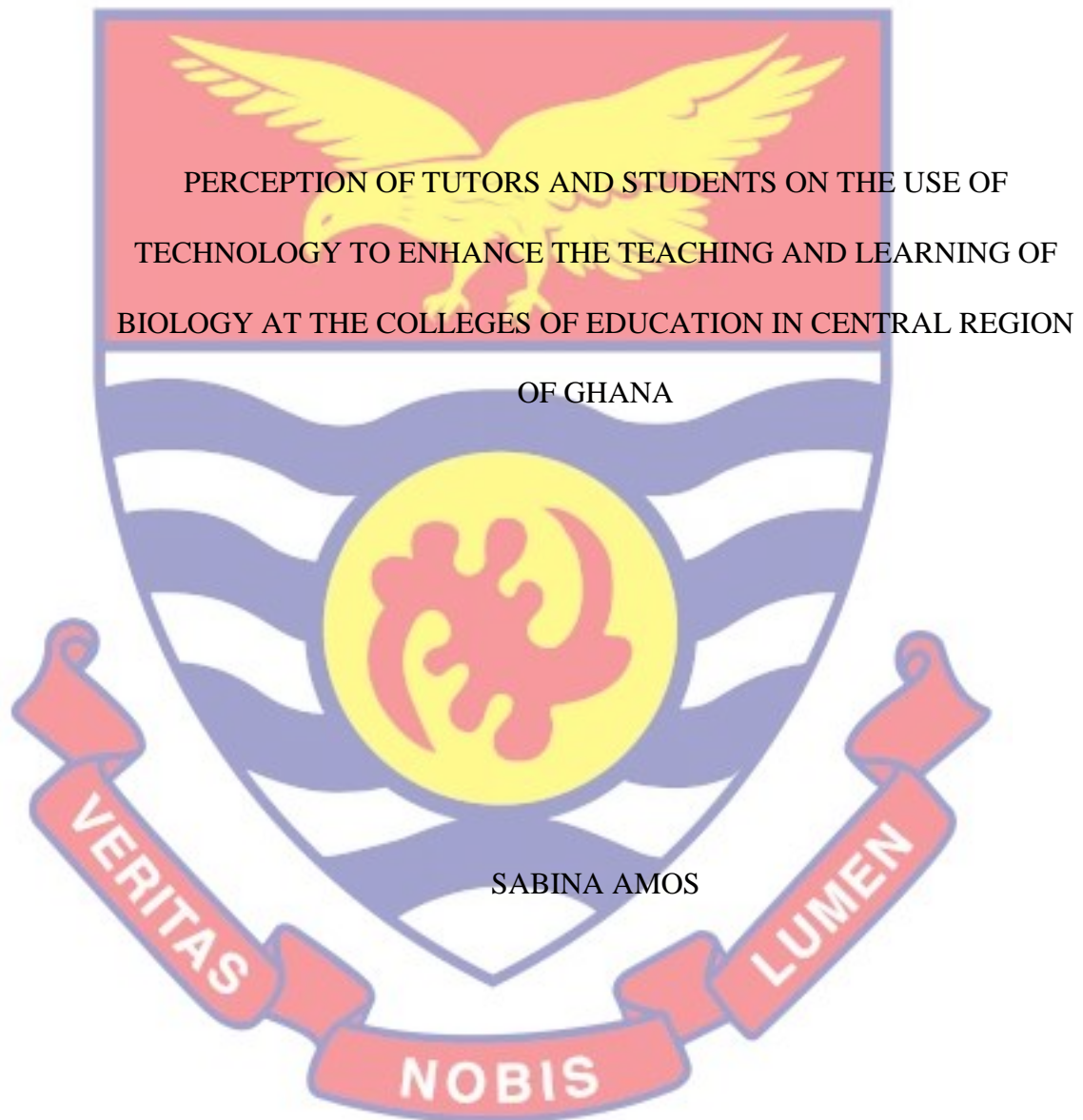


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PERCEPTION OF TUTORS AND STUDENTS ON THE USE OF
TECHNOLOGY TO ENHANCE THE TEACHING AND LEARNING OF
BIOLOGY AT THE COLLEGES OF EDUCATION IN CENTRAL REGION
OF GHANA

BY
SABINA AMOS

This thesis submitted to the Department of Basic Education of the Faculty of Educational Foundations, College of Education Studies, University of Cape Coast, in partial fulfillment of the requirements for the award of Master of Philosophy degree in Basic Education

AUGUST 2022

DECLARATION

Candidate's Declaration

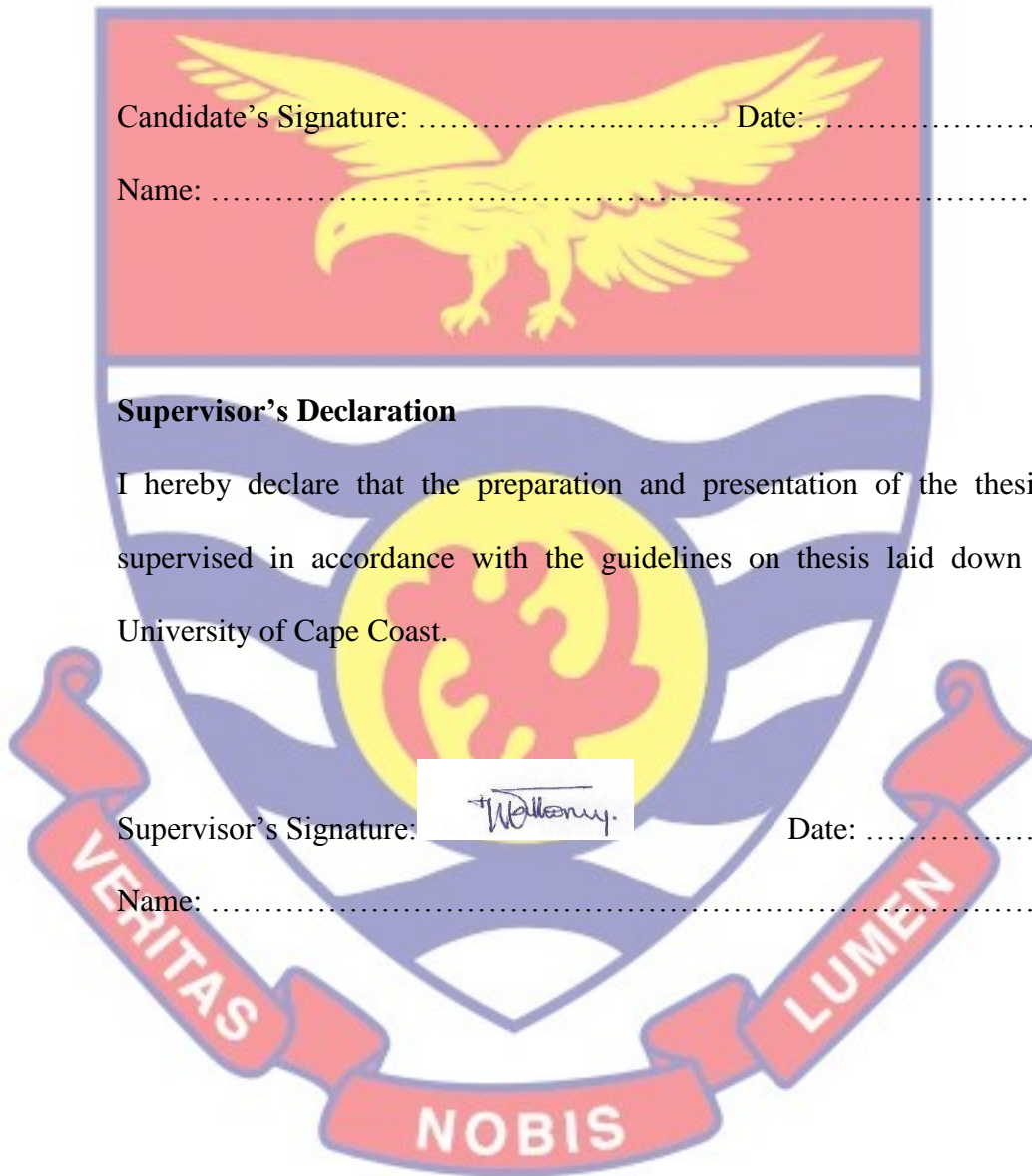
I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature: Date:
Name:

Supervisor's Declaration

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

Supervisor's Signature:  Date:
Name:



ABSTRACT

In Science, especially biology, technology has become an effective instructional device, facilitating the study of abstract topics. Descriptive study design was used to investigate perception of tutors and students on the use of technology to enhance the teaching and learning of biology at the Colleges of Education. A total of 240 Level 200 Students and 15 Science tutors were polled for collecting data using a questionnaire. The three Colleges of Education used a combined sample size of 225 students. Participants ranged in ages from 21 to 30 years and 35-50 years level 200 Students' and Tutors respectively. The students were in their second year of degree programme. The findings showed that level 200 students generally find it difficult using Technological tools in studying. Instead, majority of the students and their tutors use internet in teaching and learning processes. Furthermore, inability of tutors to use various technological tools stems from a lack of expertise, as well as a scarcity of instructional software and hardware in the Colleges of Education. Technological and technical support system should be provided in all colleges so as to ease the problems of technological failures in the colleges. Regarding factors that hinder effective use of technology in teaching and learning of biology. The researcher recommends colleges to find solutions to some of the issues by engaging experts outside the colleges of Education.

KEYWORDS

Hardware

Instructional Technology (IT)

Software

Biology

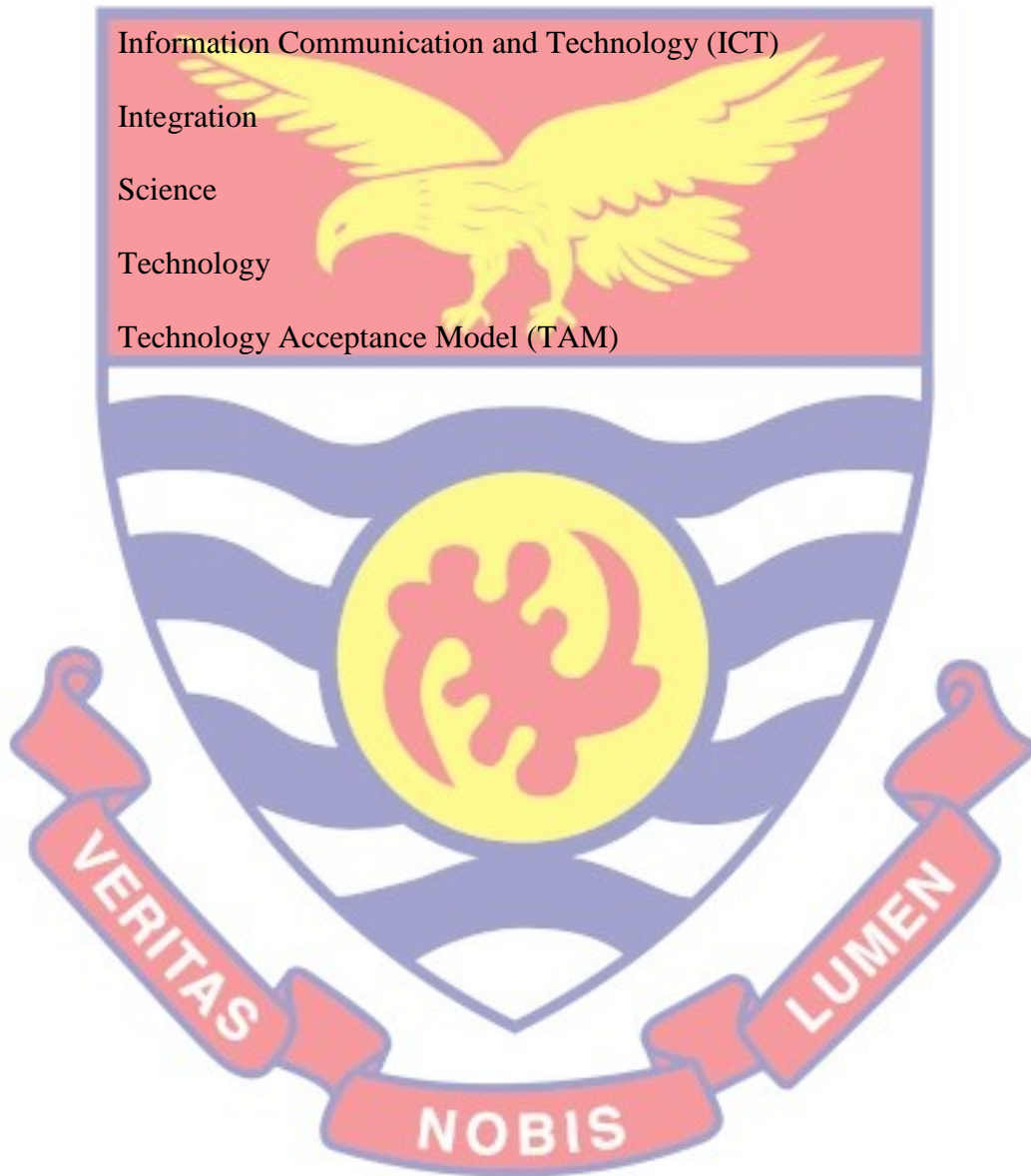
Information Communication and Technology (ICT)

Integration

Science

Technology

Technology Acceptance Model (TAM)

