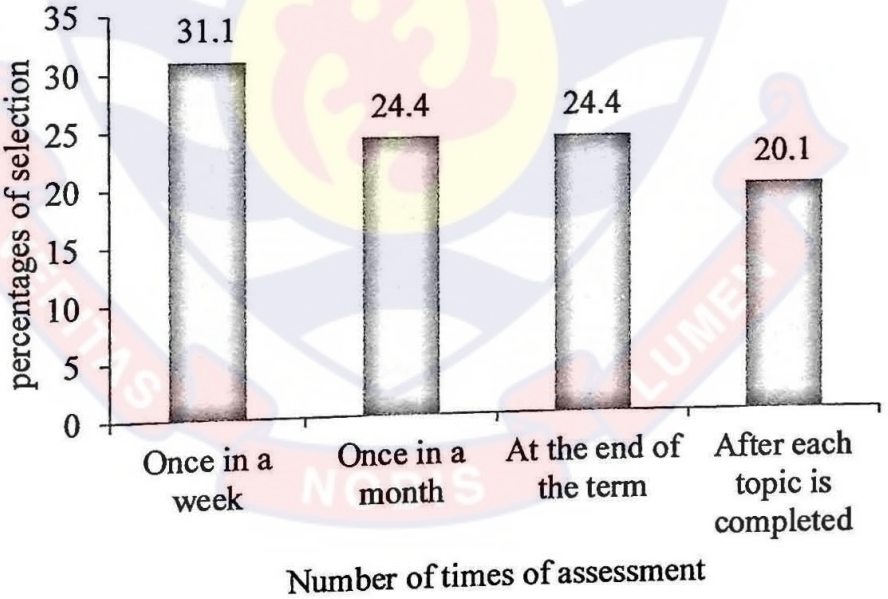


*Figure 3*: Number of times Teachers Assessed Students (N = 45).

**Source:** Field data (Dadzie, 2020)

Figure 3 shows that one out of three teachers indicated they assessed their students once a week. This means that sometimes the topic of study is not completed before the assessment is done.

## Modes of Assessment

Teachers' modes of assessing students are presented in percentages as seen in Figure 4. From Figure 4, it can be seen that generally, teachers used various modes of assessment to assess students' learning. Written tests, practical work, and assignment/project work constituted about two-thirds of students' assessments. Quizzes seem not to be popular in Ghanaian SHS and constituted only 8.8%.

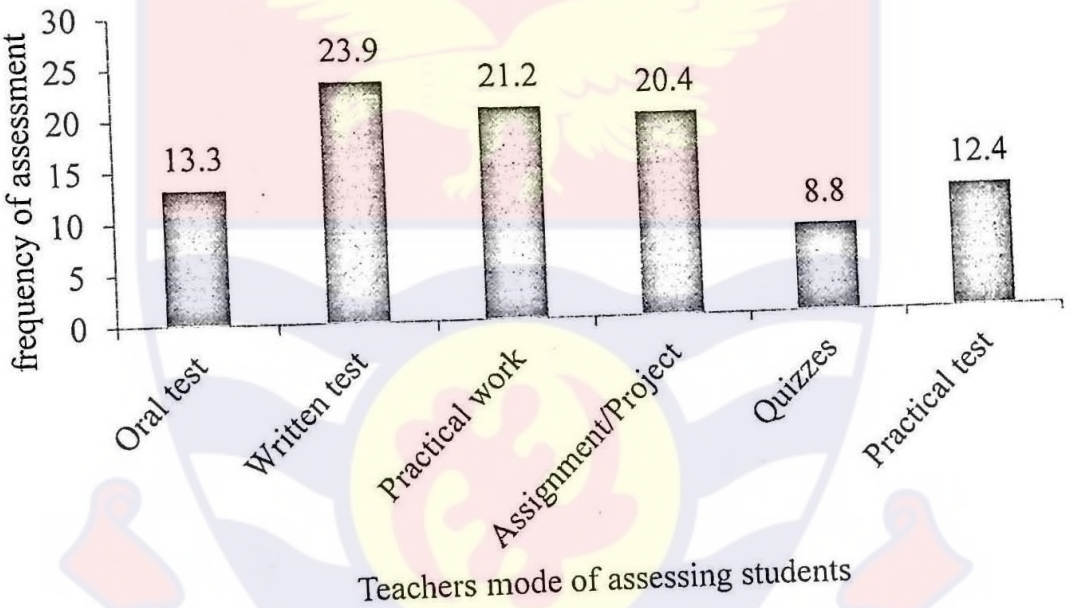


*Figure 4*: Teachers' Mode of Assessing Students (N = 113).

