UNIVERSITY OF EDUCATION, WINNEBA

USING THE MULTIMEDIA APPROACH TO ENHANCE TEACHING OF BIOLOGY AT TECHIMAN SENIOR HIGH SCHOOL

DANIEL OSEI-BOATENG

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DANIEL OSEI-BOATENG

(7130130037)

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

2015

DECLARATION

STUDENT'S DECLARATION

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

SIGNATURE……

DATE ……

SUPERVISOR'S DECLARATION

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

NAME OF SUPERVISOR Prof. Kolawole Raheem

SIGNATURE ……

DATE ……

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DEDICATION

I dedicate this work to my mother Ernestina Yaa Oforiwaa and my wife, Florence Akua Yeboah who always makes sure, education runs through my blood.

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ABBREVIATIONS

WASSCE: West African Senior Secondary School Certificate Examination

SSSCE: Senior Secondary School Certificate Examination

2C1: Form two (2) science one

2C2: Form two (2) science two

SHS: Senior High School

JHS: Junior High School

STME: Science Technology and Mathematical Education

NGOs: Non-Governmental Organizations

ABSTRACT

The study focused on enhancing Senior High School students‟ performance in biology using the multi-media approach. The research was a quasi –experimental design involving Three General Science classes. The sample was one hundred and five (105) students of Techiman Senior High School in the Techiman municipality in the Brong-Ahafo Region of Ghana. Purposive sampling technique was adopted for selecting the sample for the study. The experimental group Form Two Science students composed of thirty five students were taken through the multi-media approach of teaching while Two Science students made up of thirty seven students, the control group continued with the traditional method of teaching. The students were taught for six weeks and were made to take a test composed of essay type questions before and after each lesson. The data of the study was collected by using the instructional packages, pretest and posttests. The lesson plans were used to observe and monitor the trend of conceptual understanding of biological concepts through written answers, practical skills and students‟ responses and explanation of phenomena. The findings of the study showed that the performance of students‟ exposed to multi-media approach of teaching were enhanced. The study recommends more and deeper research on multi-media approach of instruction in teaching abstract biological concepts in Techiman Senior High School.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter is the introductory chapter to the study. It presents a background to the study, statement of the problem and the purpose of the study. The chapter also depicts the research questions that guided the study, hypotheses for the study, significance of the study and the delimitation of the study.

1.1 Background to the study

Biology concepts which students have difficulty with have been investigated by a number of researchers. According to Finley, Stewart and Yarroch (1982) showed that the challenges that students have with the study of biology at the SHS level include cellular respiration, protein synthesis, mitosis and meiosis. These however, are important biological concepts and principles students had to acquire, yet these are some of the topics that the students found most difficult to learn and appreciate. Perkins (1992) in another study discovered that water transport in plants, hereditary and genetics were among the topics SHS students perceived to be difficult and so felt reluctant to learn.

An experiential experience through the work of my research as a biology teacher and a biology/integrated science examiner for the West African Examination Council (WAEC) at the Senior High School (SHS) level suggests that most students perform poorly in biology because they have difficulties in learning some biological concepts. This could be because biology is taught abstractly thereby making some of the concepts seem complex and confusing.

According to Abimbola (1998), physiology content areas are mostly abstract, microscopic and usually involve many fine processes that require proper manipulation and examination to foster students‟ understanding. To Abimbola (1998), these are some of the reasons why teachers and students usually find physiology content areas such as photosynthesis, meiosis, cellular respiration and genetics difficult to teach to the understanding of many SHS students. Some teachers also find some biology concepts difficult to teach. The study by Finley, et al. (1982) also examined both content importance and difficulty as perceived by some health science, physics, chemistry, and biology teachers. They found that most of the important but difficult concepts for the science teachers were photosynthesis, cellular respiration and mendelian genetics. Chromosomal theory of hereditary and hormonal control of human reproduction are also difficult for teachers to teach Finley, et al, (1982).Teachers who find some biology concepts difficult to teach may teach these concepts poorly. This may explain why students have difficulty understanding some biology concepts.

Poor teaching methods adopted by teachers at Senior High School are still identified as one of the major factors contribution to poor performance of students in biology, according to Kareem (2003), Ahmed and Abimbola (2011), Umar (2011). The conventional teaching method is classroom based and consists of lecture and direct instruction conducted by the teacher.

Poor performance in the study of biology specifically and science in general in Ghanaian schools must be addressed if Ghana is to achieve her aim of becoming an agro-based industrialized and a middle-income earning country. According to Asabere-

Ameyaw and Anamuah-Mensah (2004), echoes that there is the need to fuse Western science education with traditional knowledge in Ghanaian schools if the learning of science is to be made meaningful to the Ghanaian child in school. Rutherford (1985) noted that the continued progress of developed countries in economy, security, global status and attractiveness to the human society is dependent on adequate application of scientific concepts, principles and knowledge. Ghanaians are confronted daily with situations that require the use of scientific knowledge and information to make informed choices and decisions.

The advent of information and communication technology (ICT) brought about the innovative ways of teaching many subject including biology to improve academic performance. In teaching biology an instructor cannot make a killer whale come alive in a classroom but multi-media enables us to provide a way by which learners can experience their subject in a vicarious manner. The key to providing this experience is having simultaneous graphic, video and audio and these helps the students to obtain meaningful learning of biological concepts through seeing, hearing and touching.

Studies have revealed that the use of multimedia approach, the application of information communication technology (ICT) tools such as visual simulations and instructional packages in the teaching and learning of science has positive effects on the performance of students in science subjects Akpan (2001). He added that the use of computer simulations and instructional packages to enhance the learning of science in the classroom can be done before or after the completion of a didactic unit of instruction has become the focus of most recent research studies. Coleman (1998) as recorded in Akpan

and Andre (2001) has opined that computer simulations can be used as an extremely effective tool to assist students to understand difficult concepts. Governments, Parent Teachers Association, Non-governmental Organisation and Schools have invested more resources to increase the presence of computer technology in schools and one would have expected to see significant improvement in academic performance. However, results from the West African Examinations Council (WAEC) indicate that the average performance of the Ghanaian student at the West African Senior Secondary School Certificate Examination (WASSCE) in integrated science and biology has been very poor. In 2006 for instance, out of the fifteen thousand, seven hundred and four (15,704) candidates who sat in for WASSCE in the May/June biology examination in Ghana, 63.95% with a numerical representation of ten thousand, and forty-two had weak passes. In the November/December examination of the same year, out of the nine thousand one hundred and eighty-eight (9,188) candidates who sat for the examination, 81.21% with a numerical representation of seven thousand, four hundred and sixty-two had weak passes. The students grade these students" grades in biology ranged from C6 to F9.

The performance continued to decline, in 2008, the WASSCE results depicted that 85.5% of the students who wrote the May/June biology examination had D7-F9 while 75.16% of those who wrote the November/December examination had the same scores. This was not different from the 2009 results which indicated that 72.90% of the students who wrote the May/June Biology examination had grades D7-F9 while 64.95% had the same grade in the November/December examination. This poor situation has remain till date. This abysmal situation has created the perception that biology

specifically and science in general is difficult to learn. As a result of this, most Senior High School students shy away from the study of science and its related subjects at that level. WAEC Grading Procedure for assigning grades on students test results.

1.2 Statement of the problem

The performance of Senior High School students in the Techiman Senior High School in the West Africa Senior Secondary School Certificate Examination and the Senior Secondary School Certificate Examination as far as biology is concerned is a source of worry to both parents and staff of the school. This is because the performance of the students in biology has been far below average (WAEC results of the school from (2012-2013 academic year 70% of biology students had between grade C6 and F9). In this view, it came to light that the students did not fully understand biological concepts, skills and knowledge being imparted to them. An interaction of the researcher with the students of Techiman Senior High School revealed that they had issues with biological processes and concepts that are not visible. Some of these are, photosynthesis, cellular division (mitosis and meiosis), fertilization, nitrogen and carbon cycles.

Probing further the students admitted that they found it quite difficult to imagine/visualize these processes and so they usually get confused during lesson delivery and cannot assimilate the concepts, skills and knowledge being imparted. It is in the light of this discovery that the researcher embarked on this action research to use the multimedia approach to help students learn and understand some concepts taught in biology although ICT materials are available.

1.3 Objectives

The objectives of the study is to:

1. identify the academic performance of students exposed to multi-media approach of teaching biology at Techiman Senior High School
2. make analysis of the academic performance of students exposed to traditional method of teaching biology at Techiman Senior High School
3. compare the difference in the academic performance of students exposed to multi-media approach of teaching and those exposed to the traditional method of teaching biology at Techiman Senior High School

1.4 Research Questions

The study was guided by the following research questions:

1. What is the academic performance of students exposed to traditional method of teaching biology at Techiman Senior High School?
2. What is the academic performance of students exposed to multi-media approach of teaching biology at Techiman Senior High School?
3. What is the difference in the academic performance of students exposed to multi-media approach of teaching and those exposed only to the traditional method of teaching biology at Techiman Senior High School?

1.5 Purpose of the study

The purpose of this study is to:

- identify the performance of SHS students exposed to computer simulation instructional approach in Techiman Senior High School

- Use multi-media approach of teaching to improve students‟ academic performance in Techiman Senior High School.
- Deduce strategies that can be employed to encourage biology teachers in the Techiman Senior High School to use the multimedia instructional approach to teach biology in the school.