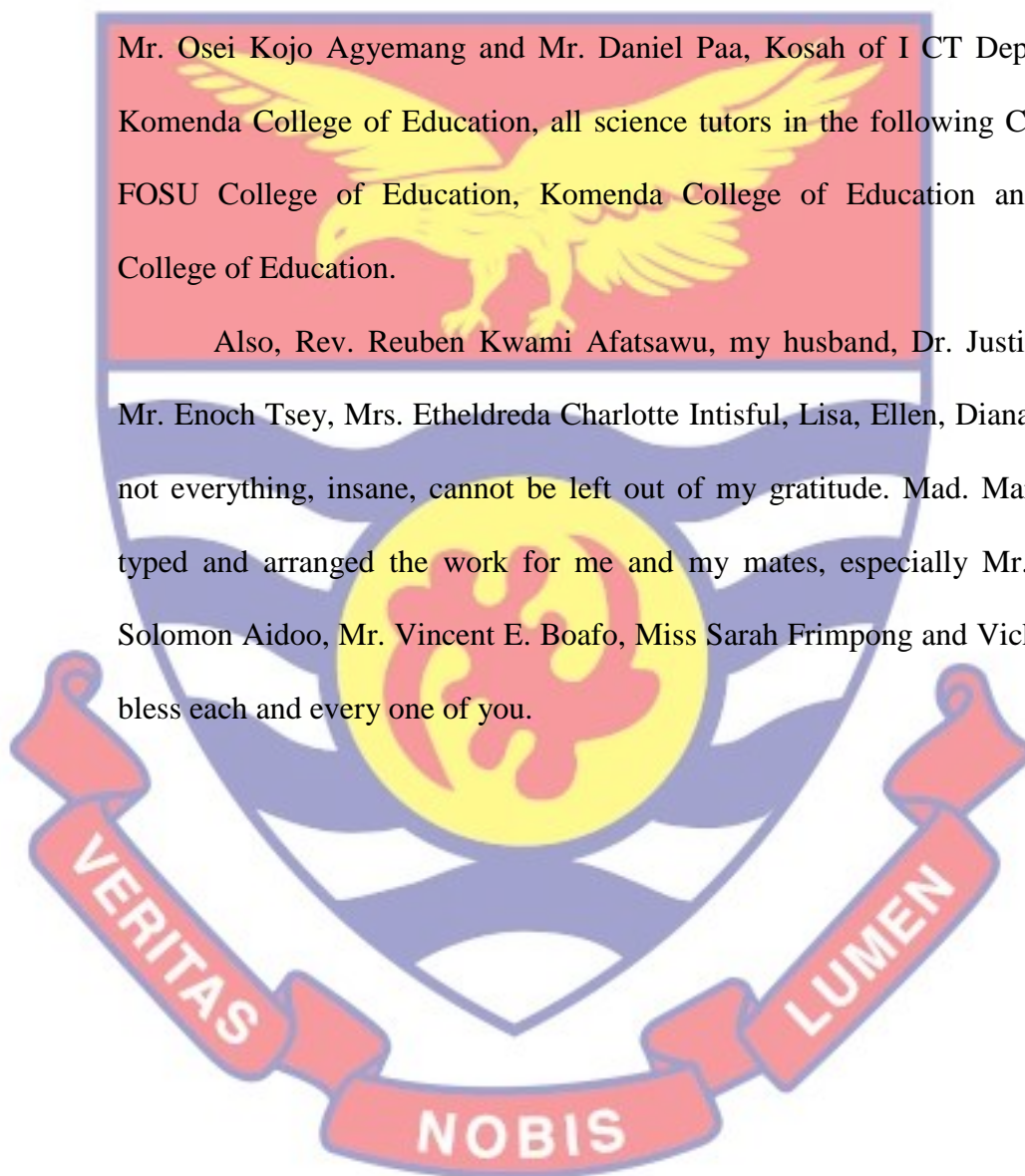


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DEDICATION

To my family and friends



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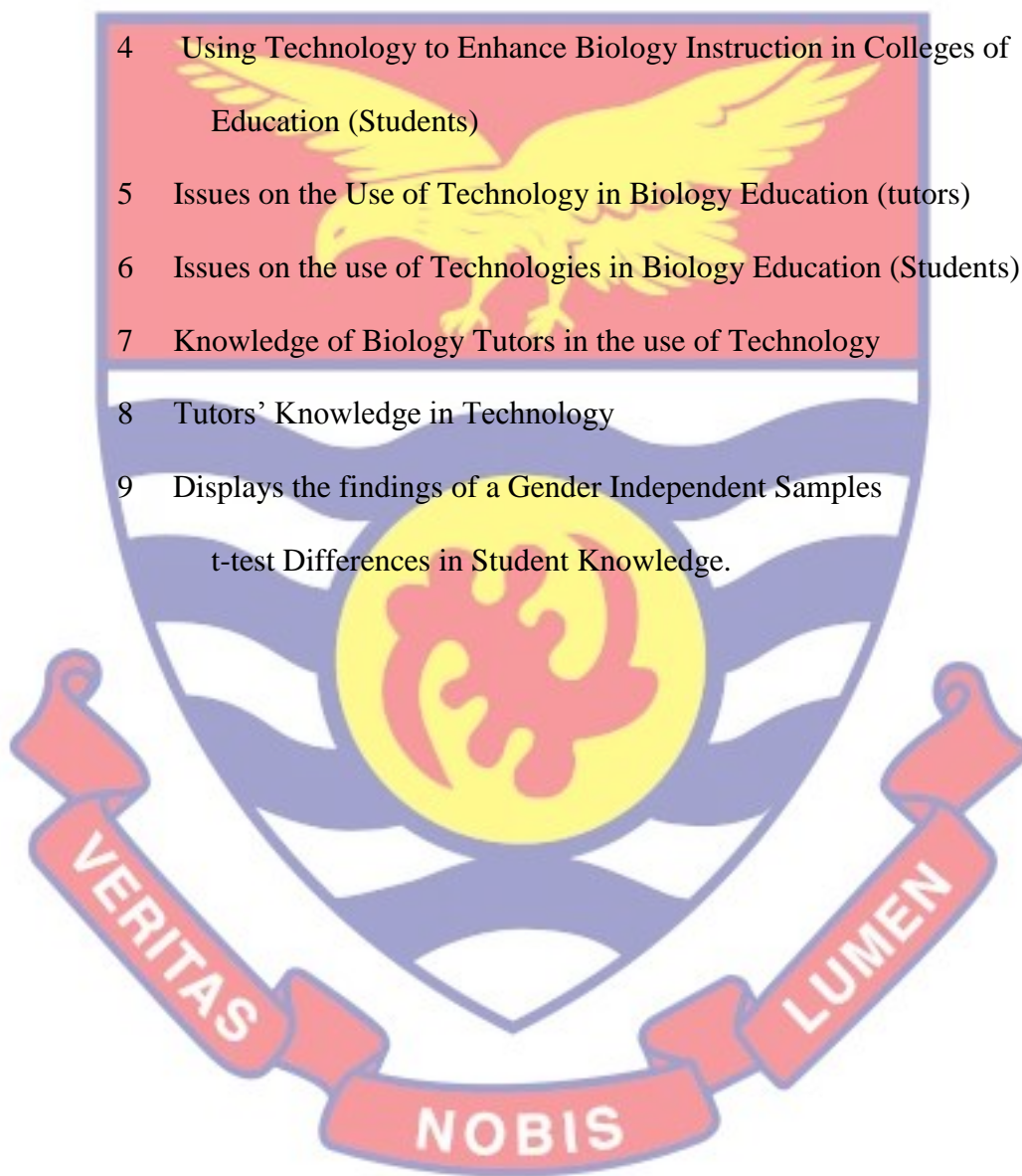
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CHAPTER ONE

INTRODUCTION

Studying biology as a college subject has improved people's understanding of their immediate environment and its importance when "technology" is use in the teaching and learning of biology at Colleges of Education in a developing country like Ghana. Colleges of Education in Ghana should prepare students in the teaching and biology using technology effectively in this new era of technology. Volman and Van Eck, (2001) are of view that, Technology usage has created strong acquisition of knowledge that has strengthened the teaching and learning process which has made students able to manage their own learning using technology effectively.

The term "technology" can be seen as a major issue in many fields, particularly biological education, in the 21st century. According to Ghavifekr, Afshari, and Amla (2012), are of the view that, universities can team up with different academic organizations to design structures that can modify the students means of learning in an "information society", that demand incorporates technology into existing course of study in all walks of life.

Technology integration explains how Instruction Acquisition makes the effort to blend subject based education for everyday classroom Teaching and learning. Tutors become instrumentalists in the application of applied science in their regular courses, as well as educating students for the modern digital era. This is attributed to technology's potential to create a diverse and proactive learning experience for students.

According to, Albirini, (2006, p.6), “Although technology integration seeks to strengthen and enhance the consistency, accessibility and cost-effectiveness of teaching delivery to students, it also refers to the advantages of networking learning groups to address the challenges of current globalization”.

In education, subject area integration usually means the world is influenced by the advancement of technology and biology, which have greatly contributed to the convenience and comfort of humans. Technology is used at home, church, market and workplaces for so many activities. In other words, how data is accessed, gathered, processed, displayed, distributed and simulated can be done by technology. Through technology, student’s achievement has been improving the success of people.

According to Plomp et al., (1996) today’s technological application can be realized as the major instrument which encourages modern methods in the teaching and learning process. It is used to build teamwork, engagement, problem resolution and long education skills for students. The incorporation of technological knowledge as seen in a goal favourably impacting instruction with acquisition has developed over the past 20 years (Dias & Atkinson, 2002). Technological ideas enhance the normal teaching and learning through instructive and subjective information, example acquisition of knowledge, and content with more educational methods which are used in the classroom. (Flanagn & Jacobson, 2003).

The economy of the 21st century, in line with changes in society, needs tutors and students to be well aware of new electronic knowledge, to accept

computer technology and other types of media in order to stay competitive in the global job market.

Technology enables teachers in biology to explain things and complex processes that are difficult to imagine. For example, the inside of a living cell is difficult to imagine of scientific knowledge for enhanced learning. In addition, biology teachers thought that when they could convey life processes using motion pictures and animations to display living objects opposed to static written texts, teachers could teach better. This suggests that computer-free learners are at risk of being left out of business opportunities worldwide.

The visual depiction of the learning component is simplified by technology. Visual and active participation accounts for 80% of learning among students. Thus, the visual presentations of a particular topic by the student may easily be grasped by allowing tutors to talk less to deliver more hands-on activities that will shout the following benefits, reducing time barriers

Background to the Study

Technology is necessary for the development of information and procedures in order to create structures that solve challenges and extend human ability. In other words, how data is accessed, stored, processed, presented, distributed and simulated can be modified by technology. Webber (2003) is of the view that, the influence of technological content display important role on tutors and learners but pose a great challenge in educational system as its control in use cannot be verified at all times.

Technological incorporation can be used in teaching all subjects with ease. It gives room for adding or modifying to suit a specific topic (Flanagan

& Jacobsen 2003). In practice, innovative usage of technology will encourage student-centered teaching (Drent, 2005). Technology aid learning approaches by improving the knowledge of the students through hands on activity. Every teacher in the classroom should therefore make sure education on technology can be intensified through the teaching and learning of biology which requires reasoning and judgment of students in the subject. Therefore, recent trends focused on what really occurs in the classroom with computer technology.

Technology integration encourage autonomous self-paced learning and since biology tutors play a significant role in the teaching and learning paradigm transition, the potential of technologies may not be maximized if there is no improvement in the learning and teaching paradigm. Indeed, recognizing the pedagogical, psychological and behavioural barriers to the productive use of technology that has essential precondition in improving how it is use in the teaching and learning of biology (Benzie, 1995). In this world of globalization, information technology has become the most important method for biological science. In contemporary times, the use of technology is the order of the day. Learners need to be prepared to participate in dialog with their tutors with each other openly, without any display of ego.

Students need to be educated in the sense of open discourse and inquiry in order to formulate their own theories and challenge the theories of others. Technology is a vast set of tools and services for communication and management. The effect of technology on education cannot be overemphasized (Tinio, 2003). Technology eliminates space and time challenges that allow students to communicate their ideas in a short possible time. Technology makes it simple to serve and share information, learners can

generate record notes and presentations separately or together, record their progress and use them in examinations. Technology allows world wide access to information, acquiring scientific knowledge, access to natural event, and world-class training on complex task with their step by step approaches.

Technology is a paragliding concept that playwright innovative communicating tools and device that improve teaching and learning in the classroom. Technology is seen as a worldwide approach in seeking for solution to our day-to-day problem in the process of teaching. Technology can be seen as the multimedia devices, networks and services which is characterized as a mixture of video, monitor, and telecommunications techniques. Recognize the fact that it is possible to describe technology in several respects. Technology is a diverse set of technical resources and one of the meanings used simply in putting data,

Technology is used for the management and support of communication data, which facilitates learning. Biology is a subject commonly studied and generally studied in the abstract. Awareness of this requires a balanced education in Secondary Schools.

Technology has accurately and economically transformed Education, aviation, agriculture, development, and so on are all facets of human life. Inside Ghana, most students and schools tend to be lacking resources, such as technical facilities. Perhaps the effect of media tools such as projectors will enhance the subject's teaching and learning.

Statement of the Problem

When tutors and students in tertiary institutions use technologies in teaching and learning biology, a larger number of qualified teachers are

produced per year. The students might not have seen an organism they have learnt about physically but for the use of technology. The idea where by students are given organism only in an examination room to identify its parts create a lot of difficulty in the mind of the students because they have no idea about what has been given to be labelled.

In addition, some tutors' attitudes towards the use of technical resources in classrooms are not motivating enough, because tutors often use their computers to simply present their lessons without any technical know-how that will make the subject being discussed interesting.

Purpose of the Study

The purpose of the study is to survey the perception of tutors and students on the use of technology to enhance the teaching and learning of biology at Colleges of Education in Central Region of Ghana. It is also to find out the knowledge of tutors and students on the use of technology in the teaching and learning of Biology.

Also, the study explores the perception of the tutors and students on factors that affect the teaching and learning of biology use when technology is used at the colleges of Education in Central Region of Ghana.

Research Questions

To find out the perception of tutors and students in the teaching and learning of biology using technology, the researcher posed the following research question that aid in to the findings of the study.

1. How do tutors use technology to enhance the teaching and learning of biology at Colleges of Education in Central Region of Ghana?

2. To what extent does the use of technology promote biology teaching and learning at Colleges of Education in Central Region of Ghana?
3. What are the factors that affect the use of technology in the teaching and learning of biology in the Colleges of Education in Central Region of Ghana?
4. What knowledge do tutors and students have about the use of technology in the teaching and learning of biology at the colleges of education in central region of Ghana?

Research Hypothesis

H₀: There is no difference between the knowledge of male and female students in the use of technology in studying biology.

H₁: Male and female students use technology to study biology.

Significance of the Study

The findings explore effective way of enhancing the use of technology to teach biology in Educational colleges in the Central Region of Ghana. It would also make biology teaching more realistic than purely theoretical studies. Finally, as they move to the wider world, it introduces students to different forms of searching for internet knowledge using various technological resources on their own and also extends to their teaching in their schools. In the design of their curriculum, the results of this research would be critically examined by teacher training institutions for better improvement in the process of acquiring information in this technological era. Also results from the study can serve as a plan in which organizations can use to update course of study in teacher Education in Ghana, by seeking ways to analyze in depth whether or not the existing curriculum enables tutors to integrate

efficient technological tools in their Biology lessons since, it has been discussed how biology teaching can be improved with the use of technology integration. This will also help learners who practice to overcome the challenges of using technology in searching for information. It will enhance conceptualization and thus contribute to progress in the academic performance of students.

The results will also enable other researchers to undertake more research in this area by widening it to other subject areas in Ghana. This would further extend the literature relating to the field of incorporation of technology; thereby making a substantial contribution to the body of information on the same subject at various locations this study will offer educators and students the opportunity to use technology to design new teaching environments as a tool for their own further studies. This research aims at enhancing the use of technological tools to teach biology by combining various strategies such as the use of video streaming, science sports, tweeting, podcast, cooperative operation, etc. Even though, Tutors and students face some difficulties when using technical resources to teach and learn biology, but they remain focused on using technology to teach and learn biology. The aim of instructor development initiatives is to assist potential educators to explore higher in their education.

Delimitation

The researcher was only interested in using technology to enhance biology teaching and learning in Ghana's Central Region colleges of education. Although there are many variables in the teaching and learning frameworks that assess the extent and efficacy of the inclusion of technology,

what has been studied is just how it can be enhanced and the impact it can have on teaching and learning of biology. The analysis was also limited to level 200 students and the science tutors in the core area of the studies.

Limitations

The expansion of this study to other areas of the nation will be constrained by the time and finances available. This research was limited to three Educational colleges in Central Region. Not all the other Academic Institutions were considered. The data obtained from this study might therefore not be appropriate to generalize the whole of Ghana's Educational Colleges.

Definition of Terms

Hardware: Refers to the physical and tangible components of educational technology

Instructional Technology (IT): The use of products and services to facilitate the teaching of scientific material, including both hardware and software.

Software: Refers to virtual systems that can be mounted, managed and used for instructional purposes.

Biology: Is the field of study which talks about the knowledge on organism that have life and those that do not have life in them.

Information Communication and Technology (ICT): Is a diverse collection of technical instruments which is use in the study to reach, acquire, control and display or communicate information.

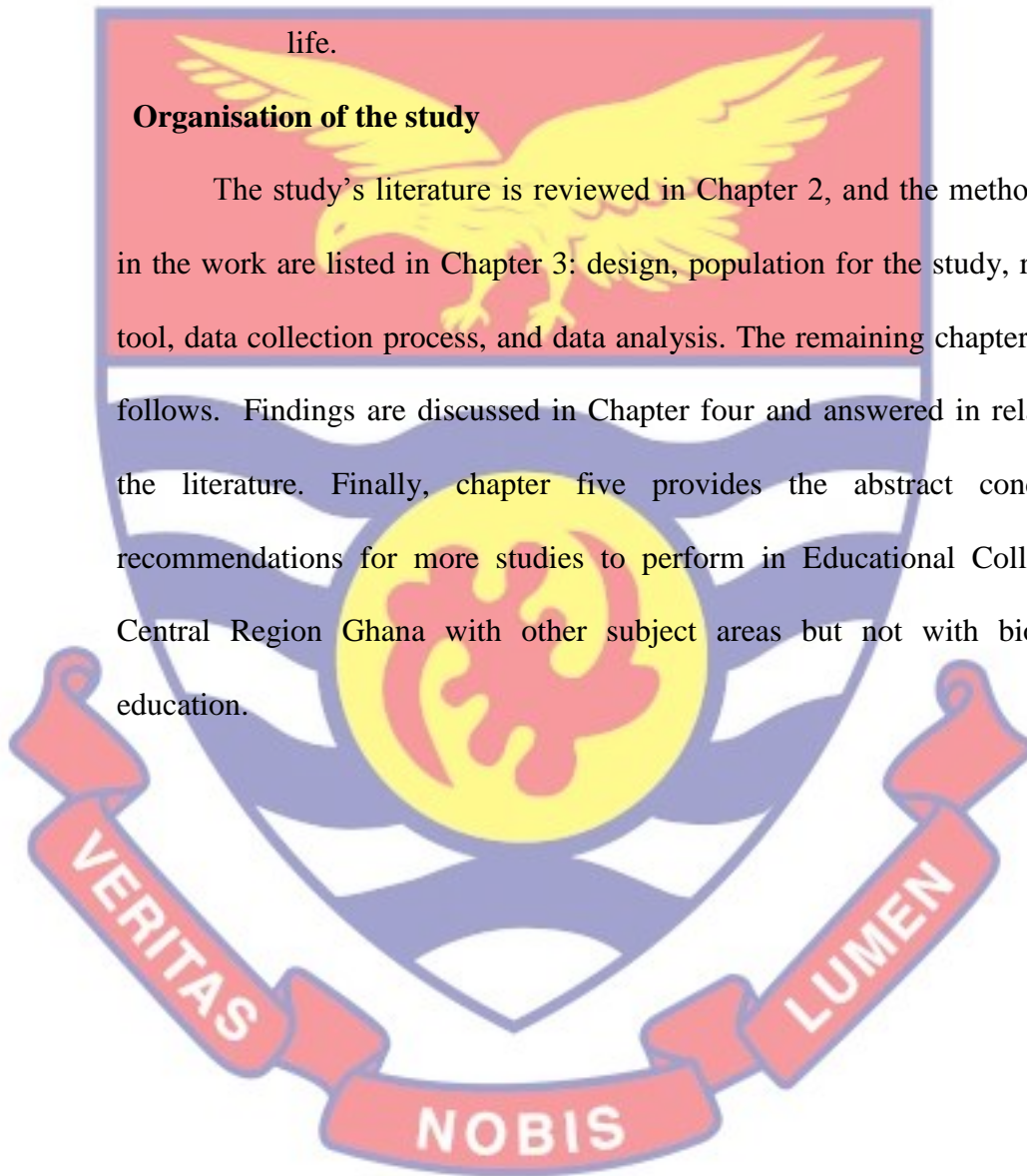
Integration: In a report, components, sections or elements are seamlessly integrated into a complex yet harmonious whole.