**Source:** Field data (Dadzie, 2020)

**Marking of students' Work and Feedback by Teachers**

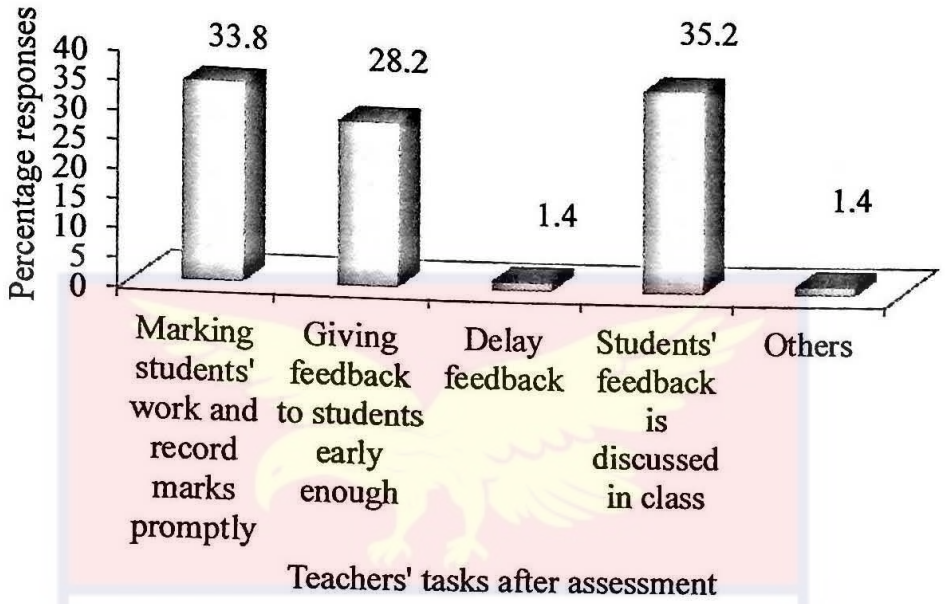


*Figure 5*: Teachers' Tasks on Students' Assessment (N = 71)

**Source:** Field data (Dadzie, 2020)

Figure 5 shows what the teachers do after the students have completed a class or laboratory task such as marking students' work and recording marks promptly, giving feedback to students early enough, delaying feedback, and students' feedback was discussed in the classroom. This suggests that students are given feedback after teaching to determine the students' strengths and weaknesses in learning. The finding is consistent with Hirvonen and Viiri (2000) study which reported that students become more motivated, and teachers are given the chance to assess their students' understanding. This generates diagnostic information that will enhance students' learning, aids instructional planning by giving teachers well-informed feedback, helps to determine the efficacy of approaches and methods, and functions as a medium for communication. Students are made aware of the desired learning

outcomes, the type of performance required to succeed, and the areas in which additional effort is required through the feedback (Elliot, 2000).

Figure 5 shows teachers indicated they used marked scripts of students and gave feedback to them. Figure 5 shows that students were given feedback by the teachers 25 (35.2%) and feedback was discussed in class after marking of students' work and recording of marks done 24 (33.8).

As seen in Figure 5, the teachers were required to indicate as many modes of assessments they used. The mode of assessments was indicated by the teachers as an oral test, written test, practical work, assignments/projects, quizzes, and practical work. This suggests that individual student needs are taken into consideration with regards to the mode of assessments. In learning some students may be good orally, some may be good in writing, others may be good when given some assignments, project work, and practical work and the rest may perform very well in quizzes.

Students are assessed by teachers to find out the progress they have made in learning to help the teacher to offer necessary assistance when needed. The emphasis on written test suggests that teachers might have acquired skills in putting the items together to assess students' academic performance.

Formative assessment in the classroom which allows provision of feedback to let the students be aware of how well they are performing was included in the teachers' assessment. The finding is consistent with Black (1998) study which stated that the purpose of formative assessment is to provide the teacher with accurate feedback on the teaching and learning processes. Formative assessment findings educate the teacher on the academic

accomplishment capabilities of the students, and the teacher uses the information to change his or her teaching (Atkin et al., 2001; Darling-Hammond & Baratz-Snowden, 2005; Shepardson & Britsch, 2001).