1.6 Significance of the study

For any research to be useful it must contribute to the volume of existing knowledge of the field under investigation. In view of this, it is true that information obtained from this study helped addressed some of the challenges that confront the effective teaching and learning of biology at the Techiman Senior High School.

The study suggested remedies that made students learning of biological concepts interesting and enjoyable via multi-media simulations. Teachers on the other hand identified the problems with their methods of instruction and the effects of these methods on the learning behaviour of the biology students at the Techiman Senior High School.

Furthermore, the study provided information to the Ministry of Education, the government and other educational stakeholders to embark on interventions to promote the teaching of biology specifically and science in general at the SHS level.

Finally the findings augmented the pool of data required by other educational researchers in their bid to design interventions to solve educational problems in the teaching and learning of science.

1.7 Delimitation

The researcher‟s work was limited to the Techiman Senior High School in the Techiman Municipality of Brong Ahafo Region. The research was focused only on Techiman Senior High School and might not be applicable to other schools in the Techiman Municipality.

1.8 Limitation

There were lot of Senior High Schools in the Municipality, however, due to time constraint and inadequate resources, the researcher did not involve all the schools even though the problem cuts across all the schools. The research limited itself to the teaching and learning of Biology using the multi-media approach. The study has tried to find some problems associated with the teaching and learning of Biology.

There were certain constraints which limited the progress of the research. The combination of the research work with the teaching practice posed a big constraint to the researcher. The attitude of both teachers and students towards the nature of the research was at first not quite encouraging especially with the use of the observational instrument. They however, agreed to be observed and willingly accepted copies of the questionnaire and responded to the question. The teachers also helped for the students to accept the questionnaires. In spite of these constraints, the study has no doubt contributed in detecting, deducing and deciding on the problems associated with the teaching and learning of Biology.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Introduction

This chapter is devoted to discussion of literature related to the study. It also focused on work done by other researchers in related fields. Some of the topical issues reviewed in the literature include the theoretical and conceptual framework of the study, the concept of computer simulations, and the use of computer simulations in the teaching of and the merits and demerits of computer simulations. The reviewed literature also discusses the concept of cooperative learning and its application in the teaching of biology. Furthermore, the reviewed literature discusses the empirical evidence of the issue of gender and multi-0media issues in science teaching as well as the social interdependence theory of cooperative learning.

2.1 Theoretical framework of the study

The theoretical framework that was used to guide the study was Jean Piaget‟s theory of cognitive development and Lev Vygostsky‟s social construct vision theory. To Piaget (1954), the cognitive development of children towards formal thought could be facilitated through three cognitive processes. He identified the processes as assimilation, accommodation and equilibration.

Assimilation according to Piaget (1954), when children assimilate, they perceive new objects and events according to their existing schemata, mental models and/or cognitive structures. The mental models of children formed by their prior knowledge and

experiences therefore, control how they incorporate new experiences and new information into their minds depending on experiences and information already existing in their minds. This is made easier for the child when the new experiences and information the child is acquiring aligns with the already existing schemata (mental models or internal representation of the world) or as a result of their failure to change a faulty understanding. He added that sometimes, when a child‟s experiences contradict their existing knowledge, internal representations or schemata, they may change their perceptions of their experiences to fit their representations.

When children modify their existing schemata or mental representation of the world to fit their new experiences for learning to occur, they came out with these results; Accommodation and Equilibration. In the perception of Piaget (1954), the state of disequilibration and contradiction arising between existing schemata and the more sophisticated mode of thought adopted by the new experience therefore, has to be resolved through equilibrium process. The equilibrium process maintains the balance between always taking in new knowledge, and always assimilating knowledge with previously gained knowledge. Knowledge is therefore, not a mirror of the world but created or “constructed” from the individual‟s continuous revision and reorganization of cognitive structures in conjunction with existing experiences. Thus in the view of Piaget, students are actively involved in the construction of their own concepts, knowledge and skills.

It is therefore, argued that knowledge is constructed through action and that children must continually reconstruct their own understanding of phenomena through reflection on objects and events till they eventually achieve an ad vet perspective. Piaget

(1954) hence poised that the process of intellectual and cognitive development is similar to a biological act which is an adaptation to and of environmental demands.

To achieve this state of equilibrium and cognitive adaptation, Lev Vygostsky (1978) felt that social learning precedes development. To him, every function in the child‟s cultural development appears twice: first, on the social level and later, on the individual level; first between people (Inter-psychological) and then inside the child (Intra-psychological). According to Vygostsky (1978), children are capable of performing at higher intellectual levels when asked to work in a collaborative situation than when asked to work individually. He also believed that less skilful individuals are better able to develop a more complex level of understanding and skills through collaboration, direction or help of an expert or a more capable peer than they could independently. The social interaction therefore extends a child‟s Zone of Proximal Development (ZPD). The zone of proximal development is the difference between a child‟s understanding and his/her potential to understand more difficult concepts. According to Vygostsky (1978), children are capable of constructing their own knowledge through collaboration, direction or help of an expert or a more capable peer, in other words, children are socially engaged in constructing their own knowledge. This is what has been termed “social constructivism”

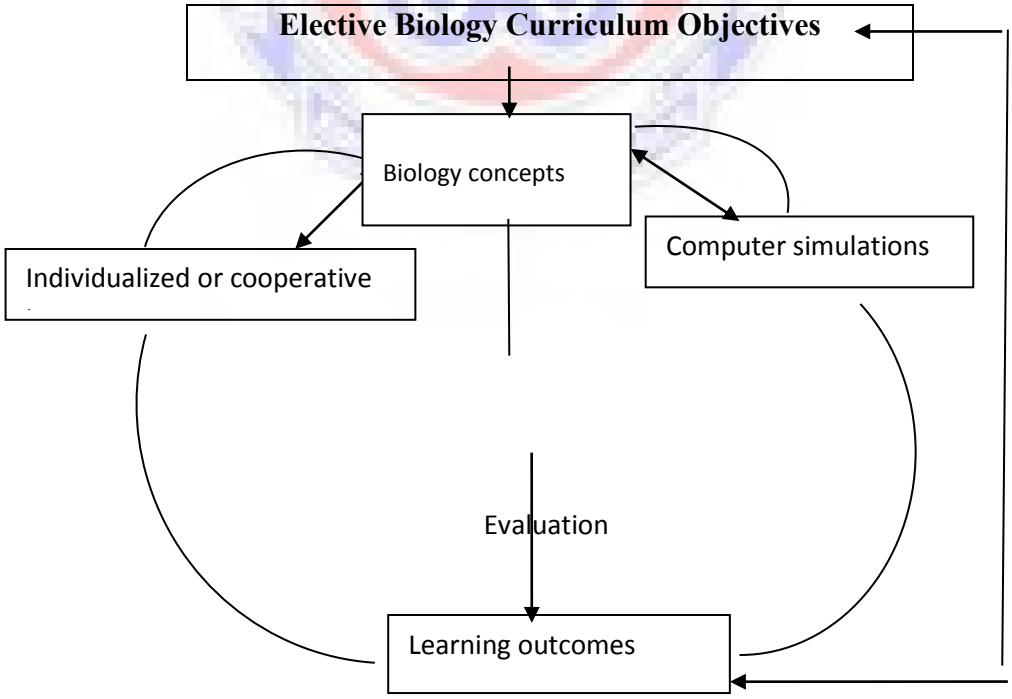
Social constructivism therefore does not only acknowledge the uniqueness and existing complexity of the learner, but it also encourages, utilizes and rewards the learner as an integral part of the learning process (Werstsch,1997). Thus, Vygostsky‟s ideas concerning the zone of proximal development provide a strong support for the inclusion of cooperative learning strategies in classroom instruction. Research findings have clearly

indicated the effectiveness of cooperative learning methods over other competitive or individual learning methods in the development of higher – order thinking skills as well as the achievement of greater outcomes (Johnson & Johnson, 1985). For instance, Stahl and Vansickedl (1982) have noted that every cooperative learning strategy, when used appropriately, enables students to move beyond text memorization of basic facts and learning lower levels skills to higher levels of learning such as application and synthesis of learnt facts and processes. Also, Ajaja and Eravwoke (2010) have opined that cooperative-learner strategies results in cognitive reconstructing, which leads to an increase in understanding of all the students involved in a cooperative group.

Thomas and Milligan, (2004) have noted that computer simulations can be considered a variant of cognitive tools, that is, they allow students to test hypothesis and more generally what –if scenarios. Computer simulations, they continued, can enable learners to group cognitive understanding of their action in a situation. In the perception of Lavrillard (1993), as stated in Thomas and Milligan, (2004), computer simulations are compatible with a constructivist view of education. These they said provided the child with an experiential approach as a result of the interactions between him/her and the simulations. Light and Mevarech (1992) have pointed out that since the early 1980s there has been a growing interest in the potentialities of both cooperative learning and of Information Communication Technology as facilitators of student learning. In the view of Newberry (1999), the claims made for each processes emphasizes the role of student in each of these interactions to enhance a wide range of school outcomes including academic achievements, cognitive process, meta-cognitive skills, motivation towards learning, higher self-esteem and meaningful social development.