Science: it is a trunk of regulated knowledge which brings about the explanation of organized concepts in an orderly content of natural phenomena.

Technology: is the application of scientific knowledge to the design of goods, systems, and processes that have an effect on people's quality of life.

Organisation of the study

The study's literature is reviewed in Chapter 2, and the methods used in the work are listed in Chapter 3: design, population for the study, research tool, data collection process, and data analysis. The remaining chapters are as follows. Findings are discussed in Chapter four and answered in relation to the literature. Finally, chapter five provides the abstract conclusion, recommendations for more studies to perform in Educational Colleges of Central Region Ghana with other subject areas but not with biological education.



CHAPTER TWO

LITERATURE REVIEW

Introduction

In order to examine their contributions to technology incorporation in the teaching of biology, this chapter concentrated on the works of other scholars. It looks at the conceptual structure, theoretical framework and empirical studies in the three Colleges of Education as seen in Central Region of Ghana on the subject which improve teaching and learning of biology.

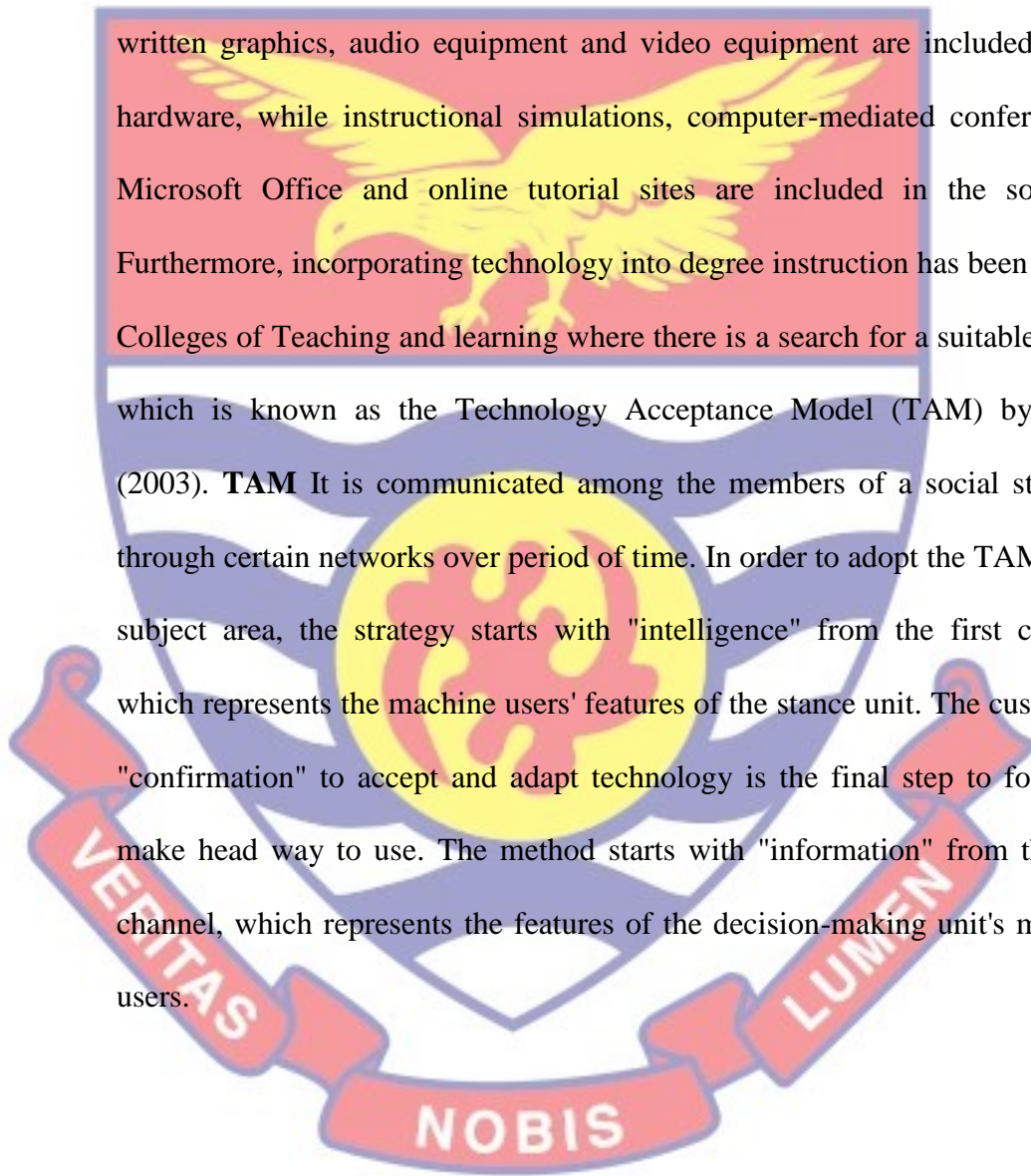
Conceptual Framework

Technology is used in our homes, our schools, our vehicles, market and church, has become widespread. Students, Education body, nurture workers, People are calling for technological integration into classroom instruction in general. To put it another way, technology is being introduced into the classroom, and as more schools adopt it, innovative approaches to teaching are being applied.

The successful use of technology will help to improve teaching and learning. Technological tool is defined by Lucido, and Borabo (1997) as the aspects of educational technology that are concerned primarily with instruction. Biology concepts and processes in various areas are not possible without technology. The materials of technology have been divided into two categories: software and hardware which can be strengthened with the effective use of technology. Lucido and Borabo (1997), describe technology as the elements of educational tool that are specifically concerned with

education. This can be used to promote the educators of biological concepts and processes in a variety of ways that are impossible to do without the use of technology. The hardware is equipment or physical components, while the software is programs or instructions for guiding hardware to perform data processing functions (Camarao,1991). In addition, written text, projectors,

written graphics, audio equipment and video equipment are included in the hardware, while instructional simulations, computer-mediated conferencing, Microsoft Office and online tutorial sites are included in the software. Furthermore, incorporating technology into degree instruction has been seen at Colleges of Teaching and learning where there is a search for a suitable model which is known as the Technology Acceptance Model (TAM) by Davis (2003). TAM It is communicated among the members of a social structure through certain networks over period of time. In order to adopt the TAM to the subject area, the strategy starts with "intelligence" from the first channel, which represents the machine users' features of the stance unit. The customers' "confirmation" to accept and adapt technology is the final step to follow to make head way to use. The method starts with "information" from the first channel, which represents the features of the decision-making unit's machine users.



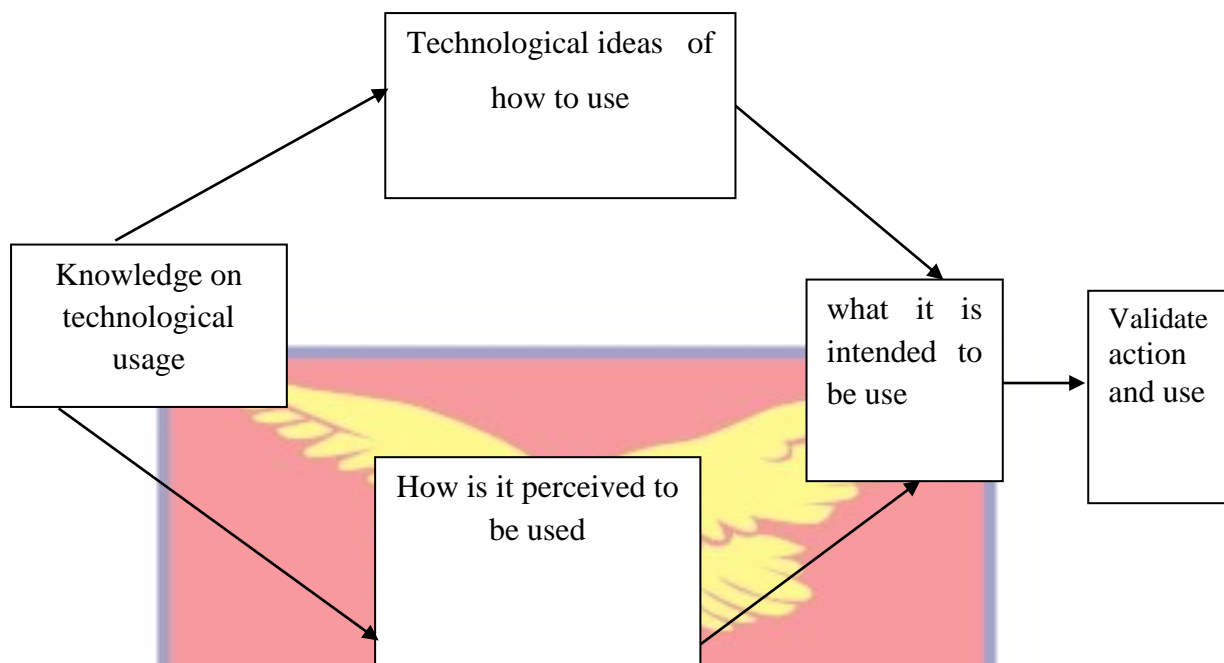


Figure 1- Conceptual Model of the study

Authors construct 2021

The study model outline various factors that directly relate with the core intention of the study which explains how knowledge and perceptions will affect the perceived usefulness and ease of use of technology integration in Colleges of Education. The issues surrounded in the conceptual framework have been exactly interlaced, so that the interrelation among them will constitutes the effectiveness on technology integration in the teaching and learning by the classroom tutors. Though the intension of integrating technology in to the teaching and learning process by the tutors are the main adjustable variable that supports the conceptual model such as ease-of-use, functionality, flexibility, accessibility and integration. Not all, the intention of tutors to use technology is strongly emphasizes on the perceptions on the usefulness of the system as well as perceived ease of use and the determines that actual improve the use of technology in teaching.

In general, a conceptual approach involves a variety of variables that are closely linked to the study's main objective that explain how skills and attitudes affect the perceived of use utility and ease of instructional design usage in the teaching and learning process of science. One need to have an idea of technological usage before a learned concept can be apply using technological tools. The variables in the framework have been carefully intertwined so that their interactions can be used to determine overall effectiveness in integrating technology by teacher in the teaching and learning process. The purpose of tutors integrating technology into teaching is the primary variable that promotes key components of the TAM system. The TAM system has the following features as ease of use features, usability, accessibility, and incorporation. Furthermore, educators' expectations of its system's utility as well as its relative advantage of use have a significant outcome in the desire to use technology in decision making process. The framework which guided this study, looked into the variables that make it easier for college tutors to incorporate technology into their teaching and learning process.

Technology in Biology Education: A Brief History

Through with efficient usage of technological information, teaching and learning can be strengthened. Lucido, and Borabo (1997) describes these educational technologies as the elements of Educational technology that are predominantly concerned with instruction. It can be used in ways feasible without technology to enable the teaching and learning of biological concepts and processes (Camarao,1991).

Projectors

An LCD projector that adds interest and interactivity to lessons is one main tool tutors use through a simple USB link, a white board, and a projector stand, these lightweight projectors easily project something that is already on your device. Teachers who use projectors say it offers new ways to

meet students,

Furthermore, a study has it that, LCD (liquid crystal display) projectors suggested that this educational technology can provide even more creative displays where students can experience the lesson on a larger screen that improves teaching and learning.

Printed visuals

Study indicates that students make sense of a visual scene more quickly than a spoken or written scene; that when they are viewed in visual form, people learn abstract, modern, and novel ideas more easily (Salomon, 2002). Other empirical evidence indicates that printed visuals make concepts more accessible than text media to an individual (Cowen, 1984). Visuals improve the visual literacy of a student's ability to understand, make sense of, and communicate by visual means, generally in the form of photos or multimedia, according to Wikipedia.com. Some of the printed visuals include pictures, charts, diagrams, sketches, posters, and maps. The aim of printed visuals is to support students who do not use standard printed images to make biological learning real. Graphics help to explain biological concepts just as printed pictures

Audio equipment

From music and language teaching to archival recordings of lectures, audio can be used in various academic ways. Making audio content available can be a great way to meet learners who can listen at any time and from any place. Increasingly, devices such as radio, speakers, microphones and voice recorders make this material open to students and, luckily, it is becoming increasingly easier to use the means of dissemination (Presto, 2009).

Video equipment

There is an equally growing market for videos in the education arena, including Audios. DVD and CD players, television, computers and video tapes or discs make these available, but they are not limited to them. Teaching with videos strengthens the awareness of concepts. Videos can be used by fields of science, especially biology, to present life processes and features such as locomotion. Videos allow educators to educate students beyond what is available in the classrooms and in the current setting. In certain cases, video can be as good as a teacher in communicating information or presenting techniques to assist in mastery learning, where a student can see as many times as they like a complicated technique.

Instructional Simulations

The study describes integration of technology which enhance the quality of teaching and learning outcomes in colleges of Education in Central Region of Ghana. Technology Acceptance Model (TAM) by Davis (2003), has been identified and adapted to the research setting as the conceptual framework for this study (Figure 1). The process will start with “knowledge” of the first channel that represents characteristics of the decision-making unit

by technological users in order to integrate the technology into teaching and learning of biology. The model ends with “confirmation” by the users to accept technology to be able to integrate it in to the teaching and learning process. TAM theory is made up of various parts which is representing the process of Technology acceptance by the users including; behavioral intension, perceived usefulness and perceived ease of use. While, perceived usefulness refers to the degree to which person believes on the benefit from the use of a particular technology improving on tutor’s performance on the use. Perceived ease of use which stress on the importance of a technology being user friendly for the users as the tutor or student. Typically, TAM theory was established to find out the usefulness of technology in improving on the value and effectiveness of a particular technological system in use. It is also use to measure one of the most influential theories in contemporary information systems in the classroom setting of this study. However, the theory has evolved with more specific variables explaining how a user can accept a technology over a period of time.

Online simulations provide students with an excellent opportunity to work as extension of the classroom or as a substitute for the real thing in a realistic learner-focused setting (O’Neal, 2007). In an article written by O’Neal (2007), he argues that, while teachers say that students thoroughly enjoy online work and virtual activities, the use of simulations in the classroom has been intermittent. There is a shortage of finance and capital to move deeper into the simulated universe that make teaching and learning interactive.

Computer-mediated Conferencing

Computer-mediated communication, such as emails, messaging on social media sites and chat rooms, is also intended to distance education, although, the usage of databases, electronic lectures and computer conferences (Berg & Collins, 1995). Researchers have argued that this teaching tool helps students to consult home pages and engage in interest groups online or even promote teaching and learning processes for students. Students using emails learn that the truth is that students using emails find that more than posted office hours are available to the faculty. In discussions of shared educational interest, they can also discover and learn to use educational opportunities that exist outside the limits of campus (Hassett et. al, 1995).

Microsoft Office

Microsoft Office offers free e-mail, blogs, online document editing, networking and video conferencing for teachers and students. Word processing (MS Word), MS Power Point, MS Excel and many more are included. These apps provide teachers with the convenient and easy development of the requisite teaching and planning papers for presentations and reports.

Online Tutorial Sites

Millions of user-generated and professional videos are hosted by these pages. Videos and online animations, such as simulations that allow students and teachers to see phenomena that can be too dangerous, distant, beyond scale (both macro and micro), are one of the most widely accessible websites in the Ghana. YouTube offers videos that can also be used to promote student learning of content for distinction. According to an article published on Educ.

Teacher.com, one of the largest benefits of someone using YouTube is the ability to post projects for other students, professors, and family members to see. Anyone can create a free you tube page, especially with a Mobile App for School account. Some schools or educators may construct one solely for student projects.

Class Website

Among the most significant advantages about using video, according to an article published in Educ, is the ability to share projects with other students, teachers, other relatives. Everyone, particularly those with a Google Services for School account, can create a free YouTube channel. Other colleges or educators may decide to build one specifically for student-run businesses.

Wikipedia and Class Blogs

In the school, a variety of Web 2.0 tools are currently being used. Wikipedia is a collaborative editing platform that enables several users to work on the same document. Finally, they create a file that has been carefully edited and is genuinely collaborative.

Wireless classroom microphones

With the aid of microphones for the simple comprehension of students, classrooms are very noisy in our everyday situation. When they hear the teacher clearly, children understand more.