In the classroom practices, the idea is that teachers are supposed to use all the assessments techniques but my observations in the classroom revealed that teachers were mostly using summative assessment even when the intention was to diagnose students' difficulties to address them. The focus, however, seems to be on completing the curriculum. This was summarised by a teacher as follows:

"I have to use an assessment that will help me to finish my syllabus in time." (Kwamina, School B)

Findings from the interviews concerning assessments suggest that the teachers were always under pressure to complete assessment tasks hence resorting to only summative assessment. Teachers' assessment practices were geared more towards assessment of learning rather than the assessment for learning contrary to what they indicated on the questionnaire. All the four teachers interviewed affirmed using only an assessment system for elective Biology that will enable them to finish the syllabus on time. As claimed by Teacher B;

"So if we are to use all the types of assessment could waste our time," (Kobina, School A)

Teachers suggested some ways that might help improve the quality of Biology teaching. One of the ways suggested was to reduce the curriculum content and assessment requirements. This was clearly shown earlier that the subject content load and assessment practices seem to have taken up most of

the time that could have been used to prepare lessons to improve students' performance. Additionally, the majority of the teachers suggested that Biology teaching is more practical oriented therefore, the number of times for practical work on teaching time table must be increased. Furthermore, teachers suggested that some teaching and learning resources/equipment for teaching and learning biology must be brought in every year to replace resources/equipment that may be found in bad condition.

**Availability of Teaching Resources for Teaching Biology**

Research question 5 sought to find out the teaching and learning resources that were available and seen in the classrooms/laboratory to support Biology teaching and learning. This was done by the use of checklists (OCBE) containing basic items required by the schools for teaching and learning (see Appendix C). The results in percentages are presented in Table 7

**Table 7: Resources that are Available for Biology Teaching (N=397)**

| Equipment | Total | Good Condition | | Bad Condition | |
|---|---|---|---|---|---|
| | | n | % | n | % |
| Magnifying glass | 33 | 30 | 90.9 | 3 | 9.1 |
| Microscope | 5 | 5 | 100 | 0 | 0.0 |
| Dissection kit | 12 | 12 | 100 | 0 | 0.0 |
| Preserved specimen | 9 | 9 | 100 | 0 | 0.0 |
| Bunsen Burners | 25 | 20 | 80.0 | 5 | 20.0 |
| Models | 5 | 5 | 100 | 0 | 0.0 |
| First Aid kit | 13 | 13 | 100 | 0 | 0.0 |
| Apron | 10 | 8 | 80.0 | 2 | 20.0 |
| Wash bottles | 50 | 45 | 90.0 | 5 | 10.0 |
| Forceps | 40 | 40 | 100 | 0 | 0.0 |
| Glass culture tube | 18 | 10 | 55.6 | 8 | 44.4 |
| Stirring rods | 18 | 18 | 100 | 0 | 0.0 |
| Chart and posters | 15 | 10 | 66.7 | 5 | 33.3 |
| Test tube holders | 20 | 20 | 100 | 0 | 0.0 |
| Weighing balances | 3 | 3 | 100 | 0 | 0.0 |
| Beaker tongs | 4 | 4 | 100 | 0 | 0.0 |
| Crucibles | 9 | 9 | 100 | 0 | 0.0 |

**Table 7 Continued**

| | | | | | |
|---|---|---|---|---|---|
| Litmus papers | 9 | 9 | 100 | 0 | 0.0 |
| Thermometers | 3 | 3 | 100 | 0 | 0.0 |
| Graduated cylinders | 30 | 30 | 100 | 0 | 0.0 |
| Incubators | 0 | 0 | 0.00 | 0 | 0.0 |
| Reagents | 20 | 20 | 100 | 0 | 0.0 |
| Test tube rack | 24 | 24 | 100 | 0 | 0.0 |
| Computers | 30 | 25 | 83.3 | 5 | 16.7 |
| Textbooks | 25 | 25 | 100 | 0 | 0.0 |

**Source:** Field data (Dadzie, 2020)

From Table 7, it can be seen that all the equipment listed on the checklists were present except incubators which were absent. Not all 6 schools could provide some of the teaching and learning resources. For example, the magnifying glass found in schools A and B were 33 in total. Out of the number, 30 (90.9%) were in good condition and 3 (9.1%) were in bad condition. However, schools C, D, E, and F could not provide magnifying glasses. Therefore, magnifying glasses were virtually unavailable in those schools to support teaching and learning. My observation in the schools confirmed that only two schools had a total of 33 magnifying glasses. This confirmed what the teachers had indicated on the questionnaire.

Classroom and laboratory observations were made purposely to confirm or disconfirm the resources present and in good conditions or bad conditions and teachers incorporate the available resources in the teaching and learning. A classroom/laboratory observational checklist (OCBE) was

developed to be sure of the Biology classroom/laboratory practice including the resource materials available to both the teachers and the students. The classroom practice dealt with teachers' pedagogical content knowledge and the use of the available teaching and learning resources. The five teachers who were involved in the observation were asked to make a self-reflection note to see whether the teachers' observations corresponded with their notes to reconcile the differences.