The inference is that both computer simulations and cooperative learning strategies have a positive influence on student‟s achievements and is therefore a major tool that can be used to enhance academic achievements and outcomes. Based on the theories of Jean Piaget and Lev Vygostsky, a conceptual framework (Figure 1) was developed for the study. Available literature has indicated that when students are exposed to confusing or complex concepts, they are thrown into a state of disequilibrium. Computer simulations as instructional packages (administered in cooperative or individualized learning settings) however, seems to enable students to develop cognitive structures and mental models that reorganize their existing ones to better understand confusing and complex concepts such as photosynthesis.

Figure 1: Conceptual framework of the study based on the theories of Piaget and Vygostsky



Computer simulations instructional packages therefore, seem to provide students with experiences that facilitate conceptual development which leads to an increased understanding of difficult concepts. An evaluation of the instructional process however reveals learning outcomes which could serve as evidence of the attainment of the curriculum objectives or a basis of the need to refine the curriculum objectives.

2.2 The concept of computer simulations

Computers have been used in teaching and learning for several years. Currently, computers are used in many ways during the teaching and learning of science subjects including biology. According to Sahin (2006), one type of computer application is the computer simulation. With simulations, teachers can potentially better focus students‟ attention on learning objectives. This is because with simulations the real-world environmental conditions are simplified, causalities of events are more clearly visualized and unnecessary cognitive task are reduced and made meaningful (De Jong & Van Jooligen, 1998). Sahin (2006) has also observed that computer simulations give students the opportunity to observe a real world experience and interact with it. As a result of this, worthwhile goal for science education is to develop computer simulation pedagogies that will maximize student learning outcomes (Lindgren & Schwartz, 2009).

Thompson, Simonson and Hargrave (1996) have defined a simulation as a representation or model of an event, object or some phenomena in an active form or motional pictures. According to Akpan (2001) and Miller and Castellaws (1996), a simulation is a dynamic execution of the processes within a relational model system of an object. Broadly defined therefore, computer simulations could be seen as computer-

generated dynamic models that represent theoretical or simplified models of real-world components, phenomenon, or process.

Trundle & Bell, (2010) however, have noted that a computer simulation in science education is the use of the computer to simulate dynamic systems of objects in a real or imaginary world. According to Sahin (2006) computers simulations also take different forms from two to three dimensional simple shapes to highly interactive laboratory experiments and inquiry environments. In the view of Trundle and Bell (2010), computer simulations can include animations, visualizations and interactive laboratory experiences. They also perceived that computer simulations have positive effects on students.

According to Strauss and Kinzie (1994), computer simulations are useful for stimulating laboratories and theatres during practical lessons and demonstrations, providing practical exposure and experience to students on impossible or activities that are too complex to run. Computer simulations also contribute to conceptual change in students‟ attitudes towards learning (Stieff & Wilenskyl, 2003; Zietsman & Hewson, 1986). White & Frederikson (2000) as recorded in Dwyes & Lopex (2001) have noted that computer simulations provide students with problem solving experiences and tools for scientific enquiry. Due to this realization, computer simulations are very effective tools in helping students understand and experience practical applications of scientific thinking (Akpan, 2001; 1999; Akpan and Andre, 2000; Coleman, 1998).

2.3 Some computer tools and simulations (Educational Technology) and their role in science education

According to Hooper and Rieber (1995) noted that Science teaching is such a complex and dynamic profession that it is difficult for teachers to stay up-to-date thus for a teacher to grow professionally and become better as a teacher of science, a special and continuous effort is required. To achieve this feat, Hooper and Rieber (1995) advocates that to better prepare students for the science and technology of the 21st century, the current science education reforms requires science teachers to integrate technology and inquiry-based teaching into their instructions and classroom interactions. One of such technologies that can be inculcated in the science lesson is the computer simulation. The Wikipedia Encyclopaedia as noted by Hooper and Rieber (1995) states that technology in education involves the ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources. The term educational technology is often associated with, and encompasses both instructional theory and learning theory.

Educational technology is usually associated with and includes other systems used in the process of developing human capability Hooper and Rieber (1995). Hooper and Rieber (1995) have noted the fact that Educational Technology includes, but is not limited to, software, hardware, as well as Internet applications and activities. They emphasized the integration of technology as a science inquiry teaching tool in the classroom. They made mention of a variety of tools such as software programs, probe ware, mind-mapping tools (C-Maps), and Internet applications such as computer simulations, digital images, and movies. Hooper and Rieber (1995) added that

educational technology tools such as computers, probe ware, data collection and analysis software, digital microscopes, hypermedia/multimedia, student response systems, and interactive white boards can help students actively engage in the acquisition of scientific knowledge and development of the nature of science and its inquiry skills.

Hooper and Rieber (1995) have stated that when educational technology tools are used appropriately and effectively in science classrooms, deaf students are actively engaged in their knowledge construction and they improve upon their thinking and problem solving skills due to the fact that they are better able to visualize the concepts and processes and so do not depend absolutely on language.

They reiterated that teachers need an ongoing support while they make efforts to develop and sustain effective technology integration in their science lessons. Some of the acclaimed benefits of educational technology as listed by Perkins (1992) are:

2.3.1 Easy-to-access course materials

Instructors can post the course material or important information on a course website, which means all students, can study at a time and location they prefer in addition to the fact that they can obtain the study materials very quickly with minimum stress and distortions.

2.3.2 Student motivation

Computer-based instruction has the ability to give instant feedback to students and explain correct answers especially covert scientific processes. Moreover, a computer is patient and non-judgmental, which can give the students a motivation to continue learning. Sahin (2006) has noted that students usually learn more in less time when receiving computer-based instructions and they also tend to like classes more in that they

develop more positive attitudes toward computers in computer-based classes. This provides an additional incentive and motivation in the pursuance of science lessons for the students with ample challenges in appreciating scientific processes and procedures.

2.3.3 Wide participation

The same learning material can be used for long distance learning and are accessible to a wider audience –handicapped, disabled and the marginalized. Thus no child in the classroom feels left out in the learning environment.

2.3.4 Improved student writing

Educational technology makes it convenient for students to edit their written work on word processors, which can, in turn, improve the quality of their writing and linguistic output. According to Hooper and Rieber (1995) some students are better at critiquing and editing written work that is exchanged over a computer network than with students they know.

2.3.5 Subjects are made easier to learn

Many different types of educational software are designed and developed to help students with appreciable amounts of learning difficulties to learn more specific subjects such as the sciences. Examples include pre-school software on basic scientific principles, computer simulators that simplify complex scientific procedures, and graphics software among others. An example of such is the operations of nephrites in the Bowman‟s capsule of the mammalian kidney.

2.3.6 Assessment

This is a structure that is more amenable to measurement and improvement of learning outcomes. Perkins (1992) advocates that with proper structuring, educational technology makes it easier for all students to monitor and maintain their work while also quickly gauging modifications to the instructions necessary to enhance each student‟s learning.

2.3.7 Differentiated Instruction

Educational technology also provides students with deafness a means to focus on active student participation and to present differentiated lesson delivery and questioning strategies. It also broadens individualized instructions and promotes the development of personalized learning plans. Thomas and Milligan (2004) have outlined two major roles of technology in education. The roles they outlined are

a) The traditional role of technology in education and.

b) The contemporary role of technology in education.

2.4 Traditional role of technology in science education

Thomas and Hooper, (1999) as quoted in Thomas and Milligan (2004) outlines two main types of technology in education. These are "product technologies" and "idea technologies." Product technologies include: 1) hardware, or machine-oriented technologies that people most often associate with educational technology, such as the range of audio-visual equipment, both traditional like film strips, movies, audiocassette players/recorders and contemporary materials like videocassette players/recorders, laserdiscs, computers, CD-ROM) and; 2) software technologies, such as print-based

material like books, worksheets, overhead transparencies and computer software like computer-assisted instructions.

In contrast to product technologies, idea technologies do not have such tangible forms therefore students with deafness do not derive much of the benefits of an idea technology unless these idea technologies are represented in or through some product technology example, simulations which are by and large, idea technologies. Simulations give people with deafness experiences with events and concepts which are generally not possible under normal conditions e.g. travel back in time, probable concepts such as ride aboard a space shuttle, or desirable concepts like the greenhouse effect.

The idea of simulations is usually realized through products, such as the computer software. In this way, the idea is supported or made possible by the product technology thereby making science lessons and experiences meaningful to the student with deafness. These according to Hooper and Rieber (1995) give the student with deafness an experience of concepts that language cannot best describe.

According to Hooper and Rieber (1995), Saettler (1990) views learning as a consequence of receiving the information. This, they added, according to him is beneficial to the student with deafness in that they lack incidental learning hence a conscious effort must be made at giving them the specific and required information. The contemporary notion of educational technology goes well beyond this philosophy of learning and education especially, when it comes to the education of individuals with deafness. Teachers who adopt technologies without considering the belief structure into

which these products and ideas are introduced are not necessarily imparting the knowledge and concepts they hoped to.