Mobile phones

Smart phones, such as visual aids or mobile phones, are used in the classroom to improve students' learning experiences.

Interactive whiteboards

Touch control of technology applications is now possible thanks to an integrated curriculum. Through the computer screen, they enhance the instruction and learning experience in the classroom. Students may use the smart board to draw, write, or manipulate pictures, which not only encourages active storytelling but also makes it more meaningful.

Digital video

Their learning process system was equipped with LCD projector-like equipment more than possible. DVD players will also help us instead of using an LCD screen.

Online media

More than possible, their learning process system was equipped with LCD projector-like facilities. Instead of using an LCD screen, we will use DVD players.

Digital games

Games have evolved greatly, such as educational games and serious games. The interactive games are given as classroom resources and have given positive feedback, i.e., student motivation. Several other resources, such as federal or central funds, and even capital funding inside the institute, are used depending on the school boards. Digital cameras, camera phones, whiteboard multimedia equipment, LCD projectors, and document cams are also examples of this study.

Video streaming

Think about how many words a video will say if a technology would say 1,000 words. Video will actually assist in the identification of even more

basic and detailed classroom technology that will support students. YouTube is a wonderful resource for this; odds are you'll be able to find a video clip to go along with every lesson there.

Play games

What toddler isn't enamored with the game of chance? You can keep students involved with educational games for almost any subject area uses technological device of which some are: smart phones, iPad, etc. In order to advance to the next stage and compete with other students, students can keep track of their progress.

Social media

Support social media rather than banning it because students are already using social media outside of the classroom, and bringing these into the classroom would pique their interest. You can use Facebook or Twitter to engage and link all of your students so that you can post a debate subject. It's a realistic way for them to pool their money and support each other.

Blogging

Is a method of expressing oneself Students posting their work to blogs is a wonderful way to inspire them to show off all of their harks or works-in-progress since it would be noted as a public ally in student work, students will help one another by sharing their comments and ideas. As a result, you are more likely to receive higher quality work from them.

Podcast

Are they useful learning tools for students, especially in terms of research? You can easily create and post podcast for students who want to recap or who

have missed class, ensuring that every student has the opportunity to listen and apply what they've learned.

Video conference

Learners may use web conferencing technologies to travel the globe from their classroom, speak to virtual academic advisers, build relationships, and interact with people from all over the world.

Exercises that include Collaboration

Utilizing cellphone devices for educational purposes and making people get them in team work is an excellent way to optimize collaboration. Students will shape groups using their tablets, and the instructor will choose which ones to view on the screen. This is a great choice for classes with a small number of students who have smart phones. The first step in using technology in the classroom to increase student participation and enrich education is to set up a stable wireless system to cover these devices.

Its best way to learn is to bring technology into the classroom. Teachers should incorporate technology into education to involve more students, enhance teamwork, and, most importantly, make learning fun! School communication systems have taken over the world and continue to do so. Take advantage of the many advantages that classroom technology provides. The use of technology in the classroom and for learning has gained a lot of attention. However, online education attracts vast majority of that same coverage. The only way out has been to use technologies to enhance instructional practices.

Technology Setups in a Classroom

A computer, a wired or wireless network link, and a projection device are the most basic classroom setups that enable teachers to integrate technologies into their instruction this helps teachers to, among other things, demonstrate, present content, explain how to use software, and access websites. However, there is one drawback in this setup: every teacher must arrive early in the classroom and spend quality time fixing it because each teacher's needs are different. Technology integration would almost certainly be required for a teacher to set up the system before each use, that are time-consuming and disappointing.

A smarter setup is one in which teachers have access to the network and can further expand the idea by bringing their own laptop to class. This helps the tutor to prepare ahead of time for anything he or she has to do with the laptop. It also saves time because the equipment does not need to be re-set for each use. In such classrooms, it is better to have a lectern near the network where instructors can place their laptops and other assets like notes, textbooks, or a projection screen. Unfortunately, there is no student participation in any of the above examples. Students must have computers with tablets and power networks that they can use in the classroom in order to have true involvement and interaction. Furthermore, as wireless technology advances, These Internet connections are quickly proving to be the most cost-effective and adaptable. Teachers can physically push students' desks around in a wireless classroom with laptops to rearrange seating arrangements as needed. An overhead projector, a VCR, a document camera, and software that allows for

collaboration are some other technical tools that a teacher may want to have on hand pedagogy that track learners use of laptops, and so forth.

In a college, getting a technological setup is just the beginning. With all of these resources, the real question is: what does a teacher do? There are several responses. Both are strongly affected by the material presented by the teachers and the goals they wish to achieve. From my own teaching experiences, here are a few examples of how I've used it in those situations:

Integration of technology in classrooms is becoming more relevant as it helps students improve their ability to learn collaboratively. In addition to the development of cross-sectional skills, such as problem-solving, self-reliance, responsibility, and reflective and initiative capability, social skills are stimulated. These are all fundamental principles that students must grasp in order to succeed in today's dynamic classroom instruction around the world (Ghavifekr et al., 2014). Similarly, in Ghana, in the early 1970s, these are all fundamental principles that students must grasp in order to succeed in today's dynamic classroom instruction world (Ghavifekr et al., 2014). Similarly, in Ghana, in the early 1970s, the government began integrating technology into the educational and teaching process. As a result, several schools have invested in computer labs, internet access, smart white boards, LCDs, and other technological resources. Despite this, implementing the policy milestones was difficult due to the tutors' experience and capability, as well as technical support and system reliability. The government, on the other hand, is still working on improving and providing internet in order to fully utilize technologies. Ghanaian tutors' research into the factors that influence the use

of technologies in education will also help the country's integration of these skills into classroom activities.

Teaching Biology with the use of Technology

Students may develop overall cooperative learning skills and acquire cross-sectional skills like social skills, problem solving, self-reliance, accountability, and the ability to evaluate and take action by incorporating instructional technology. These are all core principles that students must learn in a diverse educational setting (Ghavifekr et al., 2014). Likewise, in Ghana, in the early 1970s, the government started incorporating technology into teacher personal advancement. This seems to be due to the role of literate technology in developing independent thinkers who can question and engage the country in the global economy.

Technology laboratories, internet access, smart white boards, LCDs, and other tech training facilities have been added to some classrooms. Given all of these, the challenge faced was the competence of the teachers and the system's technological support and consistency in order to effectively enforce the policy. The government, however, is still developing and updating the infrastructure to allow full use of the technology. Exploring the factors that affect Ghanaian teachers' computer usage in schools can help the country's teaching and learning processes become more technologically integrated. Furthermore, just a significant fraction of Ghanaian instructors are technologically qualified. Even a group of Ghanaian tutors had low technology knowledge, suggesting that teacher technology knowledge is one of the most significant factors in Ghanaian society's active adoption of technology in education.

The Role of Information Technology to Biology Education

Teachers acquire the knowledge, skills, and attitudes required to efficiently use technology in their teaching, teamwork, problem-solving, and professional development. In a crucial case, pedagogical concepts of technology integration may also be extended to biological education teaching.

It also creates and encourages technology-based learning methods in the context of teaching Biology. Technology helps one to assess and decide the appropriate material and background for using technology in biology classes. Furthermore, by using efficient and varied communication and interactive tools, it aids in the teaching and learning of biology (emails, blogs, an order to accurately use technologies in biology teaching, problem solving, and project-based learning, not all of them are needed.

To incorporate technology more profoundly into Biology curriculum practices so that students can take command of their technologically improved learning environment. Via innovation, only the textual mode of easily and quickly transmitting information was available. However, scholars have started to employ technology in the classroom. Other words appeared included Computer-Aided Instruction (CAI), Computer-Controlled Instruction (CMI), Computer-Based Instruction (CBI), and others.

People began to form CAI in order to teach a variety of subjects in school and at higher levels. Hayes, (1987). Technology can be used in teaching, diagnostic testing, virtual laboratory production, and more at both the secondary and higher education levels. Teachers can also improve the quality of their instruction by incorporating technology. Teachers of mathematics and biology, in particular, need to understand how technology is

used for their own purposes as well as how to teach and learn from it. The goal of this research is to use technological devices in the biology classroom in order to improve teaching cognitive development and academic learning.

Technology is Being Used to teach biology

Technology alone will not change the way we teach (and learn); teachers must have knowledge and experience to know when and how to use it. With current and evolving technology, educators need the ability to pick and combine digital resources to meet the needs and educational objectives of students. Teachers would be able to discern how and when to implement the technology through critical assessment of a specific computer, site or program. According to Pisapia cited by Lucido (2007), "Integrating technology with teaching means adding, improving, supplementing and expanding skills using learning technologies" (p,54). Regardless of the reason why technology is used, it is much more important to consider how it can be used.

Technology is not a replacement for teaching; Flick and Bell (2000) propose that technology incorporation into biology should: (a) take advantage of technology's unique features, (b) make scientific opinions more available, and (c) establish understandings of the biology-technology relationship.

It's a learning tool that students and teachers can use to develop their knowledge and abilities. Leading national science education associations have proposed recommendations for incorporating technology into biology teaching where by Flick and Bell, (2000), have the following information on technology usage:

1. In the sense of biological material, Technology should be implemented.

2. Technology should deal with the required pedagogy to discuss worthwhile biology.
3. Technology education in biology must keep track in technology's unique features.
4. Technology can be used to make science beliefs more available.
5. Technology training should establish an understanding of the connection between biology and technology.

Regardless of the method used, the classroom learning experience will be greatly enhanced as students are exposed to new and different types of material, can manipulate it on the screen through graphic displays or controlled experiments in ways never before possible, and can convey some key results to a teacher, students over the next classroom, and others.

Technology's Importance in Biology Education

By having a visual interface, technology makes teaching easier. Visuals account for more than 80% of all instruction. As a result, the visual presentations of the relevant subject were easily understood by the student. It would be much easier if student teachers knew how to integrate technology into their classrooms. Information can be communicated very easily using technology in higher Education, enabling students to better visualize the specific subject and enjoy new learning experiences.

Innovation has the following advantages in academic achievement. It reduces time barriers for students and teachers, as well as physical boundaries, since students can log in from anywhere. It allows for synchronous interaction, which leads to reflective and creative interaction; and it can be applied to new educational methods because technology allows for better group connectivity.

It has the ability to quickly disseminate information to specific audiences. It broadens the international scope of educational services by enabling company workers to be trained at the appropriate time and in the appropriate number. Non-formal education, such as health and literacy campaigns, may also benefit from it.

Biology as Teaching Method

The principles and procedures used for instruction comprise a teaching system. There are several variables that decide a teaching method's selection. Any of these variables are; the instructor, the content to be learned, the learners' entry actions, the class size, and the available teaching and learning tools. In teaching biology, the most widely used approaches are lectures, class enquiry based, and understanding of school work by students.

Public Lecture

The lecture method is described as an educational method that involves one-way communication between the active presenter (tutors) and a small or insignificant audience (learners). According to educational research, the lecture format is widely used. The lecture method, sub-topics, or summarizing and synthesizing critical details are all necessary if used to introduce a subject. This approach is strongly discouraged in biology, but the following points should be taken into consideration: this method must be used:

- A. It is important to use plain and descriptive terminology, along with diagrams.
- B. As an understanding audience is an essential element of communication, the range of material being taught should suit the learner's understanding.

C. Attention should be given to the instructional goals to be accomplished.

A thoughtful, exquisite lecture may be very good if the goal is to communicate knowledge, but if the goal is to promote critical thought, the application of data, concepts and values, other methods may be suitable.

Teaching with discussion method

This is a cooperative teaching model in which students are divided into pairs or small groups to assist one another in learning the assigned task or material.

For a group of five students, the students can be one-to-one (buzz team) or per party (task or syndicate group). It should be remembered that the discussion method has many benefits, including:

- A. It enhances learner interest, which leads to more efficient learning.
- B. It allows students to share ideas with one another in a more relaxed manner (peer learning), resulting in more efficient learning.
- C. Enables learners to share and pool skills such as process, manipulation, organization, and even linguistic abilities.

Demonstration Procedure

The instructor (teacher demonstration) or a particular student group of students performs a demonstration (student demonstration). In a demonstration, inductive or deductive reasoning may be used. Demonstrations are preferred in biology classes, according to Twoli, (2007), under the following conditions:

- A. When it is risky for the experiment.
- B. Where the equipment for learners is costly and difficult.

- C. Where resources are limited.
- D. When time is constrained.

Experiments for Laboratory (practical work)

The learning is organized in laboratory experiments to conduct certain special tasks by controlling the material and apparatus under the control of the equipment. The following benefits are associated with laboratory work:

- A. It enables students to study and practice tactics and social intelligence that can be used in everyday situations.
- B. It encourages and maintains a desire to learn.
- C. Since the scientific method of inquiry is followed by laboratory investigation, it promotes the analytical process of reasoning.
- D. It strengthens logical awareness.

Project Work

Project work offers an incentive for learners to carry out experiments to solve problems. It was noted that the primary objectives of project work are to:

- A) Deeply explore the area.
- B) Build initiative and creativity
- C) Raising academic interest
- D) Develop creative values
- E) Develop imaginative, manipulative and procedural skills.

Field Trips

A field trip involves students exploring specific points or areas of interest for educational purposes. Warehouses, science centers, and lakes are among these locations. Field trips help students understand in a realistic

manner by encouraging them to see how scientific knowledge is implemented firsthand. A school trip is one of the best ways for a biological instructor to emphasize the importance of classroom material to students, growing students' interest for biology.

Technology's Effect on Biology Education Studies

Software is designed to address issues that emerge from social needs. Technology is not established or approved if there is no problem to solve. Although there are potential justifications for integrating technology into biology classroom instruction, the only real justification can be dependent on if there is a meaningful rationale. This segment would examine the research on the impact of technological convergence on various areas of biology education and studying. Furthermore, Salomon (2004) defines an academic environment as a set of interconnected elements that affect teaching in addition to (but separate from) significant personal and societal inequalities. The school climate offers a forum for faculty and students to coordinate learning and develop responsibilities. The training development can be defined as a geological learning process.

In a learner-centered learning environment, relationships and questioning are prioritized over facts and repetition, which are prioritized in teacher-centered settings. The teacher's position is more of a partner than a fact in this case. A learner's function in educational setting which is more of partnership in the learning process rather than a passive listener. as seen in simple terms as gaining knowledge that focused on a learner-centered approach in connection with knowledge-based transformation. in which is measured by the degree of its outcome (student) rather than its amount in

knowledge gained, that basis on assessing success story of the student. A classroom where teacher attention is placed on the teaching, based on the information presented above, it is clear that learner-centered learning environments promote learning more than teacher-centered teaching methods, especially in science subjects. As a result, it follows that studying in a learner-centered setting is more beneficial than learning in a teacher-centered environment. Technology can help educators strengthen educational change by encouraging Instructors and learners to step away from conventional teaching and learning processes which depend on recall of facts, task given process, teacher-centered and move toward modern methods of teaching which centered on interaction activities, development of collaborative experiences, learner participating in a meaningful learning contexts, thereby creating innovative problem-solving skills and high level thinking skills).

Technology's Effect on Teachers' Pedagogy

Wong et al. (2006) argue that technology can help to facilitate one on one learning process in an academic environment. Biology, like every other science, is a complex discipline with a shaky substance. As a result, Cradler and Bridgforth (2005) argue that successful biology pedagogy necessitates constant approach which is about current subject matter. This access information contributes to enhanced involvement in a pedagogy that increases the caliber of a particular method of teaching which is done by a tutor. Teachers may use technology to help them try new methods, learn about what they're doing, focus on what they're doing, and interact with new content.

Technology's Effect on Students

People develop new conceptions and awareness centered on something they already think and understand, according to the constructivism approach to learning. According to the World Bank, technology is used to create information and solve problems (via internet mail, CD-ROM, databases, and video conferencing); use process skills to help concept clarification; and communicate ideas (via power point, desktop publishing). As a result, students who study in an advanced technology environment have a higher chance of acquiring knowledge than students who learn in conventional learning environments. The degree to which students learn a discipline is primarily determined by the student's motivation for the discipline. Biology teaching and learning has become more interesting as a result of the use of applications (such as CD-ROMs, PowerPoint presentations, simulations, and so on). Computer systems often allow the creation of a diverse array of engaging experiential learning that are more likely to hold students' interest and appeal to a broader audience (Cradler & Bridgforth, 2005). This allows a student to devote more effective teaching time to both the study, resulting in greater student results. The software's collaborative and creative elements can be used to assist students in grappling with concepts and ideas. Similar facts and perspectives may be addressed to students in a variety of ways with greater ease. This improves learning speed, which in turn improves biological output.