Observation in the schools also shows that five schools (A, B, C, E, F) had 5 microscopes which were all in good condition. School D did not provide any microscope. However, only one microscope per school was highly inadequate to support teaching and learning. Aside from the microscopes which were in good condition and seen in the five schools, there were many microscopes that did not have lenses and so could not be used by the teachers and students.

Twelve dissection kits were found in all the five schools and all the kits were in good condition but the number of microscopes that were not in good condition could not be counted.

Observation made also showed that many of the items in the dissection kit could not be seen. The teachers said that "anytime the kits were used by the students some of the items could not be traced" (Coffey, school B). Because of that some were packed under lock and could not be opened to be counted.

For preserved specimens, there was a total of 9 in all the schools and they were found to be in good condition. Laboratory observation revealed that preserved specimens were in good condition and displayed on the shelves. Four of the teachers agreed that "lack of formalin solution (a chemical used

for preservation) has made it difficult for preserving more specimens for Biology practical work" (Kwamina, School B)

There were 25 Bunsen burners in all the schools with 20 (80%) in good condition whilst 5 (20%) were found to be in bad condition. This indicates that the schools had Bunsen burners for practicals when it comes to heating and boiling water. Hence, the Bunsen burners were inadequate when the practical work involved heating with regards to the population of Biology students. Observation showed that there were some gas leakages on the burners so some were discarded and were not counted at all by the teachers.

Models 5 (100%) were found in only school F and they were in good condition but rarely used by the teachers. Models were not found in the other 5 schools. Therefore, models for teaching and learning Biology were woefully inadequate. The teachers in schools C and E did not indicate the presence of models. Surprisingly, observations at these schools had more models than school F which indicated five. The reason given was that they recently saw that the models were kept in the box. This suggests that the two schools did not use models to teach and that they did not keep proper records of equipment given to the school.

From the questionnaire in 13 classrooms and laboratories, first aid kits were available in all the schools and were in good condition. This indicates that first aid kits were present in the schools. Hence, first aid kids were present in all six schools. Observation in the schools confirmed the presence of first aid kits in all six schools as indicated. Out of 10 aprons, 8 (80%) were in good. Inspection in the schools also shows that the aprons were available. School observation showed that there were more than 10 aprons. When I found out

from schools B and C, the response was that the aprons in the box were for the students that was why the number was not declared.

Even though some of the equipment were in bad condition, Table 7 shows that quite a number of them were in good condition.

The teaching and learning resources have been found to play an important role in teaching and learning. It helps both teachers and students to realise set objectives in practical work or demonstrations for a deeper understanding of concepts. Therefore, if the teaching and learning resources are not adequate then students will be left out in terms of use of equipment.

Lack of teaching and learning resources may affect the practical application of the knowledge acquired. This has been put forward by the research study by Gbamanja (2002) that the use of materials in teaching could make learning more practical, applicable and meaningful. At least, the basic teaching and learning resources for teaching Biology in senior high school must be provided. This should be for all schools offering Biology to make it easier for teaching and learning.

Much concentration was on how teachers' incorporated the use of teaching and learning resources in their lessons. How the introduction was made, teacher presentation of new materials on the chalkboard, teachers engagement with students in learning activities, the use of resources related to the activities in the teaching and learning, and summary of lessons. The eight sub-scales were used to observed teachers' lessons (see Appendix D).

Findings from the classroom observations showed that topics were written on the board before the introduction, lessons were mostly teacher-centred, only a few students were made to participate in the activities due to an

inadequate number of teaching resources. Even then, teachers sometimes did not use the scanty teaching resources at all.

The findings again suggest that the teachers' attention must be focused on the students with the use of teaching and learning resources so that they can freely interact among themselves to enhance teaching on the part of the teacher and learning on the part of the students. This suggests that, if the teaching resources are inadequate it may be difficult for the teachers to attain the set objectives on skills acquisition.

The findings in this study suggest that the manipulations of both laboratory and classroom apparatus (resources) to develop skills should be done by each student if it means doing it in batches to avoid skills sharing. The activities that students engage in the science laboratories should foster an environment that encourages them to gather their wits and reveal their latent skills. It should be a setting where students are free to hone their fundamental scientific abilities, including manipulative, observational, sketching, and reasoning abilities.

Therefore, the inadequate number of equipment in the school laboratory may not allow students to feel and have direct contact with and handle science apparatus and objects physically. Experimental evidence may be absent for students to exhibit or portray their competencies in basic scientific skills. Because the laboratory tasks are designed by the teachers, they determine the skills that are to be exhibited by the students. Therefore, teachers should have in-depth knowledge on how the tasks are designed. For this reason, the classroom/laboratory must be fully resourced so that teaching

and learning that require resources and scientific equipment could not be compromised.