Another traditional role of technology in the academic life of a student with deafness is that when a teacher uses a spreadsheet to have students build and construct the knowledge themselves, whether it be the principle of mathematical average or a range of "what if" relationships in economics or history, the product technology of the spreadsheet will directly support the idea technology of a "micro world" where students will live and experience the content rather than just study of Hooper and Rieber (1995) as stated in Hooper and Rieber (1995)). It is this fundamental principle of learning that underlies most of the contemporary views of idea technologies that helps all stakeholders in the science teaching learning process to enter a reorientation phase of adopting technology in education and this is the goal of the contemporary role of technology in science education.

2.5 Contemporary Role of Technology in Science Education

Among many educational goals, the three cognitive outcomes of education are that students should be able to remember, understand, and use information (Perkins, 1992). These cognitive outcomes are relevant in all aspects of education most importantly in science education for without these outcomes, students will find it difficult to apply the science they learn in the classroom to everyday life situation. Perkins (1992) has noted that apparently, one of these outcomes is very difficult to achieve in that after more than a decade of schooling, many students leave school unable to use much of the content they have learned.

According to Dwyes and Lopex (2001) students' inability to apply their learning is attributable to the shallow processing of learned concepts that often occurs in the school. He added that schoolwork often focuses on remembering and organizing lesson content, but rarely on making information meaningful. Meaningful learning, he continued is the product of building external connections between existing information and new information. Dwyes and Lopex (2001) identified three learning stages that affect the meaningfulness of education/learning as selection, organization, and integration. He elaborated that information must initially be selected, and then the selected information must be organized in the working memory if it is to be transferred to long term memory. By this notion therefore, information that is not organized is meaningless in that the nature of the organization determines the degree of meaningfulness and for a student with deafness, this is most paramount.

Invariably, information that is integrated within familiar knowledge or experiences is more durable than information that is not associated to prior knowledge. It is in light of this awakening that technology is applied in education to give some experience to regular students in general and deaf students in particular on scientific knowledge, concepts and processes involved in the acquisition of skills. In school, students select information that they memorize and organize sufficiently to enable satisfactory performance on tests, but they often fail to integrate this information by relating it to previous experiences or knowledge stored in the long term memory, an obvious deficit of students with deafness coupled with the lack of incidental learning.

Consequently, one outcome of education, it seems, is a large reserve of inert information which is eventually forgotten; Cognition and Technology Group at Sahin

(2006). In a sense, teaching with technology is unlikely to differ greatly from teaching in general in that they follow the selected pedagogy of the teacher. Effective technology-based teaching therefore is more likely the result of a teacher's ability to design lessons based upon robust instructional principles rather than on technology per se Thomas and Hooper (1991). In other words, the contemporary role of technology in science education is to afford the science teacher of students with hearing-impairment/deafness an opportunity to structure and deliver science lessons that are customized to the educational needs of children with deafness.

Consequently, the guidance for designing an effective technology-based classroom should be grounded in the literature on effective pedagogy in general. Although technology is designed primarily for instruction in complex and ill-structured domains, the principles are relevant for many instructional tasks such as the education of handicapped children in general and specifically, students with appreciable degree of hearing loss and deafness.

2.6 Computer Simulations in the teaching of Biology

Thomas and Hooper (1999) have classified computer simulations in five (5) categories, these are experiencing simulations, constructive simulations, informing simulations, reinforcing simulations and integrating simulations.

Experiencing simulations are used to set the cognitive or affective state for future learning and their use precede the formal presentation of the material to be learned.

In the perception of Sahin (2006): Informing simulations are used to transmit information to the students and are more appropriate when incorporated in a supporting environment, such as regular classroom or laboratory work.

- ❖ Reinforcing simulations are for strengthening specific learning objectives (Thomas & Hooper, 1991). According to Thomas and Hooper (1991), the most common format for reinforcing simulations is drill and practice, in which a sequence of stored exercises is presented for students to compute. These simulations can be designed to adjust to students‟ knowledge and to track the students‟ progress Thomas & Hooper (1991).
- ❖ Integrating simulations however, seem to be most prevalently used simulations form the acquisition of diagnostic skills, where students first learned the factual information and principle and the used the simulations to relate and apply that knowledge (Thomas & Hooper, 1991).

De Jong and Van Jooling (1998) have also indicated that computer simulations could be divided into two main categories namely; simulations containing a conceptual model and those based on an operational model. According to De Jong and Van Jooling (1998):

- ➢ Conceptual models hold principles, concepts and facts related to the systems being simulated while
- ➢ Operational models include sequences of cognitive and non-cognitive operations, procedures that can be applied to the simulated systems.

Gredler (1996) however, distinguishes between the two main types of simulation as symbolic and experiential simulations. He explained further that the student in an experiential simulation takes on a serious role in an evolving scenario and experiences the privileges and responsibilities of that role in attempting to solve a complex problem or realize a goal. He added that experiential simulations therefore, immerse the student in a complex changing environment in which the student‟s ability to execute multidimensional problem solving strategies is a part of their role in the programme and provide them with opportunities to develop their cognitive strategies by learning the organized and manage their own thinking and learning.

According to Sahin (2006), experiential simulations may be cooperative or individualized exercises due to the nature of the participant‟s roles and types of decisions and interactions in the exercise. Gredler (1996) has asserted that the four essential components of an experimental simulation are a scenario of a complex problem or task that unfolds in part response to learners‟ actions. These scenarios he contends are roles taken by the learner in which he/she executes the responsibilities of the position, multiple plausible paths through the experience and learner control of decision making. He recognized four major types of experiential simulations. These include a) data management, b) crisis management, c) diagnostic management and d) social-process exercise. Of these,

a) Crisis management simulations are developed to meet the pre-established criteria regarding the nature of the crisis and expected students‟ reactions.
b) Symbolic simulations on the other hand, are dynamic representations of the universe. System, process or phenomenon by another system, in which the

behaviour that is simulated involves the interaction of at least two variables over time. To Gredler (1996), the students interact with symbolic simulation from the outside, unlike with experiential simulation. In symbolic simulations therefore, the student is not a functional component of the programmed environment.

The types of symbolic simulations according to Gredler (1996) are data universe, system, and process and laboratory-research simulations.

Sahin (2006), on the other hand, viewed computer simulations in two broad perspectives: reflecting constructive and instructive pedagogies. He noted that constructive simulations provide learners with a contextual environment in which they take place and play roles. To Sahin (2006), the constructive simulations may include integrated simulations, experiential simulations and conceptual simulations.

Instructive simulations, on the other hand, include learners as external players on the provided conditions Sahin (2006), examples include Bio Lab – Frog, mtn sim and photosynthesis. In advanced forms, the computer simulations instructional packages can be used in the study of other subjects. According to Sahin (2006), instructive simulations may include information simulations, reinforcing simulations, experiential simulations, symbolic simulations and operational simulations.

Therefore, the computer simulations instructional packages used in the study is a process or an instructive simulation, which uses symbols to represent the interactions of unobservable variables in naturally occurring phenomena like photosynthesis, cellular respiration, cell division: mitosis and meiosis, protein synthesis, Newton‟s laws of motion, complex atomic reactions and the like.

2.7 Cooperative learning in biology

Cooperative learning and computer stimulations, according to Millis and Cotell (1998), are partners. Cooperative learning has been defined by Johnson and Johnson (1978) as an approach that engages students in working together non-competitively toward a common goal. Cooper and Mueckk (1990) also described cooperative learning as a structured, systematic instructional strategy in which small groups work together towards a common goal. The goals of cooperative learning are to enhance students‟ learning and to develop student‟s social skills like decision-making, conflict management and communication Bonwell and Eison (1991). The cooperative learning methods used in contemporary education have evolved over the last 30 years Mills and Cotell (1998) and proponents of cooperative learning have developed class strategies that emphasize small groups of students working together in a structured process to solve academic tasks (Newberry, 1999). The cooperative learning tends to be more carefully structured and delineated than most other forms of small-group learning (Newberry, 1999). According to Borich (2004), in cooperative learning interaction among students is intense and prolonged and students gradually take responsibility for each other‟s learning. Cooperative learning is thus, the instructional use of small groups so that students work together to maximize their own and each other‟s learning.

According to Dareo and Orwig (1947), the five critical elements that make cooperative learning successful are positively interdependent. It is established when students perceive that they are in positive and interdependence relationship with other members of their group. There are several ways of achieving positive interdependence. These can be established through mutual goals for the group, division of labour for

mutual goals for the group: a division of labour for a mutual task: dividing materials resources or information so that group members will have to cooperate to achieve their task. To ensure positive interdependence teachers must develop bonding and group trust, use group roles structures content areas

Individual accountability is the second critical element of cooperative learning. Individual accountability ensures that individuals become accountable for learning and assign materials though they work in groups. Cooperative learning is not having one person do a report for two or three others. The aim is for all students to learn the materials. In order to accomplish this, it is necessary to determine the level of mastery of students and then assign groups to maximize achievement. Thus individual accountability, each student within a group thus be held accountable for mastery of the instruction presented to the group.