Skills to Incorporate Technology in Biology

There are many impediments to technology-based teaching and learning. Solomon (2004) adds to this by claiming that the success of technological advancements is largely determined by teachers' experience and

knowledge. They also recommend that teachers be prepared for this by learning how to use technology effectively and creatively. Despite the fact that traditional teaching approaches consistently produce poor results, the principles of technology incorporation are focused on experience. Technology cannot enhance performance by itself. Technologies on their own have little stable or sustained effect on school learning, which must be used in conjunction with traditional approaches, a process known as technology integration. Despite the fact that traditional teaching approaches consistently produce poor results, the principles of technology incorporation are focused on experience. Technology can't improve efficiency on its own. Technology by itself has no stable or long-term influence on College learning, so it must be used in combination with traditional approaches, a process known as technology integration.

Theoretical Framework

Theoretical Foundations of Modern Biology Education

The researcher wanted to create a framework for creating novel models that can be empirically tested in evaluating such theoretical positions, i.e., to decide which teaching methods used in biology classes will easily boost students' performance in learning biology at all levels of education. There are several modern learning theories, as well as modern teaching theories, available today. The importance of learning motivation, cooperative learning, interactive learning, and environmental learning are all taken into account. Students learn in new ways that are more active, self-aware, imaginative, and autonomous as a result of the new circumstances.

This ultimately begins with systematic-theoretical didactic, which employ system theory methods and processes, especially in order to solve problems in the science, technological, and ideological fields. Since the goal of system theory is to examine complex systems and devise technological solutions for their successful implementation, biology teaching is viewed as a complex system made up of a variety of complex teaching situations. One of the goals of this research is to identify the elements of instructional circumstances as well as the relationships that exist between them. The incorporation of technology into biology teaching has been a huge success. It makes no difference which approach is used for system-theoretical didactic; what matters is the learning situation and the operations a student must conduct (observe, understand, remember). Concentrate on the student's actions, the relevance of the exploration, experience, and events that occur during the learning process. During the study era, three methods are used in the biology teaching unit: the essence of science and its everyday applications.

The Instruction Model of Herbart

The three initial phases of a learning cycle correspond to the steps in Herbart's successful instruction model, which Bybee, et al (2006). Posit as “We begin with the students' current knowledge and experiences, as well as new ideas related to concepts they already know. It will gradually shape concepts by adding new ideas that relate to those already in place. A next step is reflective practice, in which the teacher thoroughly discusses concepts that the students are unable to learn on their own. The final step is that, the instructor asks students to demonstrate their act of comprehension by way of applying the concepts learned to new circumstances” (pp.4-5).

The characteristics mentioned in the preceding quotation represent the learning activities that take place during the various phases of the learning cycles.

Theories of Learning

Learning theories, according to Dunn (2000, p. 8), help us understand why students learn; they help us understand the learning process. As a result, they give us a strong basis for assessing, discussing, and conducting research in the field of practice and learning. As a matter of fact good learning theory will condense a lot of knowledge about learning laws into a small amount of space. The researchers contrasted constructivism and behaviorism as learning theories in this chapter. The literature survey indicates that most educational researchers proceed from the foundation of constructivist theory.

According to new studies, constructivism has a lot of clout in the field of student learning theory. Behaviourists' belief that student is not the only one who has understanding of the universe. When it is transferred from an external reality, the instructor, to an internal reality, the pupil, it becomes internalized "(Driscoll, 1994), behaviourism is thought to have fallen out of favour among concerned scholars and researchers. Contrary to popular belief, constructivism as a philosophy proposes that "the student's conception of knowledge is to be derived from a meaning-making quest in which" the student's conception of knowledge is to be derived from a meaning-making search in which Cycle of learning.

Gilbert (2006) noted that, in general, researchers do not systematically structured and apply all of the suggested principles of context-based teaching for the enhancement of effective learning and improved results, as intended.

The instructional cycle was introduced as an integral part of the theoretical framework for this study to address some of those criticisms. In this study, Bybee et al (2006) and colleagues used a five-phase learning cycle adapted from the Biological Sciences Curriculum Studies (BSCS) which makes up the 5E instructional model. The elements of the BSCS 5E model are Engage, Explore, Illustrate, Elaborate, and Evaluate, as defined. In addition, there were five phases to the learning cycle used in this study: context introduction, context interrogation, material introduction, content and context linkages, and learning assessment.

The phases in the BSCS 5E model and the five-phase learning cycle used in this analysis have certain similarities. The learning series, teaching and learning tasks, emphasis, and aims of the phases of the two learning cycles are not exactly the same for an understanding of the discrepancies between the two learning cycle approaches). The main concept of the learning cycle produced for this analysis was the creation of opportunities to situate learning in particular situations or circumstances that enabled learning. In addition, the learning cycle was developed to give educators the ability to look at how learners understate contexts and content. The teaching and learning activities were expected to improve student participation by enhancing logical comprehension and the development of investigative, logical, and problem-solving and decision-making abilities are examples of higher-order thinking skills.

Finally, the theoretical framework for this study was given by three groups of components: the central component, the process component, and the learning cycle. The content and structure of the training manuals were the

most important aspects. Students' prior knowledge was revealed using the five-phase learning cycle, which allowed them to reorganize and probably reorganize it. Change their pre-conceptions through interactions with themselves and with the teacher, and allow the teacher to address learner's pre-conceptions.

Constructivism Theory

Constructivism is a theory of how people think, based on observation and empirical study, (Hein, 1991) According to Hein (1991), people construct their own perception and awareness of the world by experiencing things and reflecting on those experiences. When we are faced with previously accepted facts or information about existence, we must reconcile our new experience and understanding with our previous beliefs. This is actually a constructivist mentality in motion, whether we know it or not. New information, new experiences, and new data all force us to weigh what is unique against what we already know and believe about life and the universe.

We can either withdraw and rationalize or justify our discomfort in the face of the new challenge, or we can focus on our new opportunities and incorporate them into our existing comprehension patterns by altering the old patterns in the process. Learners are actively engaged in the constructivist phase (whether consciously or unconsciously), according to observation. They inquire, investigate, and assess what they have learned in light of their prior experiences and aspirations. They learn new things and make new discoveries while doing so. To put it another way, new definitions are developed and then synchronized with what they've know and believe (Hein 1991). The constructivist approach to teaching was described by Jonassen, Davidson,

Campbell, and Hagg (1995) as a philosophy that requires an understanding of how learners produce successful learning.

We need to understand how meaning is produced because it is so relevant in constructivist theory. The happier students are, the more successful, they are in promoting and fostering meaning-building in their academic work. When teachers are efficient in what they teach they are in good position in promoting and cultivating meaning-building in their students. Jonassen, Davidson, Campbell, and Hagg (1995) described constructivism as a teaching philosophy that requires an understanding of how learners produce good learning. We need to understand how meaning is produced because it is so relevant in constructivist theory. In the pursuit of comprehension, mastery, and self-actualization, the instructor establishes an environment which students feel comfortable enough to engage with the teacher in the creation of knowledge and understanding of concepts. Thus, constructivist learning is a process in which students construct their own meaning from their own experiences: what they encounter guides them to develop meaning from what they have learned; Learning should be driven by cognitive dissonance, which arises when students are confronted with new experiences and ideas, rather than reinforcement, according to Dewey (1938). Traditional (behavioral) knowledge reinforcement only produces performance, according in all facets of their comprehension in order to bring various higher order skills into action.

As a consequence, an instructor is in charge of developing learning experiences in which students are faced with problem situations and must respond. "Learning is an active process in which learners generate new ideas or concepts based on their current or previous experience," according to

Bruner (1996). Students have reported that they use their cognitive framework to choose and transform knowledge, build hypotheses, and make decisions. Students make and transform data, shape hypotheses, and make decisions while depending on their cognitive framework (Bruner, 1996). Furthermore, Cronje (2000), point out that, the objectiveness approach is the polar opposite of Cronje then proposed that objectivism, behaviourism, and constructivism are diametrically opposed in terms of structures, means, assumptions, and intentions, which he describes in his four-sector, two-dimensional model (as the model clearly demonstrates). When you compare the two philosophies, behaviorism and constructivism, you'll notice that they're very different four learning conditions.

Duty in the Classroom of the Constructivist

In a constructivist classroom, roles are essential Mann (1994, p. 174) claims that modern modes of technology, such as computers in classrooms, have helped constructivism gain traction in recent decades. Technology in colleges and universities offers these new innovations. Such technical tools, when used in alliance with the Internet, motivate students by allowing them to work on "real-life" projects and solve real-world problems. Any practicing teacher will attest to the fact that access to the Computer network has altered activity of the school environment.

Today's students would have access to an endless amount of data, compared to what their parents had in the classroom a few generations earlier. Students in previous generations may have been expected to memorize simple, predetermined types of knowledge provided by the teachers. The precise aspects of such information were clearly specified in a rigidly defined

"curriculum," and no deviation was ever tolerated. The issue with machines, on the other hand, isn't one of intelligence or information. Those with Access to the internet have access to a wealth of factual information. The main challenge for students now is to make educated decisions over which data is relevant to the problem they must solve. Teaching must be based mostly on teaching practice itself, as well as the educational goals of the teachers involved and the education department as a whole, in today's technologically advanced world. Technology is incapable of reacting on its own. Effective obstacle and issue negotiation is dependent on how well the technology is used, as well as the student's human gifts and expertise brought to the problem-solving process by the student who uses the technology, according to Campoy (1992).

Learning must be focused on the learning process itself, as well as the educational objectives of the teachers involved and the school system as a whole, in today's technologically advanced world. Technology is incapable of reacting on its own. Technologies are "merely instruments or vehicle calls for instruction transmission," according to Campoy (1992, p. 17) "How well technology is used, as well as the human gifts and skills brought to the problem-solving process by the student who uses the technology, determines how effective challenges and issues negotiation is.

- i. Instead of lecturing, the teacher coaches, orients, promotes, and uses debates to teach.
- ii. Rather than focusing on weaker students, teachers interact with them more often.

- iii. Differentiated instruction for brighter students (as is the case in conventional environments)
- iv. Learners become less passive and more aggressive participants.
- v. Students become more cooperative and less competitive as individuals.

In a constructivist classroom, learners' visual and verbal thought is more visible than primary verbal thinking. Students may use different forms of technology in activities such as self-expression, exploration, synthesis, negotiation, communication, and reflection. In the classroom, technical modes are often used by students to express themselves creatively. As a consequence, technology is devoid of inherent value. The use of technology in a constructivist environment determines the consistency of teaching and learning. Constructivism is more concerned with how we as people develop new skills and talents, as well as how we acquire new knowledge and expertise. Through doing, acting, and making deliberate communication, humans comprehend. These types of dialogues and consultations are particularly interesting to constructivist teachers because they more accurately represent the abilities that learners have acquired as they master their environments than any written test could. A constructivist educator is a sensitive yet non-directive listener who chooses to remain "invisible" while teaching draws well-informed conclusions about the consistency of homework assignments, levels of engagement, and the characteristics that individual students bring to the task at hand

According to Lunenburg (1998), constructivist teachers are comfortable with learners' autonomy, freedom, and initiative displays. One of the most significant distinctions between a constructivist and a conventional

classroom is this. The constructivist instructor is not an objective observer to a superficial or threatened audience. The instructor is very clear about the most important requirements of students' duties when they are engaged in true learning. The implicit goals of constructivist learning best-practice models decide the hopes and actions of constructivist teachers. Airasian and Walsh (2012) agree that it is the obligation of constructivist teachers to create. When learners take the initiative in group, person, or team learning situations, they should not feel judged, exposed, criticized, or humiliated. Taking the initiative needs self-disclosure.

As a result, constructivist learning resembles and incorporates other types of creative practice. By disclosing oneself, one is exposing oneself to the undoubtedly harsh scrutiny of one's colleagues and teachers. As a consequence, a constructivist mentor is someone who is at ease with other people's self-disclosure and initiatives. As a consequence, a non-directive specialist is required of a constructivist teacher. They may be anyone who believes that motivation, passion, personal warmth, tact, challenge, and professional self-effacement have educational value. The constructivist teacher is often at ease with ambiguity, which manifests itself in the form of tentativeness or "imperfection" that is characteristic of uncertainty. Many of life's problems have no correct response due to both learning techniques and a large number of often counter-technology solutions. The learners' point of view and fresh start condition, along with pre-existing knowledge and assumptions, serve as "raw material" for the new epistemological syntheses they would develop. A constructivist teacher, according to Brooks and Brooks (1993, pp. 103-118), will:

i. Students' autonomy and effort should be encouraged and recognized.

Students should be shown the innovations that can be implemented in their original interpretations and interpretations for problems and situations, followed by questions as well as debates.

ii. Allowing students to develop relationships and make metaphors

iii. Encourage student investigation by asking open-ended, thought-provoking questions.

iv. Assess student comprehension by using open-ended tasks and completing them.

v. Encourage students to communicate with their teachers and one another.

vi. Collect and render available to students a diverse range of resources, like data sets, historical documents, and representing a sample.

vii. Before learners express their own interpretations of those concepts, ask them what they mean by concepts.

viii. Motivate students to ask each other question.

ix. Inspire learners to share their preliminary reactions and theories with the rest of the class.

Brooks and Brooks (1993) equate detectives and students. Since a detective solves problems by concentrating all critical skills on single problem that metaphor is used. In cases and stories, the detective is always on the lookout for inconsistency, incompatibility, and incoherence.

Like the detective, the constructivism learner is far more concerned that their critical skills are used to construct. Instead of memorizing textual matter and planning for any future ordeal (as is seen appearing in

examination), students can learn a modern combination. Technology changes the characteristics of problems and learning activities, making them more difficult to solve. When students use computers as sources of knowledge and cognitive tools, they become fully absorbed in the learning process. As more students use computers as sources of information and cognitive resources, the effect of technology on advancing how students learn will continue to increase (Reeves and Jonassen, 1995).

Form of case studies based on digital technologies include and promote resource-oriented, student-centered learning, which opens up many possibilities for constructivist learning by allowing students to link learning to practical experiences in a variety of settings (Berge, 1998). Using multimedia, students were able to easily understand the lessons taught to them, and tutors were able to make their lectures more appealing and vibrant. The lessons stayed with them for a longer period of time because the class was interacting, which helped them during the examination period. More than any other type of technology as internet communication would increase learners' excitement since it incorporates the richness of television with the interactivity of other technologies, as well as the opportunity to connect with real people and engage in real-world activities. Student-directed and diagnostic learning are aided by technology. Technology-enhanced learning, unlike static, text- or print-based instructional approaches, acknowledges that there are several different ways to learn about given information.

Instead of only listening and remembering, technology allows students to explore and discover ideas on their own from The World Wide Web (W.W.W.) in a realistic world gallery where students can show their piece of

work. Technology has been quoted as a factor impacting ready-to-use readiness because it can educate and inspire learners.

Technology Improve Scholastic Performance

The need to dispel misconceptions about the use of technology as a teaching instrument seems to be driven by the widespread acceptance of technology in education. Technology is said to help students gain educational opportunities by raising the importance of education among a rising number of digital staff and enhancing educational quality. Nonetheless, over the last few decades, the experience of implementing different technology in classrooms and other educational settings around the world has been invaluable. It ensures that all of the potential educational benefits of technology are fully realized. The direct connection between the use of technology and student academic performance has been the subject of extensive research.

Students benefit from technology because it enhances communication with their teachers Valasidou & Bousiou, (2005). The research into the influence of methodological and technical advancements on students' attitudes toward learning and performance appears to be coming to a consensus that the proper implementation of new technology in education can have major positive effects on both learners' attitudes toward learning and their achievement. The impact of professors' mindsets on students their achievement is seen as special workforce.

According to research, the proper application of technology will catalyze the paradigmatic shift in both material and pedagogy that is at the core of twenty-first-century school reform. In a meta-analysis report, Kulik (1994) discovered that students who received technology-based training

performed better on average than students who did not. The proper implementation of technology will catalyze the paradigmatic shift in content and pedagogy that is at the core of school reform in the twenty-first century. When technology-based curriculum was used, students were more involved in the teaching and learning process. Fuchs and Woessman (2004) used international data from the Program for International Student Assessment (PISA) to show that while the bivariate model is efficient, the bivariate model is not. When other aspects of the learning environment at school are considered, the connection becomes minor and unimportant. Attwell and Battle (1999) investigated the relationship between having a home computer and academic achievement, and found that students who had access to a home computer for educational purposes scored higher on tests. Technology increases student curiosity, which leads to more time spent working outside of the classroom.

On-campus students, according to Coates et al. (2004), outperform their online studies better than their counterparts who have less access to computer, instead of simply student learning technology, especially digital and internet technologies which allow them to get new teaching methods and approaches by encouraging tutors and students to do something differently than they have in the past. In order to build the types of learners and people required in a knowledge environment that enhances and improves learning and teaching efficiency, technology often serves as a catalyst for rethinking teaching practices (McCormick & Scrimshaw, 2001; Wagner, 2001). Students' understanding of material can be enhanced by the use of technology, which can also involve them in improving their own understanding and encourage

the development of complex thinking skills (Kozma, 2005; Kulik, 2003; Webb & Cox, 2004).