Twenty-four SHS biology students were interviewed on the perceived very difficult or difficult biology topics to learn. Using the students' Interview Guide (SIG)(Appendix F) students were asked about their preferred science area, how they perceived Biology teaching in their schools, difficulties encountered in understanding Biology concepts, and what could be done to reduce the impact of difficulties students have identified.

Eight of the students offering biology were in the Vocational Skills programme in schools A and B. According to these students,

> "Because Biology or chemistry was compulsory for us, we have to choose one. Even Biology was forced on us when the teacher found out that our knowledge in chemistry was very weak." (Kwansima, school B).

> "We do not do Biology practical work at all and we are about to go to form three without knowing anything in Biology." (Akos, School B)

The finding here suggest that the Home Economics students' background may be weak, thus contributing to their finding biology very difficult or difficult to understand.

Again, some issues emerged during interview of students: teachers' style of teaching the subject, students' learning and studying habits, students' negative feelings towards the topic, inadequate teaching and learning resources, and the nature of some topics. Students from (school A) said

> "the nature of the topic itself is my reason for my difficulty in learning biology. Biology has a lot of concepts, a lot of activities, some biological events cannot be practicalised and experienced, some concepts are too abstract, and that there are a lot of Latin words difficult to memorize them. I struggle to learn Biology because some of the textbooks do not have illustrations to be understood. Few examples are given so if you do not have other textbooks you cannot add to any of the examples so you only have to hold on the few examples in the textbook." (Enu, School A)

Five students from school B added to the problems with biology topics and summarised by Amokoh:

> "the nature of Biology forces some of us to memorize biological facts to learn them. We don't do practical work at all because of lack of specimens but our lessons are also done in the Biology laboratory." (Ama, School A)

Thus memorisation of learning strategy was common to many of the students interviewed.

A few of the students said that

> "teachers' lack of mastery in Biology teaching negatively affected their learning." (Franca, School B)

Some students reported that even though teaching of biology was done in the laboratories they did not have adequate teaching and learning materials to

carry out Biology practical activities as they expected. According to the students,

> "we could not conduct enough biological experiments in the laboratories." (Enu, school A)

> "time for teaching Biology was insufficient because Biology needs more time for both practical work and classroom activities." (Frema, School A)

All the 24 students interviewed indicated that they preferred more student-centred approaches geared towards their needs than the lecture methods and other methods used in teaching them. According to the students

> "our interest in elective Biology will be more enhanced if Biology lessons were designed to focus more on the students where practical questions were given them with time to discuss among themselves." (Ama, School A)

The students who were interviewed indicated that they wanted teaching methods that sustains interest and supported active participation. They called for cooperative learning, more learner activities, discussions among themselves, and hands-on activities with some guidance from the teachers to boost their confidence in the learning of the subject. They further suggested that there should be enough provision for teaching and learning materials, introduction of videos and projectors for teaching, go for excursions

to experience real-life situations. They also wanted better explanation of concepts for better understanding, and that there should be a reduction of the number of elective biology topics because it was too much for learning.

# CHAPTER FIVE

# SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents a summary, conclusions drawn based on the findings and some recommendations for further research.

## Summary

The study's purpose was to find out the state of Biology teaching in SHS of the Cape Coast Metropolis. This included the challenges that both teachers and students had while attempting to teach and master specific biological topics. The research was directed by one hypothesis and five research questions. The data for the study were gathered using a mixed-methods sequential explanatory design approach. The investigation was carried out in the Central Region's Cape Coast Metropolis. The participants were chosen using a multistage sampling procedure for the first portion of the quantitative strand. Two schools (A and B) were simply chosen at random from the pool of six schools for the qualitative strand's semi-structured interviews and classroom observations. Selective sample through the use of purposive sampling was used to select the teachers. Twenty-eight teachers and 281 students participated in the study.

Six research instruments were used to collect data for the study. The research instruments that were developed for the research were a teacher questionnaire on some difficult biology topics [TQDBT], a students' questionnaire on some difficult biology topics [SQDBT], an observation checklist on biology equipment [OCBE] and an observation checklist on classroom practices [OCCP]. The TQDBT, SQDBT, and OCBE were the instruments used to collect the quantitative data of teachers and the students

respectively. The qualitative data was collected by the use of OCCP, TIG, and SIG instruments.

The research instruments TQDBT and SQDBT for the data collection on research questions 1 and 2 were analysed using descriptive statistics, such as frequencies, percentages, means, standard deviations and inferential statistics. Data collected on research questions 3 and 4 were analysed by the use of frequency counts, percentages and bar charts. For data collected on research question 5, analyses were done in frequencies and percentages. The qualitative instruments OCCP, TIG and SIG were used to collect data to explain and expand issues as well as validate some of the findings from the questionnaires.