The third critical element of cooperative learning according to Johnson and Johnson (1978) is face-to-face ‚promotive" interaction. Face-to-face promotive interaction is where interaction is individual supporting each other in a cohesive growth in which they promote each other"s success by sharing resources, helping, assisting, supporting and applauding each other"s efforts to achieve and encouraging one another. Also, face-to-face promotive interaction teaches and encourages one another during the exercise to ensure that any team member randomly chosen will be prepared to answer for the group. There are important cognitive activities and inter personal dynamics that can occur when students promote each other"s learning (Johnson & Johnson, 1999). This includes orally explaining how to solve problems, teaching ones knowledge to others, checking for understanding, discussing concepts being learnt and connecting present with

past learning (Johnson & Johnson, 1999). Lampe, Rooze and Tallent-Runnels (1998) have stated that peer interaction is central to the success of cooperative learning as if related to cognitive understanding and facilitated comprehension. During cooperative learning therefore, the feedback reinforcement and support come from student peers in the group. This implies that science teachers dividing their students into groups of four or five, working together in physical closeness promoted by a common task, will encourage collaboration, support and feedback from the closest and most immediate source-one‟s peers (Ajaja & Eravwoke, 2010).

According to Ajaja and Eravwoke (2010), science teachers should therefore, module their instructions to enforce teachers- student interaction. In a cooperative learning therefore the teacher must specify both academic and social skill objective, explain the task and goal structures, and assign rules within the group to facilitate learning.

The fourth critical element of cooperative learning according to Johnson and Johnson (1999) is the use of inter-personal social skills. To promote effective cooperative learning, Johnson & Johnson (1999) suggested that students must be thought interpersonal social skills such as leadership, decision making, trust building, communication and conflict management; just as purposefully and precisely academic skills. Vermettle, Harper and Dimillo (2004) have found that conflict do arise between students in cooperative learning groups, however, they need to be resolved in a healthy manner for effective cooperative learning. They assert that students cannot just be placed together in a group situation and expected to be cooperative. They must first be thought the social skills needed for collaboration, and they must be motivated to use them

The fifth and critical element of cooperative learning according to Johnson and Johnson (1999) is group processing. According to Gredler (1996), group-processing may be defined as reflecting on group session to describe what members actions were helpful or unhelpful and take decisions about what actions to continue or change. Continuous improvement of the process of learning results from the careful analysis of how members are working together and determine how group effectiveness can be enhanced (Johnson, Johnson & Holubec, 1993). To Johnson and Johnson (1999), group members discuss how well they are achieving goals and maintaining effective working relationships while discovering how well each member performs and adjust to change.

Trundle and Bell (2010) has noted that cooperative-learning approaches empower students, bolstering their self-esteem and confidence. Perkins (1992) speaks convincingly of the need to alter philosophies and practices and advocates a switch to alternative, non–lecture based pedagogies such as structured group work. Millis and Cotell (1998) has noted that the close affinity and links between cooperative learning and technology by asserting that cooperative learning and technology (such as computer simulations) are natural partners. This is because the use of technology involves human dimensions of caring, community and commitment (This is because the use of technology involves human dimensions of caring, community and commitment (Yusuf & Afolabi, 2010).

Accordingly, using technology in ways that promote sequenced learning within groups can lead to more in-depth processing of course content and hence, more retention of information (Newberry, 1990). Bareo and Orwig (1947) have also opined that technology can be used to enhance and encourage cooperative learning in our schools

through small groups using a simple computer network-based instructional programmes or collaborative projects on the internet.

2.8 Related Studies

A number of studies have indicated that the use of computer simulations instructional packages have a positive influence on the achievement or performance of students in science. Kiboss, Wekesa and Ndirange (2006) for instance, assessed the effects of Computer-Based Instruction Simulation (CBIS) programme on students‟ understanding and perception of cell theory in biology. The CBIS programme was developed for the teaching of school biology, as part of a classroom innovation for science instruction to improve students‟ understanding and perception of cell theory, Kiboss et al. (2006) found that the CBIS programme positively affects the development of students‟ understanding and perception of cell division in school biology.

Okoro and Etukudo (2011) in a paper entitled “Computer Assisted Instruction (CAI) versus Extrinsic motivation based traditional method: its effect on female Genders‟ performance in chemistry” presented at 42nd STAN Annual Conference in Ilorin, noted that students exposed to the CAI performed significantly better than those exposed to the extrinsic traditional method.

Huppert, Lomask and Lazarowitz (2002) also investigated the impacts of computer simulations on the development of higher-level inquiry skills. They found that high school students using a simulated yeast lab outperformed those completing with hands on lab. Additionally, Akpan and Andre (1999) investigated the effectiveness of computer simulations versus injunction with hands on frog dissection. Akpan and Andre

(1999) found that students receiving simulation before dissection (SBD) and simulations only (SO) learned significantly more anatomy than students receiving dissections before simulations (DBS) or dissection only (SO).

2.9 Students' difficulty with some biological concepts

Sert, Cibiik et al (2008) have observed that biology is a more interrelated science field with respects to concepts that it covers compared to other science fields. As a result, students have problems in learning some biology concepts meaningfully and therefore, choose to memorize these concepts. Sert Cibiik et al (2008) further noted that the most evident example of his can be seen with the concepts of photosynthesis and plants respiration.

Johnstone and Mahmoud (1980), also found out that photosynthesis and plants respiration are the most confusing biology concepts for students. Furthermore, photosynthesis, cellular respiration, protein synthesis, Mendellin genetics, Mitosis and Meiosis, have been shown by Finley, et al. (1982) to be difficult and important topics for students to learn whereas Anderson et al. (1990) have indicated that photosynthesis, respiration and gaseous exchange are difficult for students to learn.

Photosynthesis is one of the most fundamental concepts in biology and it is the traditionally taught in several topics in biology, such as cell biology, plant physiology, ecology and botany. The process of photosynthesis, according to Sert, Cibiik et al. (2008), is complicated and knowledge in chemistry and physics is essential to acquire a full understanding of all the process which happens with the cell. The complex and

confusing nature of photosynthesis and some other biology concepts may explain why most students perform poorly in the subject.

CHAPTER THREE

METHODOLOGY

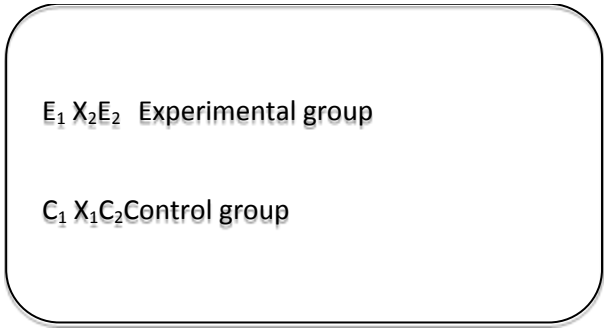
3.0 Introduction

This chapter is about the method adopted by the researcher to achieve the results. The methodology taken is a gradual intensive investigation carried out in Techiman Senior High School, which is intended to modify and improve teaching and learning of Biology. This chapter explains population used, sampling techniques and size and data collection instruments. Also, this chapter present the intervention, strategies that were implemented. Sample of the lesson plan, data analysis and the effect of the intervention on the teaching and learning of Biology.

3.1 Research design

The research design used for this work was Quasi-experimental research design which was adopted for this study. Studies of the effectiveness of particular instructional strategies and/or materials are typically conducted in the context of many course(s) including Biology. Oftentimes students‟ performance in a reformed course is compared to other sections of a similar course taught traditionally, or to past years in which the course was taught differently. Comparisons are typically made between courses within a single institution, but occasionally researchers make cross-institutional comparisons Perkins, (1992). Quasi-experimental design was used by the researcher because intact classes were used instead of randomly composed samples.

Figure 2.1: Diagrammatic representation of Quasi-Experimental Design



E_1, and C_1 represent pre-test

E_2, and C_2, represent post-test

X_2 represents treatment (Multi-media)

X_1 represents treatment (traditional method)

3.2 Population

The target population for the study comprised all Biology Students in Techiman Senior High School in the Techiman Municipality while the accessible population was focused on all the Science Students, SHS 1 –SHS 3. A sample size of sixty (105) students and ten (5) teachers were selected from the accessible population.

Out of the One Hundred and Five students chosen as respondents, thirty (30) were girls and the remaining seventy-five (75) were boys. This was a coincidental but it was fair in view of the state of affairs with regard to the teaching and learning of Biology using multi-media approach in the school.

3.3 Sample and Sampling Technique

A sample is a finite part of a statistical population whose attributes are studied to gain information about the larger population (Webster, 1985). According to Castillo (2009), sampling techniques are the strategies applied by researchers during the sampling

process. Three classes from the Science classes at Techiman Senior High School were purposively selected as the sample for this study. The students in that class were selected because

- they had experienced one year of learning Biology as an elective subject and are so familiar with the many of the various concepts in the course
- the students also have basic knowledge and learnt some concepts in Photosynthesis as a subject the previous term
- had resource persons to help the researcher in conducting this study

A purposive sampling on the other hand was also use to put the two classes into control and experimental group. A simple random sample is one in which each and every member of the population has an equal and independent chance of being selected (Fraenkel & Wallen, 2009). The control group i.e. form 1 – 3 Science classes experienced the traditional method of teaching whiles the experimental group i.e. form two Science two ($2S_2$) class experienced the multi-media approach of teaching.

Table 3.1: Class Sizes

Gender	**Control group [Two Science one ($2S_1$)]**	**Experimental group [Two Science two ($2S_2$)]**
Male	25	27
Female	12	8
Total	37	35

3.4 Instrumentation

The main instrumentation used in data collection for this study was tests supported by an interview. The researcher also observed the students during instruction (lesson) as well.