Through research, a number of constructivist learning methods have been developed (e.g., students work in collective groups or students create). Things that would have the potential to change how students engage with knowledge and represent what they've learned (Windschitl, 2002). Asynchronous CMC instruments, according to Bandura, Girasoli, and Hannafin (2008), can boost student personality and thus academic achievement. Fister et al. (2008) show how tablet PCs can help teachers boost biology instruction. New strategies have the ability to improve education's relevance and efficacy while also increasing access. Students who use technology for academic purposes are completely engaged in the learning process, and as more students turn to computing resources as sources of knowledge and cognitive resources, the learning process will become much more immersive (Reeves & Jonassen, 1996), technology's impact on how students learn will continue to evolve in our study world.

Criteria for Using Technology in Biology Education

Because of the realistic aspect of the subject, some students thought Biology was a difficult subject. Integrating technology tools into educational strategies for teaching Biology will make learning simpler and more comfortable. In biology classes, the use of technology acts as a tool for classroom advancement. As a result, in order for student teachers to be able to use technology in their classes, the teacher education program should place a greater focus on computer skills. The curriculum for teacher education should be revised to incorporate cutting-edge technologies for information

dissemination. All of these learning technologies should be considered by future teachers. As a result, the learning process would be facilitated.

The students will be better off as a result. Integrating technology into pedagogy can result in higher education that is of high quality. The teaching-learning process should be adjusted to meet the evolving demands of

technology-enabled education. Technology directly increases educational quality while indirectly improving the country's economy. Furthermore, the “complex interplay of the multiple embedded contexts of the school workplace” is highly reliant on the efficacy of teaching and the use of emerging technology for learning, such as computers and the Internet

(McLaughlin, 1990, p. 4). Furthermore, Fullan (2001) claims that in order for the reform to succeed; these different layers must be overcome. He goes on to say that a desire for comprehensive school change that addresses all of these layers leads to "large-scale reform rooted in local ownership" (p. xi). Change is only effective, according to Sergiovanni (2001), when all stakeholders create sense and agree to reform the school. Participation of the group in

school activities has been hailed as a critical and influential element in educational advancement. There were two types of instructor roles: teacher-centered and student-centered. In the teacher-centered approach, the teacher's position was represented as the individual who scheduled everything in the classroom. For passing on knowledge to students, the instructor is regarded as

the primary source of learning. In the learning process, teachers in a student-centered role worked with students. Although there was no discernible difference between a student-centered or teacher-centered position in a

classroom with computers, pre-service teachers expressed the need for a balance between the two roles.

According to Wang (2002), the lack of interest in a student or instructor approach to computer use is due to a misunderstanding of the teacher's position in a classroom with computers. However, the findings showed that teachers were more prone to a teaching assistant position as a result of the computer program training, they had obtained. In terms of supporting their skill and information learning, it was limited and inadequate as tutor's expresses dissatisfaction with having to pay for their continuing education.

They argued that the government should pay for such technical development because it was normally the government that decided to incorporate computer use into educational curricula. Tutors were given traditional tutor-centered environments as well as bridging the cultural and learner-centered environments on their own. As seen book the emergence of Network Society, Castells (1996) argues that, networking is important in both social and technological domains and is needed by all.

Politics, economics, and culture all play a part in deciding how a society is established. According to him, a network is "a series of expandable, synchronized networks that can be used to solve problems." A "networked, highly interdependent... culture emerges [when] it is increasingly capable of applying its progress in technology, knowledge, and management to technology, knowledge, and management itself" (p. 67).

Empirical Studies Based on Constructivist Learning Theory

Despite the fact that there have been several studies and a significant amount of research focused on Constructivist learning theory, I will only discuss two at this time. Richards of South Carolina's Winthrop University was the first to attempt it in 1998. Richards' students were only permitted to use electronic technologies to accomplish their goals while conducting constructivist literacy studies. Each participant had to develop an electronic portfolio based on a list of literacy-related topics. The aim of these portfolios was to show how students differentiated between relevant and irrelevant data gathered evidence to support the selected theme or topic's claims, established arguments to support their claims, and organized their data and arguments into a coherent and convincing electronic technical type. Students were then asked to present their results to their classmates and teachers.

Among the participants' practices were "collaboration and cooperation in a community engaged in problem solving and constructing possible solutions to social dilemmas, communicating the deeper processing."

Walker (2000) of the Open University in the United Kingdom conducted another study that purports to demonstrate how the increasing incorporation of technology in the classroom can enrich and enhance constructivist ways of teaching and learning. The eleven participants in the experimental group also reported that their cognitive skills had greatly improved as a result of their involvement in the research. Walker's research institute has created a distance-learning course to help students learn more quickly and become more active students while improving their own understanding.

"The development of course modules based on constructivist practices and the implementation of technology were also beneficial to the faculty," Walker (2000, p. 236) wrote "as a result of integrating technology to help students become more effective through the use of application skills, faculty plans have changed". In situations like this, the instructor responds to requests for support, comment, or suggestion by tailoring his or her responses to the students' individual needs. In terms of funding, retention, and discipline, such an educator is no longer supposed to represent the institution's integrity and reputation, as well as the community's power and authority.

As a result, when speaking with students, the instructor's tone is qualitatively different from that of a traditional behaviorist teacher. The behaviorist coach should have far more guidance than directives, solutions and explanations. Program, assistance, and even more parts, issues, and rules to follow (Stepich, 1996, quoted in Batane, 2004).

Providing software to the students helps to consolidate teaching and learning process in a manner that is compatible with the functional concepts of constructivist teaching. Instructors are "demoted" by their historical role as the primary sources of information in a quiet classroom, as the researcher previously noted. As a result of technology like computers, students must become less reactive and take more responsibility for the outcomes. The teacher's integrity, authority, and reputation are preserved in a computer-rich classroom. Teachers who fail to acknowledge the decentralization of operation and obligation that comes with widespread computer usage in education have no place in such classes, it is real. Today's professors, on the other hand, will be specialists in both their subject areas and the software systems that their

students use. "Today's teachers are subject matter specialists who have embraced emerging technologies," says one teacher (Donley & Donley, 1996, p. 6). This current "burden" upon educators is simply a reflection of changing knowledge transmission and distribution trends in our community as a whole.

Factors Affecting the Use of Technology in Biology Education

Insufficient resources/availability

According to Wilson (2003), the most common obstacle to effective use of technology is financing out the consequences, which affect the availability of materials.

However, technology used in the classroom depends on what is available in colleges, the proper training for implementing it and the necessary technology's requirements. Having adequate resources plays a major role.

Matters of accessibility

The expensive and high demand of technology in Colleges of Education often lead to negative mindset that cannot be used to destroyed the idea of technology. Though some of these scholastic tools are available, few of these are not accessible at time of need (Simon, 2014).

Hesitation and fear

One of the fears of teachers when using the technology, as highlighted by Lucido (2007), is that "it might replace teachers". The educators are finding these tools intimidating that they refuse to integrate technology in their instruction. Apart from that their hesitation to try something new discourages them. Many of the teachers nowadays are called digital immigrants where they are still learning to teach with computers (Simon, 2014). According to a Nussbaum-Beach citation, technology may not replace people; however

instructors who are not using technologies would be substituted by those that do. As a result, it's clear that incorporating technology into classroom instruction is both essential and advantageous. The "distance" between the initial and final stages is commonly referred to as "distance."

(Schoepp, 2005), describes a barrier as "any condition that renders advancement or achievement complicated." Many academics have tried to figure out what factors could affect how technology is used in teaching and learning. Ertmer (1999) classified obstacles into two categories: extrinsic (first order) as well as inherent (second order). Extrinsic obstacle reckons instructors' views, their illusion for the integration of technology, as well as their perspectives on instruction, education, or skills.

Student and Technology Usage

Educators who have been taught to the students before technology became quite popular in society may feel challenged, oppressed, and alienated by the advent in such technologies as they discussed in the previous parts. Since instructors have been teaching for some time without using computers, and its transformation of their personality traits of classroom instruction, and also their beliefs about successful teaching and order, also necessitates. Instructors with little knowledge in operating the internet to teach must undergo a radical re-education in the latest modes of delivery. This form of re-education can elicit a great deal of opposition, fear, anxiety, negativity, and even obstruction, particularly among teachers who are nearing retirement. As everyone involved has had a terrifying experience, which is understandable.

Since digital technology creates completely different ways of interacting in the classroom, it must be presented to those who are interested in

learning more about it without looking at whether one is old or young with no prior experience with computers in a delicate and cautious manner. Attempting to integrate instructors and students in an internet classroom setting by intermittent modules designed for familiarize assignments also with technologies of application on possession, according to studies, is

counterproductive. Wetzel & Todd (1993) conclude that introducing trainees to such a vast range of courses in which the actual content (information) as well as future technology (computer package) have already been thoroughly integrated is much superior

Schacter (2001) is of the view that, providing as many opportunities for hands-on work as possible in classes where computers are already being used is the most successful way of assisting teachers and learners in becoming acquainted with computer-assisted education. The most efficient form of integration, according to Harel and Papert (1991), occurs as a result of continuous high-volume realistic experience with real computing scenarios, rather than sporadic modules which offered fragmented and separated curriculum. McKenzie (2001), Scheffler (2001), and Logan (2001) pointed out that when a well-educated student must have a thorough understanding of all computer-related skills, as well as the critical skills of interpretation and assessment. It is not enough for students to be able to complete basic programming tasks. Students should be able to evaluate the quality done on and accomplished with the aid of computer and the internet.

Pre-service teachers must also receive extensive computer-assisted education. These teachers must be highly proficient in computer-related activities and processes, as well as at ease in an environment where education

is provided through computers, in order to pass on their expertise to students with the utmost trust, abilities, and productivity. It comes as no surprise that new teachers that have a lot of prior computing experience will find learning what they need to know about using computers in the classroom much easier (Laffey et al., 1998; Hochman, Maurer, & Roebuck, 1993). “You have won 90% of the fight if you can get teachers to use technology efficiently in their own lives,” wrote Dr. Lynda Roberts, a special advisor on technologies to the US Department of Education (Rosenthal, 1999).

Rosenthal discusses what the National Council for Accreditation of Teacher Education (NACTE) requires all colleges and universities to provide comprehensive training to pre-service teachers in the skills required to introduce computer-assisted education in schools. He emphasizes that this cannot be achieved exclusively by haphazard and isolated "technical short courses." Student teachers can only be properly trained for these skills if they are educated as part of a comprehensive curriculum that is pedagogically sound, focused on sound research and content, and covers the first to last year of their training. Brush (1998) concurs, calling for technological incorporation in the teacher education program.

According to Wang (2002), pre-service teachers who are placed in practical circumstances with teachers who see attempts to integrate technology into the classroom as an unwanted inconvenience and obstacle to regular activities would never learn to appreciate the importance and potential of computers in education. Although several researches have been done on how pre-service teachers understand and value technology, there is still much more to be done. According to Diegnueller, “some expectations of good teaching

practices can represent an outdated educational system". (Diegmueller, 1993 p. 512). As part of their research into pre-service teachers' views of how technology has altered teaching roles, Carr-Chellman and Dyer (2000) asked pre-service teachers to respond to a reading about the future vision of education. According to the results, many respondents favoured conventional teacher roles that reflected the styles of teaching methods they had experienced as students. According to the researchers, these responses are typical of how people respond to change in general. Teachers are less enthusiastic about any drastic departures from their standards because they prefer that their teaching positions reflect what they personally experienced as learners and students. Carr-Chellman & Dyer's (2000) results are more likely to reflect how teachers perceive changes in the teaching profession as a whole, rather than how they perceive the role of technology in education. Technology is also changing the way schools, colleges, universities, and education departments train teachers and evaluate their success, both in terms of the metrics used and the actual outcomes.

These developments stand in stark contrast to more traditional, non-technology-supported education, which emphasizes learning that is bound to an instructor, classroom, and school building during school hours, uses textbooks that are often out-of-date, and only schedules 1% teacher conferences each semester. Batane (2004) investigates how Ghanaian teachers deal with day-to-day issues as a result of massive changes in schools and society. One such change is the introduction of computers into classrooms. Teachers are responsible for understanding, storing, and making appropriate use of these computers in the classroom.

Teachers, on the other hand, may require thorough training in the use of computers and procedures for integrating computers into classroom teaching, according to research. It is absurd to expect teachers to function in computer-equipped classrooms without adequate training, guidance, and orientation.

Technology and its Roles in Teaching

Incorporating technology into the classroom has pedagogical benefits, according to analysis. Instructional technology is the use of a range of teaching resources to enhance student learning. These tools can range from calculators and Power point slides to desktops and other digital equipment, and they can even display browser course work in some cases.

Results from different studies viewed by the researchers led to several conclusions that influence teachers to utilize or ignore the instructional technologies. Listed are the following reasons why teachers use or do not use these instructional materials:

Reasons for Using Technological tools in Teaching Biology

Instructional technologies provide enhanced understanding of difficult concepts, strengthen learning, and expand access to ongoing, updated knowledge by delivering learning in a manner that is consistent with current technological innovations.

People's interest in Technology Integration

The use of these modern aids increases student engagement by way of entertaining them raising their curiosity as well as holding their attention. Because of the user-interactivity and attractive images present in these learning tools, Clegg and Bailey (2008) claim that using mobile devices such

as laptops and tablet computers makes learning more enjoyable and conducive for students.

Represent Significant Convenience

IT is thought to help save time and effort while maintaining productivity. The most popular teacher training programs, according to Alden (2000), are those that enable teachers to first learn how they can benefit from technology themselves. Tutors must show students how technology can make their lives easier, more creative, or more enjoyable.

Chapter Summary

All sectors of our country, especially education, require growth because, education is the catalyst for all other changes in the country's growth, in the higher education sector, biology education is particularly important. Because of the ease of comprehension and appealing experience for students, the best way to convey knowledge to biology students is through technology. Traditional classrooms can be transformed into smart classrooms with the help of technology.

As a result, the most important way to improve the quality of learning in higher education is to incorporate technology into the classroom. The creation or construction of a new physical body or mental instrument brings both opportunities and challenges. In a nutshell, when a new tool is introduced, it usually:

1. Aids us to "better" solve some problems and complete some tasks that we were unable to complete prior to using the new method. "Better" can mean anything from "more cost-effectively" to "higher quality.". Assists

us in resolving issues and completing activities that would otherwise be difficult to accomplish without the new method.

2. It creates new problems. The development of the 3Rs, for example, raised educational and social concerns about who would receive and who would provide a standardized “grammar school” level of education centered on these topics. Technology is an example of a mighty change agent technology. We will look at technology through the lens of how it adds to tools that help us improve our physical bodies. Microscopes, telescopes, brain scanning equipment, automated manufacturing, and a wide range of other technologically dependent tools are now available.
3. Technology should also be used as a mental tool. It is clear that technology expands and integrates some of the power of reading, writing, and arithmetic.
4. The Internet, for example, allows for worldwide communication and the Web (a global library). Many emotional tasks can now be automated thanks to technological advancements.
5. Technology causes a slew of issues in education, including digital equity, the need for a relatively costly addition to a school's infrastructure, and how to provide appropriate technology education to students.
6. Technology in education poses challenges in terms of dealing with prospective changes in curriculum content, educational procedures, and evaluation in a way that benefits students.
7. The issue of choosing what we want students to learn is exacerbated by technology.

We're conditioned to believe that a method can be improved over time simply because it was invented. Humans, on the other hand, have no experience with instruments that have been designed to be extremely useful and then improved by a factor of a million or more. Operating system capacities in technology continue to advance at a breakneck rate, with capacity doubling in less than two years. In itself though, the rapid pace of change presents a major challenge to our educational system.