**Key Findings**

1. (a) Generally, SHS Biology teachers in the sampled schools found it easy to teach biology (M=3.0, SD=0.99). However, about 40% and above of teachers found 5 out of the 10 topics difficult or very difficult to teach. Genetics= (42.9%), Kreb's cycle= (53.6%), Hormones= (42.8%), DNA molecules= (46.5%) and Control and coordination= (53.6%).

(b)(i) There was a difference in the mean scores of teachers who have taught Biology for 5 years or more (M=3.1, S.D=0.98) and those who have taught Biology for 5 years or less (M=2.9, SD=1.01). However, there was no evidence of a mean score difference between teachers who have taught Biology for 5 years or less and those who have taught biology for more than 5 years on their perceptions of difficult biology topics (p=0.496, t=-0.553, df=26).

(ii) About one-third or more teachers who had taught Biology for more than 5 years rather found 7 (Genetics, Taxonomy of plants and animals, Photosynthesis, Ecology, Krebs's cycle, DNA molecules, and Control and coordination) out of the 10 topics more difficult to teach compared to about one-fifth of teachers who had taught for 5 years or less.

2. (a) Generally, majority of the students perceived 8 out 10 Biology topics very easy or easy to learn. More than one-half of the students perceived Kreb's cycle (54.5%) and DNA molecules (63.0%) as very difficult or difficult to learn. What was very easy or easy to learn were Ecology (92.2%) and the Life cycle of insects (90.4%).

3. (i) Teachers teaching Biology preferred the lecture method (60.9%) compared to the inquiry method (21.7%) and problem-solving (17.4%). They also relied on the use of discussion and group presentation methods/strategies for teaching biology. (ii) Teachers also relied on the use of discussion (34.4%) and group presentation methods/strategies for teaching biology. Teachers' methods of teaching did not reflect inquiry-based and activity methods as suggested by the biology curriculum. Teachers attributed this to large class sizes, overloaded curriculum and inadequate time to complete the curriculum.

4. Out of the four areas of profile dimensions that guided teaching and assessment of students, teachers most of the time assessed students on knowledge and understanding of Biology content 27 (36.5%) and application of knowledge 24 (32.4%). About 12 (16.2%) assessed biology students on skill and processes in learning. Only 11 (14.9%) of teachers indicated that they assessed the attitude of students towards learning

Biology. Quizzes seem not to be popular in Ghanaian SHS and constituted only 8.8% of teachers who used it.

5. All the teaching and learning resources found in the checklists were present and many were in good condition but were inadequate. Incubators were the only resource/equipment which was absent.

## Conclusion

This study investigated state of biology teaching in public senior high schools in the Cape Coast Metropolis. The study sought insight into the difficulties both biology teachers and students encounter in teaching and learning some Biology topics respectively, the teachers' teaching experience in the number of years of teaching, teaching methodologies employed, how biology students are assessed in the classroom and teaching and learning resources available in the classroom/laboratory.

The findings of this study were that quite a high proportion of Biology teachers and students perceived many of the Biology topics to be difficult to teach or learn respectively. It also shows the lack of appropriate workshops to help teachers upgrade their knowledge and skills in teaching Biology to the point where many topics in Biology were found to be difficult to teach by both experienced teachers who had taught for more than five years and those who have taught for less than five years. The use of the lecture method (60.9%) compared to the inquiry method (21.7%) and problem-solving (17.4%) as the preferred method of teaching Biology is attributed in part to the rush to complete the curriculum, bypass practical activities (as facilities and equipment are not adequate or non-existent) could account in part for students weak performance.

Even though these findings have been reported by other researchers, the findings of this study show that despite efforts made by the Government of Ghana through the Ministry of Education to revamp all the Science Resource Centres (SRCs) to play a critical role in the teaching and learning of science particularly, in supplementing the activities of satellite and less-endowed schools, state of biology teaching and learning in the Cape Coast Metropolis is not what is expected. Equipment and facilities in both SRC and satellite schools were not only insufficient but sometimes unavailable. The students said they did not have a chance to use the resources for learning in both the classrooms and laboratories because the resources were limited in supply or not available. However, when they were available teaching and learning resources were sometimes not used by the teachers when they were observed in the classroom/laboratory teaching. Biology teachers rather resorted to methods of teaching that did not reflect inquiry-based and activity methods as suggested by the biology curriculum. Teachers attributed this to large class sizes, overloaded curriculum and inadequate time to complete the curriculum. It is therefore not surprising that Chief Examiners' reports on Biology for the years 2006 up to 2020 have revealed that the majority of senior high school Biology students perform poorly in WASSCE Biology papers (WAEC, 2006; 2007; 2008; 2009; 2011; 2012; 2013; 2015; 2016; 2017; 2018; 2019; & 2020). The finding in this study that teachers found 7 (Genetics, Taxonomy of plants and animals, Photosynthesis, Ecology, Krebs's Cycle, DNA molecules, and Control and coordination) out of the 10 topics very difficult or difficult to teach resonate with topics reported in the Chief Examiner's reports (WASSCE, 2006; 2007; 2008; 2009; 2011; 2012; 2013; 2015; 2016; 2017; 2018; 2019;