3.4.1 Tests

A test serves as an instrument used to measure students‟/learners‟ performances in class. The tests used in this study were carefully selected from West African Senior Secondary School Certificate Examination (WASSSCE) past questions. The tests were the main instrument used for the data gathering. Pretest and Posttest were used to identify the problem, the poor performance of students‟ inability to answer Biology questions and also check the performances of students after the intervention was manipulated respectively. Again, series of normal class room tests were used during the intervention stage whilst a post- test exercise was used in the post intervention stage of the research. The pre-test and post-test were same in structure and content. They both consisted of only one section made of essay-type questions.

3.4.2 Interview

An interview is one instrument used to collect vital information about the students. When answers to a set of questions are solicited in person, the research is called an interview, Fraenkel & Wallen (2009). According to them, Interviews are conducted orally, and the answers to the questions are recorded by the researcher (or someone he or she has trained). An interview was organized for few students who were picked randomly

to answer questions in soliciting information concerning their attitude and performance in the study of Biology.

3.4.3 Validity and Reliability of the Instruments

A test is valid if and only if its results are appropriate and useful for making decisions and judgment about an aspect of students' achievement (Gronlund & Linn, 1990). The items in the tests conducted were selected from past questions in accordance to the subject involved from the West African Senior School Certificate Examination (WASSCE) which is a standard test for West African countries who partake in this form of examination. The validity of the questions in the interview was ascertained by a senior lecturer at the University of Education, Winneba who has an enormous experience in research, assessment and evaluation.

3.5 Data collection procedure

Data of this study were collected in three stages. The first Stage involved data on the pre-intervention exercise. Before the implementation of the intervention, lessons on photosynthesis learnt by students in the previous term were revised, and at the end of the revision students' were made to answer essay-type questions in their work books. All questions were WASSCE past questions based on what was revised. The pre-test was given to both the control and experimental group. This pre-intervention exercise was marked and the data was collected. The second stage was the collection of data on the series of normal classroom tests during the intervention period. After the pre-intervention exercise, students were introduced to the intervention weekly tests. Students were made to understand that the weekly tests were to help them learn and improve their

understanding of that they were taught in the current term. Students were taught for six weeks and at the end of each week an essay-type test was administered to them. The tests were marked and the results were collected to check students‟ improvement in their performance.

The final Stage involved the post-intervention test. After the last week, both the control and experimental groups were given a post-test which was the same questions used in the pre-test. The test was marked and the results collected for data analysis. The interviews were scheduled for the next day after the post-intervention test. Ten students were randomly selected for the interview which lasted approximately eight minutes for each student.

3.6 Data Analysis

Creswell (2008:231-237) expressed that data analysis consist of "taking the data apart‟" to determine individuals response and "putting them together" and to summarize it Creswell stated that, analyzing and investigating data refers to taking up the response from respondents and drawing final conclusions about it, where conclusions could be clearly seen and explained to any reader, how the conclusions were arrived in words, to provide answers that benefit each research questions raised.

This study employed both qualitative and quantitative methods of data analysis. Data from the pre-intervention test and the post-intervention test were analyzed quantitatively using the SPSS. An independent sampled t-test was used in analyzing the difference in performance between the two groups (control and experimental) and also the performance between male and female students. A paired sampled t-test was also

used to check difference in performance among only the control group and only the experimental group. The results from the interview were analyzed qualitatively and conclusions made from the response of students in both the control and experimental groups in the research.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Introduction

This chapter is a presentation, interview, analysis and discussion of the collected data. The raw scores of the collected data from students pre- and post-test were used for the analysis. The presentation, analysis and discussion of the result were done with respect to the three research questions posed to direct the study.

4.1 Demographic Description of Respondents

Age of Students

The students‟ ages are presented in Table 1:

Table 2. ***Age of Students***

Age of respondents	Frequency	Percentage (%)
15	15	5.6
16	54	59.7
17	36	34.7

Majority of the students are 16 years of age representing 59.7%, 17 years of age recorded 25 representing 34.7% while only 4 are 15 years representing 5.6%.

4.2 Gender of Students

Table 3 : *Gender of Students*

Gender	Frequency	Percentage (%)
Males	52	72.2
Females	20	27.8
Total	72	100

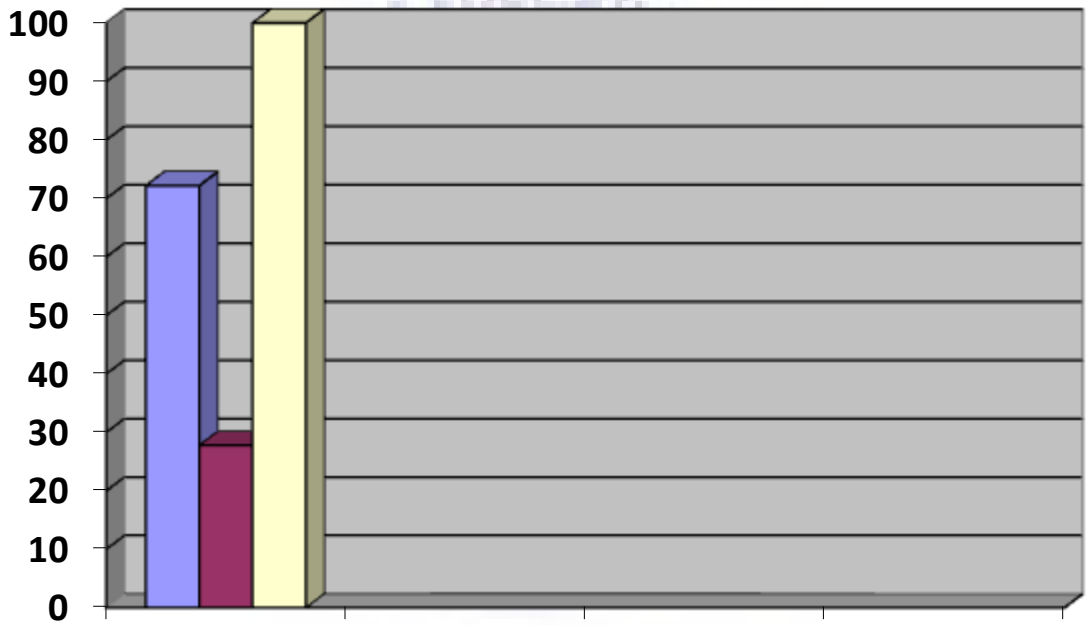


Figure 3: Graph showing the frequency and percentage of students according to gender.

key : Blue = Male students

Red =Female students

Yellow = Total number of students

The SHS two (2) science classes used for the study are male dominated class. Out of the total of 72 students, 52 (72.2%) are boys while only 20 (27.8%) are girls.

4.3 Analysis of test results with Respect to the Research Question one

RQ 1: What is the academic performance of students exposed to multi-media approach of teaching biology at Techiman Senior High School?

This question sought to find out if the use of multi-media in teaching brought difference in students‟ achievement between their pre-test and post-test after learning photosynthesis. To determine whether the performance between students‟ scores in the pre-test and post-test were statistically significant, a paired sample t-test analysis was used to analyse the scores from the tests.

Table 4.3 shows the comparison of the pre- and post-tests of the experimental group which experienced multi-media approach in teaching. The table gives the means of each of the tests (pre and post-test). The mean of the pre-test of the experimental group is 16.97 whiles the post-test mean is 34.06. This shows that there was an improvement in students‟ achievements in the post-test. To verify the difference in the academic performance, the significance (2-tailed) gave 0.000 meaning that there is a significant difference in the academic performance in the pre-and post-test of students who were exposed to multi-media approach in teaching biology.

Table 4: Paired Sample t-test for Experimental Group

	Mean	N	Std. Deviation	Std. Error Mean	df	Sig. (2-tailed)
Pre-test	16.97	35	5.118	.865	34	.000
Post-test	34.06	35				

*p<0.05 significance (α=0.05)

4.4 Analysis of test results with Respect to the Research Question two

RQ 2: What is the academic performance of students exposed to traditional method of Teaching Biology at Techiman Senior High School?

This question sought to find out if the use of traditional method in teaching brought difference in students‟ achievement between their pre-test and post-test after learning photosynthesis. To determine whether the performance between students‟ scores in the pre-test and post-test were statistically significant, a paired sample t-test analysis was used to analyse the scores from the tests.

Table 5 shows the comparison of the pre- and post-tests of the control group thus the group which experienced traditional method in teaching. The table gives the means of each of the tests (pre and post-test). The mean of the pre-test of the control group gave 15.89 whiles the post-test is 17.51. This shows that there was a small progress in students‟ academic performance in the post-test. To verify the difference in the academic performance, the significance (2-tailed) gave 0.000 meaning that there is a significant difference in the academic performance in the pre-and post-test of students who were exposed to traditional method in teaching biology. Although there is a significant difference in students‟ academic performance but it was not felt well like that of the experimental group. This could be due to the fact that the students have answered the questions before in the pre-test which influence their answers in the post-test.