Based on the literature examined, it is clear that integrating technology into conventional educational techniques and methods will increase Biology performance. This is due to the fact that technology enhances these techniques by:

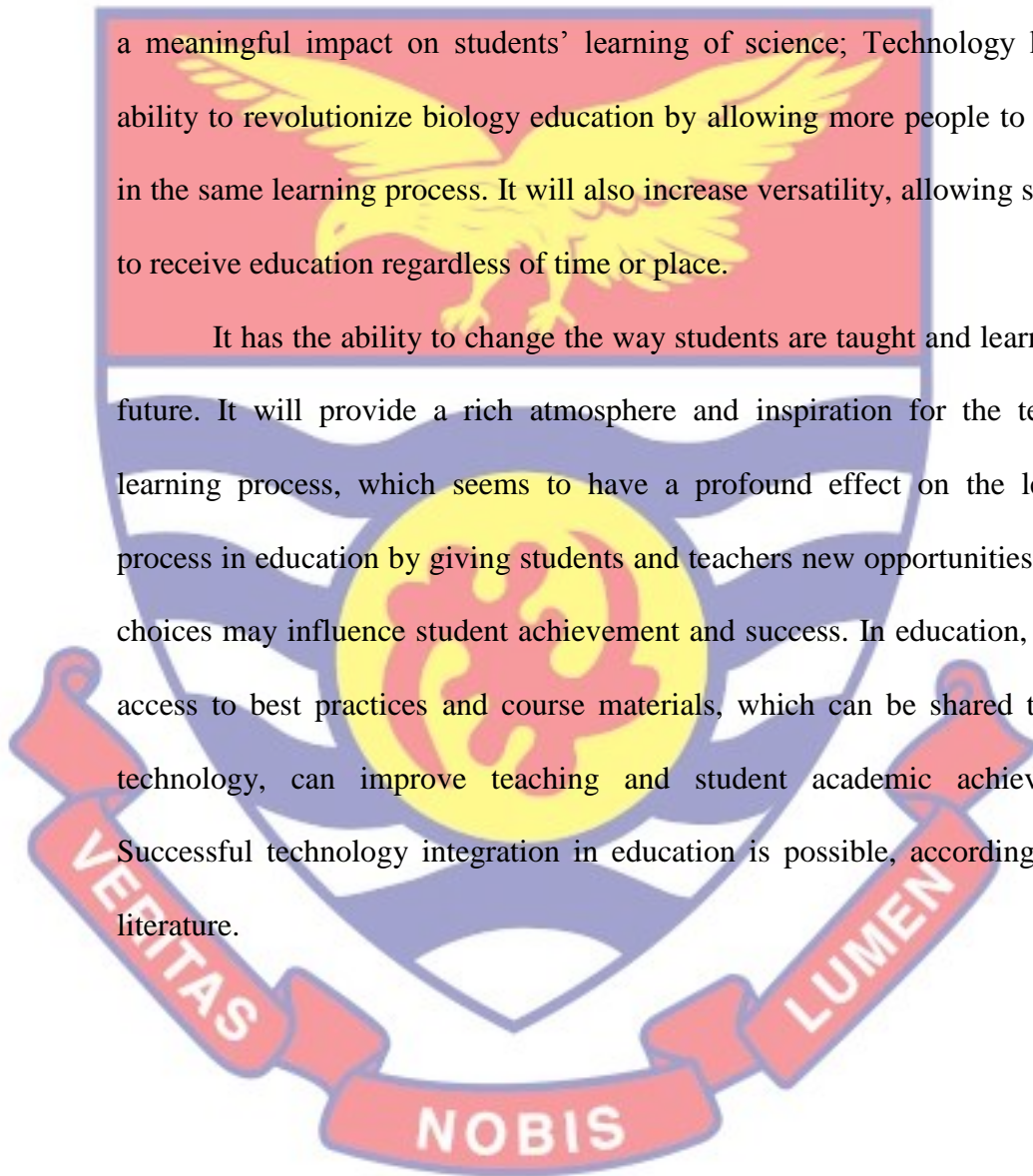
- a) Expanding access to current and relevant teaching and learning materials
- b) Moving away from an instructor center teaching strategy to student center approach.
- c) Improving tutor pedagogy
- d) Increasing student motivation

Instructors must be measured in terms of mindset, capacity, facilities, and administrative support because they promote technical incorporation in the teaching and learning process. The aim of this literature review was to look at student and tutor perspectives on using techniques of teaching and study biology in the twenty-first century.

To date, technology has had a slight effect on biology education; however, in the coming years, that impact will increase dramatically, and technology will become a powerful force for change in many educational

practices. The continued use and advancement of technology in biology will have a major effect on students: technology and the teaching-learning process; educational quality and accessibility; learning encouragement, learning climate, and technology use; and academic success, using current activities and practices as a reference. In education, technology acceptance and use have a meaningful impact on students' learning of science; Technology has the ability to revolutionize biology education by allowing more people to engage in the same learning process. It will also increase versatility, allowing students to receive education regardless of time or place.

It has the ability to change the way students are taught and learn in the future. It will provide a rich atmosphere and inspiration for the teaching learning process, which seems to have a profound effect on the learning process in education by giving students and teachers new opportunities. These choices may influence student achievement and success. In education, greater access to best practices and course materials, which can be shared through technology, can improve teaching and student academic achievement. Successful technology integration in education is possible, according to the literature.



CHAPTER THREE

RESEARCH METHODS

Introduction

The procedures and techniques used to collect data for the analysis were mentioned in this chapter. The study architecture, the population, the questionnaire and sampling methods, as well as the data collection instrument with system and data processing mode, are all covered.

Research Design

The study design was descriptive research. A survey is a means of collecting data from members of a community on one or more issues (Gay & Airasian, 2003). According to Keengwe (2007), the main goal of a survey is to collect specific information about a representative sample of a given population. A questionnaire was used to collect reliable data from the tutors and students in the sample. A questionnaire is a series of questions administered to a grouping of individuals in ordering to assess people behaviors, public opinion, principles, or proclivities in behave.

Many researchers favour the survey approach to other data collection techniques for research purpose because of its numerous drawbacks, strengths, and benefits. Surveys provide a high degree of general capability when it comes to representing a wide group of people. The data collected has a clearer explanation of the relative features of the general population participating in the analysis due to the normal large number of people who respond to surveys. In comparison to other data collection techniques, surveys are able to obtain

data that is close to the exact characteristics of the larger population. Finding statistically meaningful findings is also simpler than for other data collection approaches. Questionnaires can also be used to evaluate different factors.

Participants will be asked to fill out a questionnaire in a number of ways. The questionnaire can be submitted by e-mail or fax, or it can be distributed over the Internet. An online survey is currently the most common method of gathering data from target participants. Apart from the ease with which data can be collected, researchers would be able to gather information from people all over the world. Surveys are suitable for scientific testing purposes because they offer a consistent stimulus to all participants. The researcher's own biases are removed because of the high reliability. Since the questions in the questionnaire should be thoroughly scrutinized and standardized, they offer uniform meanings of all of the subjects that will be filling out the survey. As a consequence, the data gathered can be calculated with greater accuracy. Surveys, on the other hand, have risks and flaws that must be recognized. The questionnaire, as well as the method of performing it, that the researcher used from the beginning cannot be changed at any point during the data collection period. While this inflexibility can be viewed as a weakness in the survey process, it can also be viewed as strength because it allows for accurate and truthful research.

Because of the likely difficulties of remembering the details relevant to controversy, survey items with controversies could not be accurately answered by participants. The reality behind these controversies cannot be investigated as extensively as it would be if alternate data collecting approaches such as face-to-face interviews and focus groups were used. Another flaw is that

sample items are not standardized before being distributed to the participants. As a result, the investigator must devise questions that are broad enough to encompass the entire population. On the other hand, these questions usually may not be as suitable for all participants as they should be. Administering a survey that relies on affective factors or variables that interact with feelings is a prime example of this scenario. Despite this drawback, the researcher was persuaded that the survey design was the right for this analysis.

Area of Research

The research was conducted in Ghana's central region. The Central Region is one of Ghana's 16 regions. It is situated in the country's central zone. A College of Education, B College of Education, and C College of Education are the three Colleges of Education in Central Area of the study. Each college has the required manpower to run all of the programs mentioned. The number of students enrolled varies from one institution to the other, based on the resources available to tutors and students.

Other considerations that affected the research area's location selection include familiarity with the area and the study's time constraints. Considerations such as familiarity with a venue, time constraints, and financial constraints, according to Gay (1976), influence the author's choice of location because it affects instrument administration and the amount of data to obtain.

Bernard (1995) found that conducting research in an atmosphere where you are recognized as a friend and a colleague is easier than conducting research in an environment where you are seen as an outsider with ambiguous motives. This also improves science's ethical, legal, and public relations standing.

Population

Population, according to Polit & Hungler (1996), is the entirety of cases that follow a set of requirements.

The study included all biology tutors and students from the Colleges of Education in Central Region of Ghana. The study enlisted the help of tutors and students from three colleges of education in Ghana's Central Region. The research was restricted to colleges that offer biology as a general course. The names of the Colleges are;

A College of Education

B College of Education

C College of Education

Due to time and financial constraints, the study was limited to tutors who teach Biology and students who deliver Biology in Ghana's Central Region colleges of education. The demographic information comes from the heads of departments at Ghana's three educational institutions in the Central Region.

Sampling Procedure

The researcher can take as big a sample as time and resources allow, according to Mugenda and Mugenda (2003). This is because the sampling error increases as the sample size reduces. The target population for this study is 225 from the three Colleges in the study area. Table 1 presents the breakdown of the population.

Table 1: The Breakdown of the Population

Colleges	Students	Tutors
A	80	5
B	70	6
C	75	4
TOTAL	240	15

A basic random and purposive sampling technique was used to select level 200 students and tutors from the three Colleges of Education. The plain random sample is the most common sampling method used in statistical methods and computations. The most significant benefit of a simple random sample is that everyone in the population has a fair chance of being chosen. As a result, the sample chosen is representative of the entire population. In turn, the numerical data presented from analysis of the sample will be valid. All the Biology students from the three College of Education were used with basic random sampling method; this statistic is assumed to represent a fair percentage of the overall population of Students and Tutors in their respective Colleges of Education. The participants' ages vary from 21 to 55 years old, and there are both males and females among them.

Data Collection Instruments

A questionnaire used in this analysis consisted of open-ended and closed-ended questions. A questionnaire is a set of questions directed at specific individuals with the goal of gathering data on the study's subject. This is a machine that gathers information from a large number of people (Kombo & Tromp, 2006). Each question in the survey is intended to assist the

researcher in answering the study's research questions (Mugenda & Mugenda 2003). For this study, the researcher distributed questionnaires to biology tutors and students from the three colleges of education. This procedure was carried out over a two-month cycle. The questionnaires were circulated to the respective tutors and level 200 biology students during the researcher's second visit to the schools.

A questionnaire is a list of questions aimed at individual respondents with the intention of collecting data on the study's subject. This is a computer that collects data from a wide number of users (Kombo & Tromp, 2006). Each question in the survey is intended to assist the researcher in answering the study's research questions (Mugenda & Mugenda 2003). The researcher distributed questionnaires to both biology tutors and students in the three colleges of education for this report. This procedure was carried out over a two-month cycle. The questionnaires were circulated to the respective tutors and level 200 biology students during the researcher's second visit to the schools. A questionnaire is a list of questions aimed at individual respondents with the intention of collecting data on the study's subject. This is a computer that collects data from a wide number of users (Kombo & Tromp, 2006). Each item in the questionnaire is designed to help the researcher answer the study's research questions (Mugenda & Mugenda, 2003). The researcher distributed questionnaires to both biology tutors and students in the three colleges of education for this report. This procedure was carried out over a two-month cycle. The questionnaires were circulated to the respective tutors and level 200 biology students during the researcher's second visit to the schools. The science tutors were given time to respond to the items in the questionnaires.

The researcher collected the questionnaires after one week. On the administration of student's questionnaires, the researcher sought the assistance of the tutors to distribute the questionnaires to the students. After they are filled, the researcher collected them to minimize the limitation of low return of questionnaires, the researcher allowed them to fill the questionnaires and take them back. The researcher visited the colleges and collected the questionnaires. The research instrument for this study was self-constructed questionnaire with respect to the research questions in the study. A self-developed cross-sectional survey questionnaire which consists of 5 sections was used. The questionnaire was based on 4point Likert Scale ranging from: strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD).

Objectivity was provided by the fact that the questionnaire is filled out anonymously. The results were statistically processed using SPSS. The questionnaire was divided into 5 sections as A-E

Section A is about the demographic background of the respondents consists of; gender, teaching experience and the highest academic qualification

Section B. Technology enhance Biology education in the Colleges of Education in Central Region of Ghana

Section C. The use of technology improve the teaching of Biology in the Colleges of Education

Section D. Problems that hinder the use of technology in the teaching and learning of Biology in Colleges of Education in Central Region of Ghana

Section E. Knowledge of biology tutors have in the use of technology to teach biology. The questionnaire consists of fifty (50) items for Tutors and forty (40) for students.

Validity and Reliability

Validity and dependability of the research instrument Is a test of how accurate the findings from testing instruments are, according to Kombo and Tromp (2006). According to Orodho (2004), a reliable instrument has a small error or standard deviation. The researcher tested the test instruments to determine their validity using the Spearman- Brown prophecies formula of internal accuracy with a reliability of 0.7 and above, as follows: Where, r = reliability, N = sample size, and d = variance, the researcher used the Spearman- Brown prophecies formula of internal accuracy with a reliability of 0.7 and above. The instruments' validity was assessed by interviewing ICT experts, who analyzed the test instruments and offered feedback on their face validity. The test instruments were piloted before being modified to accommodate the instrument's material validity.

Data Collection Procedure

Tutors and students from Central Region's three colleges of education circulated the questionnaire electronically and answered it in a timely and effective manner. The researcher received assistance from Komenda College of Education's computer communication technology tutors on how to conduct the questionnaire online. Before beginning to conduct the questionnaire, the researcher obtained ethical approval from the Ethical Review Board. The survey respondents had 3-5 days to complete it and return it to the researcher for data processing. After two weeks, the researcher collected and processed all of the completed questionnaires in order to complete the research's output and conclusions.

Ethical Consideration

An ethical approval document was obtained from the Ethical Review Board before the researcher started gathering data for the survey. Tutors and students from the three colleges of education in Ghana's Central Region circulated the questionnaire and answered it in a timely and professional manner. However, with the help of science and information communication technology Tutors from Komenda College of Education, questionnaires were sent to the participants to fill out and return in order to collect data for analysis. This chapter discussed the methods and techniques used to obtain data for the study. The study's design, population, survey and sampling methods, data collection instrument and system, and data processing mode are all covered.

Recruitment and training of field assistants

For this study, few research assistants were brought on board to help in the issuing of the questionnaires and its collection. These recruited research assistants were trained on issues concerning ethical considerations in research, and administration of the questionnaire, even though the questionnaires are self-administered and Research Assistant were not to interfere in the answering of the questionnaires. The recruited research assistants were selected based on their basic knowledge in research and their ability to communicate clearly in English.

Data Processing and Analysis

Data for research question 1 uses frequency and percentages to analyze the information collected

The information obtained from the respondents was compiled in order to continue with the statistical analysis. I used descriptive analysis to analyze section A-E. Section A demographic background of the study with frequency and percentages. The mean and standard deviation were calculated in Section B, frequency and percentages in Section C, inferential statistics (t-test) in Section D, and measurements of central tendency and dispersion in Section E. The researcher used descriptive data processing methods including frequency tables, mean, and percentages to analyze the data. Using research questions as guidelines, all the data on the tutors, and students questionnaires were coded for analysis. A code book was made from which the tables were derived from. The data from the tutor and student questionnaires are used to address the questionnaire's study questions. Using a computer application called the predictive kit for social sciences; the answers were coded and analyzed (SPSS).

Respondents' Biographical Details

The students' and tutors' biographical information is presented in this section. The sex distribution was covered in the biographic details for students. However, for tutors, information including gender, maturity level, teaching experiences, educational level, and educational credentials were covered. Figure 2 presents the distribution of the students based on gender.

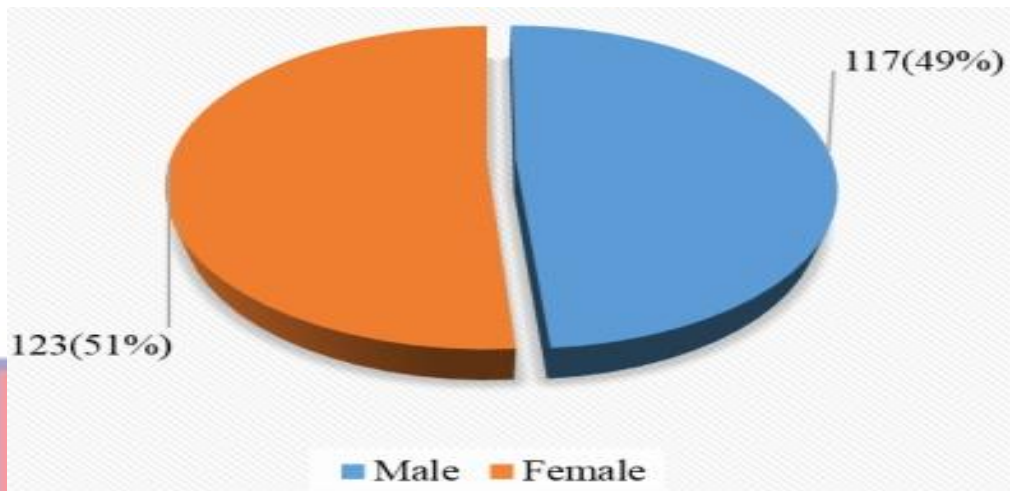


Figure 2: Distribution of students by sex

Source: Field survey (2020)

The distribution, as shown in Figure 2 indicates a little more of female students (51%), than male students (49%). Table 2 indicates the ethnicity, maturity, teacher experience, educational degree, and technical qualifications of the tutors.