2020). It is therefore not surprising that over the years the trend of weak passes (D7, E8, F9) in elective Biology has been ranging from 30% to 40% or more.

## Recommendations

These recommendations are made from the findings of this study as follows:

1. Since the majority of the Biology teachers found 7 out of 10 Biology topics as difficult or very difficult to teach, the Ghana Education Service should organise frequent refresher courses for Biology teachers to update their knowledge on new strategies for teaching difficult biology topics.
2. Since some students found some of the topics difficult or very difficult to learn, Biology teachers should use student-centred approaches in teaching biology. The concepts that are to be learned must be related to things that students can experience in everyday life to make them easy to learn. The use of videos for teaching Biology can aid students.
3. The Ministry of Education and the Ghana Education Service must improve the state of school laboratories in order to make them more meaningful and interesting to the students.

## Suggestions for Further Study

1. The teachers who participated in the study indicated that some Biology topics were difficult or very difficult to teach especially teachers who have taught for more than 5 years. The sample size of teachers was too small and hence the generalisation was limited. A future study could use larger samples in order to generalise to a wider population of Biology teachers.

2. Students' perceptions on the Biology topics were not different from teachers. It is my suggestion that future research should be conducted using written tests for students to find out the nature of the difficulties and how to address them.

3. The study investigated the presence or absence of resources/equipment and their condition. The study did not investigate how teachers used these resources in teaching. It is therefore suggested that a study could be conducted to find out how Biology teachers make effective use of inadequate resources in their teaching and learning of biology in senior high school.

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# APPENDICES

# APPENDIX A

## TEACHERS' QUESTIONNAIRE

The purpose of this questionnaire is gathering information on the state of Biology teaching in public Senior High Schools in the Cape Coast Metropolis of Ghana. Your response to the items will positively enhance the success of this research work. Information from this questionnaire would be treated confidentially. Thank you for your cooperation/attention.

**Direction**: Please thick [√] in the box, **circle** options, or **provide** your own response where appropriate.

**SECTION 1: Background Information of Respondent**

1. Sex:
   Male [ ] Female [ ]
2. Age:
   21-30 [ ] 31-10 [ ] 41-50 [ ] 51-60 [ ]
3. Qualification:
   First Degree [ ] Second Degree [ ]
   Third Degree [ ] Any other Degree [ ]
4. What is your rank?
5. How long have you been teaching?
6. How long have you been teaching elective Biology?
7. Have you ever attended In-Service Training for elective Biology?
   Yes [ ]
   No [ ]
   If yes, state the number of years in teaching elective Biology
   1-5 years [ ] 6-10 years [ ] 11-15 years [ ] 16-20 [ ]
   21 years – above [ ]
8. Area of Specialisation:
   .....
   .....
   .....

**SECTION 2: Difficult Biology Topics perceived by Teachers Teaching Biology**

Examine these topics and tick the box to show its teaching difficulty

| BIOLOGY TOPIC | VERY DIFFICULT TO TEACH | DIFFICULT TO TEACH | EASY TO TEACH | VERY EASY TO TEACH |
|---|---|---|---|---|
| 9. Genetics | | | | |
| 10. Taxonomy of plants and animals | | | | |
| 11. Photosynthesis | | | | |
| 12. Ecology | | | | |
| 13. Life cycle of insects | | | | |
| 14. Kreb's cycle | | | | |
| 15. Circulation of blood | | | | |
| 16. Hormones | | | | |
| 17.DNA molecules | | | | |
| 18.Control and co-ordination | | | | |

## SECTION 3: Assessment in Biology

Under each question you may select one or more items that suit your assessment practices in teaching Biology.

19. What do you assess?

a. Knowledge and understanding of Biology content

b. Application of Biology content and concepts

c. Attitude of students towards learning Biology

d. Skills and processes in learning Biology

e. Specify others

4. How many times are student's assessed in your Biology lessons?

a. Once in a week

b. Once in a month

c. At the end of the term

d. After each topic is completed

e. Specify others

5. How do you assess?

a. Oral tests

b. Written test

c. Practical work

d. Assignment/Projects

e. Quizzes

f. Practical test

g. Specify others

6. How do students appreciate their performance in the classroom?

a. Marking students work and record marks promptly

b. Giving feedback to students early enough

c. Delay feedback

d. Students feedback is discussed in class

e. State any other .....