Table 5: Paired Sample t-test for Control Group

	Mean	N	Std. Deviation	Std. Error Mean	df	Sig. (2-tailed)
Pre-test	15.89	37	1.891	311	36	.000
Post-test	17.51	37				

*p<0.05 significance (α=0.05)

4.5 Analysis of test results with Respect to the Research Question three

RQ 3: What is the difference in the academic performance of students exposed to multi-media approach of teaching and those exposed to the traditional method of teaching biology at Techiman Senior High School?

This question wanted to find out the difference in students‟ academic performance between students exposed to multi-media approach of teaching (experimental group) and students exposed to traditional method of teaching (control group) after learning photosynthesis. To determine whether the performance between students‟ scores were statistically significant, an independent sample t-test analysis was used to analyse the scores from the tests.

Table 6 is showing the overall comparison of students‟ post-tests in the group experimental and that of the control group. The sig, (2-tailed) value is given by 0.000 which is also the p-value in this study, it is set at 0.05, significance (α = 0.05). This shows that, there was a major difference in the post-test scores in comparing the post-test of the experimental group (i.e. the group exposed to multi-media approach) and the post-

test of the control group (i.e. the group exposed to traditional method of teaching). In other words students in the experimental group had more understanding in the concepts taught since there were audio and visual media used in the teaching of photosynthesis compared to students who were stack with their imagination on the same subject which was more abstract in nature.

Table 6: Independent Sample t-test for Experimental and Control Group

	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Experimental*Control	17.345	.000	12.179	70	.000	16.544	1.358

*p<0.05 significance (α=0.05)

4.4 Results from interview

Interviews were organized for ten students to find out some of the reasons to their performance and attitude towards biology lessons.

The first item in the interview asked the question, did you like the learning of biology before the intervention, if yes, why? If no why?

Two students said yes *they understand lessons taught with traditional method of teaching but eight of them said no. before the intervention of the multi-media approach of tuition lessons were very abstract which could not be related to anything in the environment.* The second item asked, what teaching and learning materials did your biology teacher use in his teaching?

Seven students said, *their teacher does not use any teaching aid.*

Three students mentioned that *their biology teacher normally call one of them to front and use him/her to illustrate the part of the body he intend to use in teaching.*

This suggests that teaching and learning materials like chart, audio visuals like computers are not used in teaching. It also indicated that students may not comprehend most of the biological concepts, especially photosynthesis.

The third question in the interview was, did you like the learning of biology after the intervention of multi-media approach of teaching? If yes, why? If no why?

All the students answered in affirmative yes, *this* is because students understand the biological concepts taught with multi-media teaching and learning materials like projectors, computers and other audio visual through computer stimulations.

4.5 Discussion

The multi-media approach was the intervention for the students in the experimental group. From the paired t-test analysis, it is shown that there was difference in students‟ academic performance between the control and experimental group. This is similar to the findings carried out by (Cheng, Cheng, & Chen, 2012).

Taking research question two into consideration, there was significant difference between the experimental group and control group in terms of academic performance in biological concepts. This is because the control group have already been given the platform to answer the questions in the pre-test which were the same in the post-test. Traditional method of teaching gives little or no platform for students understanding of

biological concepts being taught in any of the educational levels and do not facilitate project-based work, enabling students to collaborate in the expiration of related learning content.

Question three showed that students exposed to the multi-media achieved higher academic performance than those exposed to traditional method of teaching. The results concurred with the findings of Okwo and Asadu (2002), who reported that three media (video, audio + picture, and audio) were found to be equally effective with no significant difference effect among the means when used for teaching physics. This also agrees with Nusir, Alsmadi, Al-Kabi and Sharadgah (2012) that, the computer animation learning courseware had positive effects on students" academic performance and achievement level (high and low) and their learning styles.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter focuses on the summary of the findings, conclusion and recommendations based on the findings of the study. The research was undertaken to find out some problems associated with the teaching and learning of Biology in Senior High Schools and also ascertain whether it is taught at all. It was also to find out when its teaching is actually started and find out whether the delay in its teaching at the SHS is the course of poor performance among students in the SSS. The research was again to throw light on the situation in SHS on the teaching of Biology using multi-media approach to enhance Biology lessons. Besides, the researcher undertook the research so that the findings of the research would be used to suggest means of solving some, if not all, the problems and also recommend other scholars to do further research into the subject.

5.1 Summary of Major Findings

The study sought to find out the effects of multi-media approach of teaching in Techiman Senior High School. The study used the quasi-experimental design where two form two science classes were put into two groups (control and experimental). Students in the experimental group were exposed to multi-media approach in teaching whiles those in the control group were exposed to traditional method of teaching. Students in the two groups were given pre-tests before the two intervention were introduced to the two groups. The test was marked and the results collected for further analysis. Students were then taken through biology lessons for six weeks and at the end of each lesson students

solved some essay questions related to what is being taught. At the end of the sixth week students in both groups were given post-test to answer and after they were collected, marked and recorded for further analysis. Ten students were then selected, five from each group to participate in an interview schedule to find out some of the factors contributing to their academic performance and their attitude towards the learning of biology. A paired t-test was used to analyse the difference in academic performance in each of the groups and an independent t-test was used to analyse the post-test results for control and experimental group.

The analysis showed that there was a significant difference in performance in the group which was exposed to multi-media approach in teaching between their pre- and post-test. Also there was a significant difference in the performance of the group exposed to traditional method of teaching but in comparing the means the difference was small between their pre- and post-test. Finally, students post-test in the experimental group was compared to students post-test in the control group, and it showed that there was a significant difference in their academic performance.

5.2 Conclusion

This paper has examined the multimedia, theoretical framework for designing effective multimedia for Teaching Biology at secondary school level and relevant studies on modes of multi-media. It is the view of the researcher that there is still a wide gap to be bridged in the area of teaching and learning of science concepts. The innovative technology using multi-media approach seems to be the answer and the bridge. From the study carried out at the Techiman Senior High School findings seems to suggest that

multi-media approach is useful in enhancing the understanding of biology concepts. The concurrent use of multi-media instructional interface is more effective in teaching biological concepts than traditional method of teaching.

5.3 Recommendation

The following recommendations have been made to help improve the teaching and learning of Biology in the Senior Secondary Schools. In the opinion of the researcher when students enter SSS one they must immediately be taken through explicitly, the the multi-media approach. It is believed that this will enable students to perceive practical approach, which they have not perceived in J.S.S. A good knowledge of conversational skills will enhance students‟ ability to perform better in other skills.

It is also recommended that during the tests and examinations, students be examined on using multimedia approach to answer Biology questions. This would urge students on to take Biology lessons seriously. Teachers must not be so fossilized in their method of teaching but they should try to explore other teaching methods and use as many as they can employ to eradicate monotony during Biology lessons. Teachers of Biology must be very resourceful. They must use lots of activities and experiments in learning activities to make their Biology lessons interesting.

Multi-media approach provides a very good source of experiment during Biology practical for students. Teachers should assign students to solve some Biology problems by using Multi-media devices.

On the issue of inadequate teaching aids and Specimen, school authorities should liase with the Parent Teacher Association and other benevolent organizations to help them acquire aids like tape recorders. Authorities should also provide some specimen on Biology topics to be used for practical lessons.

There may be several other methods which could be employed in order to solve the problems associated with the teaching of Biology which are not mentioned in these recommendations. There may be lot of alternative suggestions that further research in the area of Biology would reveal. It is therefore expected that other scholars who are interested in the improvement of learning and teaching of Biology in the SSS would delve deeper into the subject, looking at some of the suggested areas for further research below;

(1). The effects of abstract teaching influences students Biology knowledge.

(2). Analysis of students‟ Biology errors.

(3). How motivation and constant practice influence good performance in Biology practicals.

(4). How lack of or adequate supply of teaching and learning materials help students in their Biology lessons.

5.4 Suggestion for further Studies.

In spite of the modest gains by the study, a few students still encountering some basic problems which mitigating their academic performances that need suggestions.

1. This research work should be conducted in another Senior High School(s) by another researcher with respect to assist students who encounter this subject.
2. The school authorities should create proper school environment and convenient learning situations in order to use the proper concrete habits for proper learning and teaching.
3. Parents and guardians should assist their wards by providing them the basic educational specimen.
4. Government should provide adequate learning and teaching materials which including other logistics for proper running of the school, especially, Biology specimen or materials.

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APPENDIX 1

WEEK ENDING: 16TH MARCH, 2014

DAY / DURATION	TOPIC / SUB – TOPIC ASPECT	OBJECTIVE / R. P. K	TEACHER – LEARNERS ACTIVITIES TEACHING LEARNING MATERIALS	CORE POINTS	EVALUATION AND REMARKS
Thursday 15th March 2014 80 minutes	photosynthesis	By the end of the lesson, students will be able to: 1. Define photosynthesis 2. Identify the structure and adaptation of leaf for photosynthesis 3. Explain the conditions that effect the rate of photosynthesis and the biochemical nature of photosynthesis	TLM"s: computer, projector, leaves of plants, variegated leaves, alcohol TEACHER LEARNER ACTIVITIES(TLA) 1. Teacher will use students previous knowledge by asking them to mention some functions of leaves to the	Skill of communication	1. How does the structure of a leaf adapts to its photosynthesis 2. How would you demonstrate that chlorophyll is essential for photosynthesis 3. State the importance of photosynthesis to life in general

		R. P. K students can identify the leaves of plants in their community	plant 2. Students response: green leaves contain chlorophyll which helps plants to prepare their food through photosynthesis 3. Teacher guide students to mention some of the adaptation of the leaf to receive sunlight 4. Students gave some adaptations like broad leaves, in addition to ability to obtain water, mineral salts, and sunlight	Understanding Instructional skills	

			energy 5. Teacher discuss with students factors that affect the rate of photosynthesis 6. Students response: these include sunlight energy, temperature, carbon (iv) oxide, concentration gradient, chlorophyll, water and pollutants. 7. Teacher discuss with students that photosyn-thesis is a complex chemical reaction and		

			this reaction proceed on two stages, light reaction stage (light stage) and the dark stage.		

SUBJECT: ELECTIVE BIOLOGY

REFERENCE: The Teaching Syllabus of Biology Page 14

APPENDIX 2

PRETEST

APPENDIX D

UNIVERSITY OF EDUCATION, WINNEBA

SCIENCE EDUCATION DEPARTMENT

PRE-TEST DATA COLLECTING INSTRUMENT

STUDENTS' KNOWLEDGE OF PHOTOSYNTHESIS TEST (SKPT)

Name of participant .....

Gender of participants .....

School of participant .....

Class of participant .....

General instructions : the following questions are followed by four (4) options lettered A to D. Find out the correct option and circle A, B, C or D to indicate your answer.

1. Photophosphorylation involves ATP ? Adenosine Triphosphate
   a. Production during the light reaction of photosynthesis
   b. Breakdown during the light reaction of photosynthesis
   c. Formation during the dark reaction of photosynthesis
   d. Breakdown during the dark reaction of photosynthesis

2. The net reaction for photosynthesis produces
   a. Water and carbon dioxide
   b. Water and oxygen
   c. Carbohydrate and carbon dioxide
   d. Carbohydrate and oxygen

3. The function of water in photosynthesis produces
   a. Combine with carbon dioxide
   b. Supply electrons in the light-dependent reactions
   c. Transports H^+ ions in the light – independent (dark) reactions
   d. Provide molecular oxygen for the light – independent (dark) reactions

4. A well watched potted green plant is kept in a brightly lighted area for 48 hours. What will most likely occur if the light is then reduced slightly during the next 48 hours?
   a. Photosynthesis will stop completely
   b. The rate at which nitrogen is used by the plant will increase
   c. The rate at which oxygen is released from the plant will decrease
   d. Glucose production inside each plant cell will increase

5. Which of these statements concerning chloroplast is false?
   a. They make some amount of ATP to drive some of the photosynthetic process
   b. They have DNA separate from nucleic DNA
   c. They contain granae
   d. They have a fluid matrix called stroma

6. Which of these statements about photosynthesis is false?
   a. Photosynthesis is initiated by the absorption of light energy by chlorophyll molecules
   b. The chlorophyll molecules of illustrated chloroplasts are raised to a higher energy level
   c. The biochemical activities of the light reaction occur in the granae
   d. Some of the energy of the excited electrons is used to split carbon dioxide into carbon and oxygen

7. All the following statements are correct regarding the light independent (dark) reactions of photosynthesis EXCEPT
   a. The energy source utilized is the ATP and ~~NAD pH~~ NADP obtained through the light reaction
   b. The reaction begins soon after sundown and ends before sunrise
   c. The five carbon sugar is constantly being regenerated
   d. One of the end products is PGAL

8. The main purpose of the dark reaction of photosynthesis is the production of
   a. Oxygen b. $NADP^+$ c. carbohydrate d. carbon dioxide

9. The essential initial role of light in initiating the light reaction of photosynthesis is to produce
   a. Free neutrons b. free electrons c. free oxygen
   d. free energy in the form of ATP

10. As far as the light reaction of photosynthesis is concerned, ~~what is the role of oxygen?~~ What is the function of oxygen.

Appendix F (SCORING SCHEME)

1.	A
2.	D
3.	B
4.	C
5.	B
6.	D
7.	B
8.	C
9.	B
10.	B
11.	False
12.	True
13.	True
14.	True
15.	False

Separate item from this, part of main

(Scoring: 1 mark) sub-total = 15

16. Photosynthesis is the process by which green plants manufacture their own food (1 mark); using simple (inorganic substances like) carbon (iv) oxide and water (1 mark); in the presence of sunlight (1mark); producing oxygen as a by-product (1 mark).

Any 3×1 = 3

17. Events which occur during the dark or light – independent stage of photosynthesis:
(i) Fixation of carbon (iv) oxide or carbon-fixation (catalyzed by ribulose, producing 3 – phosphoglycerate, 3PG). (1 mark)
(ii) Reduction of 3PG (to form glyceraldehydes 3 – phosphate). (1 mark)
(iii)Regeneration of (the CO2 acceptor) ribulose 1, 5 – bisphophate, RuBP, (by ATP) 1 mark

Any 2×1 = 2

18. (i) starch (1 mark)
(ii) Iodine test (1 mark)
19. When the chlorophyll molecule absorbs a proton (light energy), it may be:
(i) Excited/activated/has some of its electrons move to higher levels or further away from the nucleus. (1 mark)
(ii) Loose electron(s) to an oxidizing agent and becomes reducing agent which takes part in a redox reaction). 1 mark

APPENDIX 3

POST TEST

(3) USING MULTIMEDIA TO ENHANCE THE TEACHING OF BIOLOGY, A CASE STUDY AT TECHIMAN S.H.S

Using the Multimedia Approach to enhance teaching of Biology at Techiman Senior High School.

APPENDIX E

UNIVERSITY OF EDUCATION, WINNEBA

SCIENCE EDUCATION DEPARTMENT

POST TEST DATA COLLECTING INSTRUMENT – STUDENTS'

ACHIEVEMENT IN PHOTOSYNTHESIS TEST (SAPT)

Name of participant:.....

Gender of participant:..... class of participant:.....

School of participant:.....

GENERAL INSTRUCTIONS: This test contains twenty (20) questions grouped in three (3) sections, namely

Section A

MULTIPLE CHOICE QUESTIONS

INSTRUCTIONS: The following questions are followed by four (4) options lettered A to D. Find out the correct option and circle A, B, C or D to indicate your answer

1. An inorganic molecule required by green plants for the process of photosynthesis is .....
   (a) Oxygen molecule
   (b) Starch
   (c) Carbon dioxide
   (d) Glucose

2. Which of the following activities occur in the process of photosynthesis?

   (a) Chemical energy from organic molecules is converted into light energy

   (b) Organic molecules are obtained from the environment

   (c) Organic molecules are converted into inorganic food molecules.

   (d) Light energy is converted into the chemical energy of organic molecules.

3. Which reactions are involved in the process of photosynthesis?

   (a) Photo chemical reactions, only

   (b) Carbon – fixation reactions, only

   (c) Photo chemical and carbon-fixation reactions.

   (d) Neither photo chemical nor carbon – fixation reactions.

4. What biological process is described by the equation below? $2H_2O \xrightarrow{light} 4H^+ + 4\,e^-$

   (a) Photolysis of water

   (b) Dehydration of water

   (c) Oxygen synthesis from water

   (d) Electron production form water

5. The oxygen given out during photosynthesis comes out from .....

   (a) The breakdown of carbon dioxide

   (b) The breakdown of water

   (c) Surplus oxygen taken into the plant

   (d) The combination of carbon dioxide and water

6. The stacks of flattened numbranous sacks in the chloroplast containing chlorophyll are called

   (a) granae

   (b) lamellae

   (c) cristae

   (d) membranes

7. Which of the following activities occurs in the process of photosynthesis?

   (a) Chemical energy from organic molecules is converted into light energy.

   (b) Organic molecules are obtained from the environment.

   (c) Organic molecules are converted into inorganic food molecules

   (d) Light energy is converted into the chemical energy of organic molecules.

8. Which of the following processes does not occur in the calvin cycle?

   (a) Production of glyceraldehydes – 3 – Phosphate.

   (b) Formation of $NADPH^{+}$

   (c) Formation of pyruvic acid.

   (d) Utilisation of carbon dioxide

9. Which of the following cells of the leaf lack chloroplasts?

   (a) Guard cells

   (b) Ordinary epidermal cells

   (c) Palisade mesophyll cells

   (d) Spongy mesophyll cells

10. A plant with pink leaves and stem is capable of photosynthesizing because it .....

    (a) Has special cells which can photosynthesise

    (b) Has chlorophyll which has been masked

MARKING SCHEME FOR APPENDIX E (APPENDIX G)

1. C
2. D
3. C
4. A
5. B
6. A
7. D
8. B
9. B
10. B
11. True
12. True
13. False
14. True
15. False

Scoring: 1 mark each, sub total = 15

(16) Substances formed during the dark or light-independent stat of photosynthesis include:

(i) ADP **(1 mark)**

(ii) NADP **(1 mark)**

(iii) Carbohydrate / Sugar / Glucose / Triose sugar / 3 phosphoglycerate (3PG / PGA) / Glyceraldehyde 3 – phosphate (G3P/PGAL)/ starch. **(1 mark)**

(iv) Ribulose 1, 5 – bisphosphate (RUBP. **(1 mark)**