**SECTION 4: Teachers' Methods of Teaching**

7. What methods do you use in teaching Biology to your students?

Choose as many as apply

a. Demonstration

b. Inquiry

c. Laboratory work

d. Problem solving

e. Lecture

f. State any other

.....

.....

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# APPENDIX B

## STUDENTS' QUESTIONNAIRE

The purpose of this questionnaire is gathering information on some difficult Biology topics Biology students find difficult to learn. Your response to the items will positively enhance the success of this research work. Information from this questionnaire would be treated confidentially. Thank you for your cooperation/attention.

**Direction**: please thick [√] in the box or **provide** your own response where appropriate.

**Section 1:** Background Information of respondent

1. Sex:

   Male [ ] Female [ ]

2. Age: .....years

3. Type of school:

Boys only [ ] Girls only [ ] Mixed [ ]

**Students Questionnaire**

**SECTION 2: Difficult Biology Topics perceived by Students Learning Biology**

Examine these topics and tick the box to show its learning difficulty

| BIOLOGY TOPIC | Very Difficult to learn | Difficult to learn | Easy to learn | Very Easy to learn |
|---|---|---|---|---|
| 4.Genetics | | | | |
| 5.Taxonomy of plants and animals | | | | |
| 6.Photosynthesis | | | | |
| 7.Ecology | | | | |
| 8.Life cycle of insects | | | | |
| 9.Kreb's cycle | | | | |
| 10Circulation of blood | | | | |
| 11.Hormones | | | | |
| 12.DNA molecules | | | | |
| 13.Control and co-ordination | | | | |

# APPENDIX C

## OBSERVATION CHECKLIST

**Section 1:**

| Equipment/Material | Total Number Required | Number Present | Absent of Material | Condition (Good) | Condition (Bad) |
|---|---|---|---|---|---|
| 1. Magnifying Glasses | | | | | |
| 2. Microscope and Accessories | | | | | |
| 3. Dissection kit | | | | | |
| 4. Preserved Specimen (fishes, frogs, snakes, etc.) | | | | | |
| 5. Bunsen burners | | | | | |
| 6. Models (digestive, circulatory systems, etc) | | | | | |
| 7. First aid kit (Goggles, Gloves, Apron etc) | | | | | |
| 8. Wash Bottles | | | | | |
| 9. Forceps | | | | | |
| 10. Glass Culture Tube | | | | | |
| 11. Stirring Rod | | | | | |
| 12. Chart and Posters | | | | | |
| 13. Test Tube Holders | | | | | |
| 14. Weighing Balances | | | | | |
| 15. Beaker Tongs | | | | | |
| 16. Crucibles | | | | | |
| 17. Litmus Papers | | | | | |
| 18. Thermometer | | | | | |
| 19. Graduated Cylinders | | | | | |
| 20. Incubators | | | | | |
| 21. Reagents (eg. Formalin, Benedict Solution, etc). | | | | | |
| 22. Test Tube Rack | | | | | |
| 23. Computers and accessories | | | | | |
| 24. Textbooks | | | | | |

# APPENDIX D

## CLASSROOM ACTIVITIES (TEACHERS' CLASSROOM PRACTICE)

| Teaching and learning | Always done | Most of the time | Never seen in the classroom | Use of resources in the lesson |
|---|---|---|---|---|
| 1. Lesson introduction | | | | |
| 2. Teacher demonstrating problem solving | | | | |
| 3. Teacher making use of teaching resources | | | | |
| 4. Lesson centered on students | | | | |
| 5. Students working with elective Biology problems | | | | |
| 6. Lesson centered on the teacher | | | | |
| 7. Teacher engaging students in the activities | | | | |
| 8. Presenting new materials | | | | |

# APPENDIX E

## TEACHERS' INTERVIEW GUIDE (TIG)

1. How important are these methods to you as a teacher?
2. How important are these methods to your students?
3. Mention any other method(s) aside those you use.
4. Why are such methods not used by you in teaching Biology?

# APPENDIX F

## STUDENTS' INTERVIEW GUIDE (SIG)

1. Which of the science subjects is your preferred area?
2. How do you see the teaching of Biology in your school?
3. List the Biology topics you find difficult to comprehend when it is being taught.
4. What difficulties do you encounter in Biology teaching by the elective biology teacher?
5. What do you think could be done to reduce the impact of the difficulties you have identified in teaching Biology?