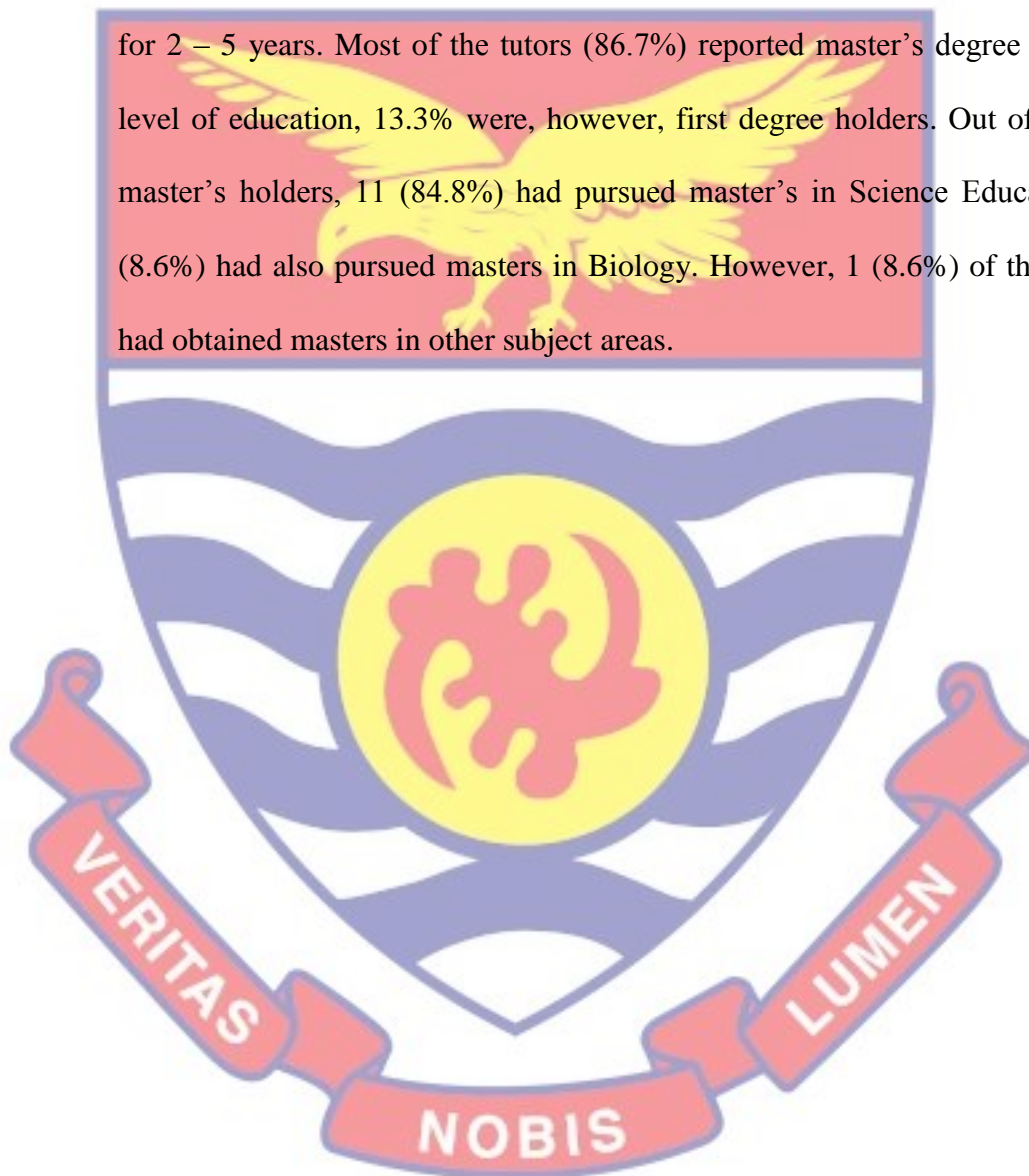
Data for research question 2 uses mean and standard deviation for the analysis

Table 2: Distribution of tutors by Biographic Information

Variable	Frequency	Percentage (%)
Sexuality		
Masculine	9	60.0
Feminine	6	40.0
Maturity level		
Below 30 years	1	6.7
30 – 35 years	1	6.7
36 – 40 years	11	73.3
41 years & above	2	13.3
Years of teaching experience		
2 – 5 old age	1	6.7
11 – 15 old	2	13.3
16 years & above	12	80.0
Level of education		
Degree	2	13.3
Masters	13	86.7
Professional qualification		
Masters in Science Education	11	84.8
Masters in Biology	1	8.6
Masters in other areas	1	8.6

Source: Field survey (2020); N = 15

As shown in Table 2, the majority (60%) of the tutors were males, while 40% were females. A vast majority (73.3%) of the tutors was from the ages of 36 – 40 years; however, 6.7% each of the tutors were 30 – 35 years, and below 30 years, respectively. A greater proportion (80%) of the tutors indicated they have been teaching for 16 years or more, only 6.7% had taught for 2 – 5 years. Most of the tutors (86.7%) reported master's degree as their level of education, 13.3% were, however, first degree holders. Out of the 13 master's holders, 11 (84.8%) had pursued master's in Science Education, 1 (8.6%) had also pursued masters in Biology. However, 1 (8.6%) of the tutors had obtained masters in other subject areas.



CHAPTER FOUR

DISCUSSION AND RESULTS

Brief introduction

The goal of this study was to investigate the views of tutors and students in Ghana's Central Region Colleges of Education on the use of technology in Biology instruction. The chapter consists of analysis of the data gathered from the questionnaires which was completed by all 240 students and 15 tutors used for the study. The first section contains the respondents' biographical details, while the second section contains the key results of the study.

Main Results

The key findings of the study are summarized in this section. The findings are presented in terms of the research questions and theories that the analysis was created to investigate. The information was gathered using a four-point Likert scale as the answer format. Mean scores for each technology were determined for the purposes of analysis and interpretation. On the scale, strongly agree = 4, agree = 3, disagree = 2, and strongly disagree = 1. The meanings were based on a mean for 2.50. Mean scores below 2.50 were interpreted as disagreement to the technology usage, whereas mean scores of 2.50 or more were described as agreement to the technology usage.

Research Question 1

How does a tutor use technology to improve Biology education in Ghana's Central Region Colleges of Education?

The aim of this study was to investigate how tutors use technology to enhance Biology instruction. Tutors were polled about how they use technology in the classroom while teaching Biology. The tutors' answers are summarized in Table 3. Using mean and standard deviation

Table 3: Enhancing the Teaching of Biology using Technology (Tutors)

Statement	<i>M</i>	<i>SD</i>
Tutors download materials from the net	3.47	0.52
The use of technology enhances students learning of biology	3.33	0.49
The use of technology in biology classes is becoming more common	3.33	0.62
The use of tutorial websites on the internet	3.27	0.46
Students use the internet to communicate with their peers	3.27	0.46
Presentation makes biology lessons real and authentic	3.27	0.59
Tutors benefit from using technological tools in college	3.27	0.59
Tutors' usage of videos and pictures while teaching	3.20	0.41
Tutors put students into smaller groups when teaching	3.20	0.68
Technology used in class make students cooperative	3.13	0.35
Tutors give students assessment on the internet	3.13	0.35
Students are engaging actively in the course of teaching	3.13	0.35
Coaching of student is preferred to lecturing	3.13	0.52
Internet conferencing is encouraged in teaching	3.07	0.46
The use of Google classroom make teaching interesting	2.93	0.46
Student learn through the internet with a guide	2.93	0.46
Students are asked to visit profonline.com	2.73	0.46
The internet is the main source of accessing educational materials	2.60	0.63
Less work is given to weaker students in the course of teaching	2.47	0.52

Source: Field survey (2020); N = 15

As presented in Table 3, the tutors agreed to all the 19 Questions on how they use technology to enhance the teaching of Biology. They suggested that they can download materials from the internet using technology ($M =$

3.47, $SD = .52$) as the most common way they use technology in teaching. The tutors also indicated they integrate technology in the teaching of Biology ($M = 3.33$, $SD = .62$), they use technology for online tutorials ($M = 3.27$, $SD = .46$), they use technology to make presentations in order to make lesson real and authentic ($M = 3.27$, $SD = .59$). The tutors further reported that through technology, the students correspond with friends on the internet ($M = 3.27$, $SD = .46$), the tutors also make use of videos and pictures while teaching ($M = 3.20$, $SD = .41$). The tutors further reported that through technology, they put students into smaller groups when teaching ($M = 3.20$, $SD = .68$), they give students assessment task through internet ($M = 3.13$, $SD = .35$), they also engage their students in internet conferencing through technology ($M = 3.07$, $SD = .46$), and among others, they also use Google classroom to engage their students ($M = 2.93$, $SD = .46$) which implies that technology really enhance the tutors teach biology when is well used in the their process.

Research Question 2

To what degree does the use of modern devices in colleges of education boost the teaching of biology?

The purpose of the survey was to see how effective technology can enhanced biology education colleges of education. In view of this research questions, views of the students were sought. Table 4 presents the responses of the students using mean and standard deviation

Table 4: Using Technology to Enhance Biology Instruction in Colleges of Education (Students)

Statements	<i>M</i>	<i>SD</i>
Teaching is more of theory than practical work	3.08	0.86
Applications aspect of the subject matter is less emphasized	2.86	0.82
Emphasis is placed on theories and talking	3.08	0.80
Less use of technology in teaching biology content	3.00	0.83
Improvement in teaching approaches	3.01	0.79
More competent biology tutors	2.99	0.86
Adequate resources for teaching and learning	2.70	1.02
Provision of good and current text books	2.91	0.96
Assessment based on originality and appropriate performance rather than regurgitation	2.87	0.84
Students' engagement in classrooms is less	2.37	0.88

Source: Field survey (2020); N = 240

Students suggested that technology helps to change teaching practices, as seen in Table 4 on the degree to which technology is being used to enhance biology education. ($M = 3.01$, $SD = .79$), technology provides adequate resources for teaching and learning ($M = 2.70$, $SD = 1.02$). Students have stated that using technology aids in supplying students with good and current textbooks ($M = 2.91$, $SD = .96$), as well as assisting tutors in conducting assessments based on originality and acceptable results rather than regurgitation ($M = 2.87$, $SD = .84$). From the viewpoint of the students, it was discovered that technology enhances biology instruction, through the use of technological methods to test students. According to the report's results,

biology tutors are in line with the use of ICT in teaching routines around the world, and that purchasing technology does not guarantee its use in the classroom (Hawkins, 2002; Resnick, (2002). According to this, tutors use technology for classroom activities, as a means of learning and networking, for preparing and studying in and outside the classroom, and most often at home.

Research Question 3

What obstacles exist in Ghana's Central Area colleges of education's use of technical tools in biology education and learning?

The purpose of this study was to look at the challenge that tutors face while using technology in the classroom. And, the challenges that students face while using technology in the classroom. Table 5 contains the tutors' responses with mean and standard deviation

Table 5: Issues on the Use of Technology in Biology Education (tutors)

Statements	<i>M</i>	<i>SD</i>
The colleges facilities on technology is limited	3.20	0.56
Tutors use technological tools as personal level as well as for teaching in the classroom.	3.13	0.52
Tutors have limited accessibility to network connection	3.00	0.53
Biology lessons uses limited time for practical lessons	2.87	0.35
Lack of effective training on the part of tutors	2.87	0.52
Most tutors lack competency in technology	2.60	0.51
Tutors have negative attitude toward the use of technology	2.40	0.51

Source: Field survey (2020); N = 15

Tutors reported inadequate college infrastructure ($M = 3.20$, $SD = .56$), limited exposure to network networks ($M = 3.00$, $SD = .53$), lack of adequate tutor instruction ($M = 2.87$, $SD = .52$), and lack of technical expertise ($M = 2.60$, $SD = .52$) as some of the issues they face when using technology to teach Biology. Tutors find it impossible to teach using technology because of these reasons. Students have expressed doubts regarding the use of technology in learning, in addition to the questions posed by tutors on the use of technologies in classroom.

Table 6: Issues on the use of Technologies in Biology Education (Students)

Statements	<i>M</i>	<i>SD</i>
Limited time for practical lessons	3.31	0.78
Uses search engines, (social media, Google etc.) in the classroom to learn	3.21	0.69
Loaded curriculum that make practical work difficult	3.19	0.76
Inadequate resources for teaching and learning	3.19	0.80
Students are engagement in the classroom	3.11	0.76
Doubts about the effective use of technology to study biology	3.06	0.83
Facilities of technology use is limited to administration	3.04	0.74
Access to information from the internet is difficult	3.00	0.91
Students have less opportunity to follow daily events. in the classroom	2.93	0.89
Hands on learning activities not provided for the students	2.83	0.84

Source: Field survey (2020); N = 240

From Table 6, the students indicated that the limited nature of practical lessons do not permit the use of technology ($M = 3.31$, $SD = .78$), the loaded

nature of the curriculum makes technology difficult to do practical work ($M = 3.19, SD = .76$). Inadequate teaching and learning tools make it extremely difficult to use technology in education ($M = 3.19, SD = .80$), and there is a lack of appropriate instruction on how to use technology in studying ($M = 3.06, SD = .83$). The students further reported that facilities for technology use were limited only to administrative staff ($M = 3.04, SD = .74$), and access to internet connectivity was also a challenge for students ($M = 3.00, SD = .91$). This implies that schools have a lot to work at to make the teaching.

Research Question 4

What knowledge do biology tutors have in the use of technological to teach biology?

The research question sought to assess tutors' knowledge in the use of technology in teaching Biology. Tutors were asked 17 questions to assess their understanding about how to use technology in the classroom. Tutors' awareness of each technology was collapsed as 'agree' or 'disagree' for the purpose of data analysis on this specific study topic. Table 7 presents the responses of the tutors using mean and standard deviation

Table 7: Knowledge of Biology Tutors in the use of Technology

	Agree		Disagree	
	N	%	N	%
Tutors understands how to strategically improvise sequences of teaching	14	93.3	1	6.7
Instruction is given based on problem solving	13	86.7	2	13.3
Tutors able to organize and manage materials for teaching	15	100.0	-	-
Tutors consider timescale of potential investigations of problem solving	13	86.7	2	13.3

Table 7: Continued

Students are given test to bring them to technology performances	10	66.7	5	33.3
Tutors recognize flaws in students' learning approaches	15	100.0	-	-
Hands on learning activities are provided for all students	12	80.0	3	20.0
Students are directed to use multiple resource in class	13	86.7	2	13.3
Tutor serve as a mentor and motivator in the course of teaching	15	100.0	-	-
The physical arrangement of changes to facilitate learning in classroom	14	93.3	1	6.7
Students are guided to choose from multi-option assignment	13	86.7	2	13.3
Students produce video-tapes and role-play when asked to do so	12	80.0	3	20.0
Physical arrangement of changes to facilitate learning in classroom is considered	14	93.3	1	6.7
Students monitor their own learning active and investigation in the classroom	14	93.3	1	6.7
Opportunity is given to students to follow daily events outside the classroom.	13	86.7	2	13.3
Tutors are confidante in their use of Technology as a teaching and learning methods	12	80.0	3	20.0
To teach tutors to use presentation	13	86.7	2	13.3

Source: Field survey (2020); N = 15

As shown in Table 7, the majority of tutors dedicated to all 17 innovations while testing their understanding about the use of technologies in teaching of Biology. For example, 93.3 percent of tutors learned how to strategically improvise instructional sequences, and 86.7 percent agreed that technology learning should concentrate on problem solving. All the tutors (100%) agreed that technology is used to organize and manage materials for teaching. Almost all tutors (93.3%) confirmed that using technologies allows students to track their own learning as well as perform active research. The tutors (86.7%) further agreed tutors use presentation software to teach.

The responses of the tutors were further scored as right and wrong with scores '1' and '0', respectively for each of the 17 technologies. Total scores were estimated for each teacher, such that their scores ranged from 0 to 17 the following criteria were added as a result: 0–4 = very bad, 5–9 = acceptable, 10–14 = nice, and 15–17 = very good. Table 7 shows the findings in greater detail.

Table 8: Tutors' Knowledge in Technology

Level	Score Range	Frequency	Percentage (%)
Very bad	0 – 4	-	-
Satisfactory result	5 – 9	2	13.3
Good	10 – 14	1	6.7
Excellent	15 – 17	12	80.0
Maximum		15	100.0

Source: field research (2020)

As shown in Table 8, that most of the tutors had very great knowledge about how to use technology to teach Biology, while one (6.7 percent) had

strong knowledge and two (13.3 percent) had sufficient knowledge. It can be inferred from the results that the tutors have ample knowledge of how to use technology in Biology education.

Hypothesis

H_0 : When it comes to using technology in the classroom, male and female students have different levels of knowledge on the use of technology to teach biology.

H_1 : There is no difference in the knowledge of male and female students on the use of technology in the teaching of biology.

The aim of this hypothesis was to see whether male and female students had different levels of knowledge in the classroom when it came to using technology. This hypothesis was tested using the independent samples t-test. Prior to this study, the normality of the distribution was verified using the standard Q-Q map (Figure 3).

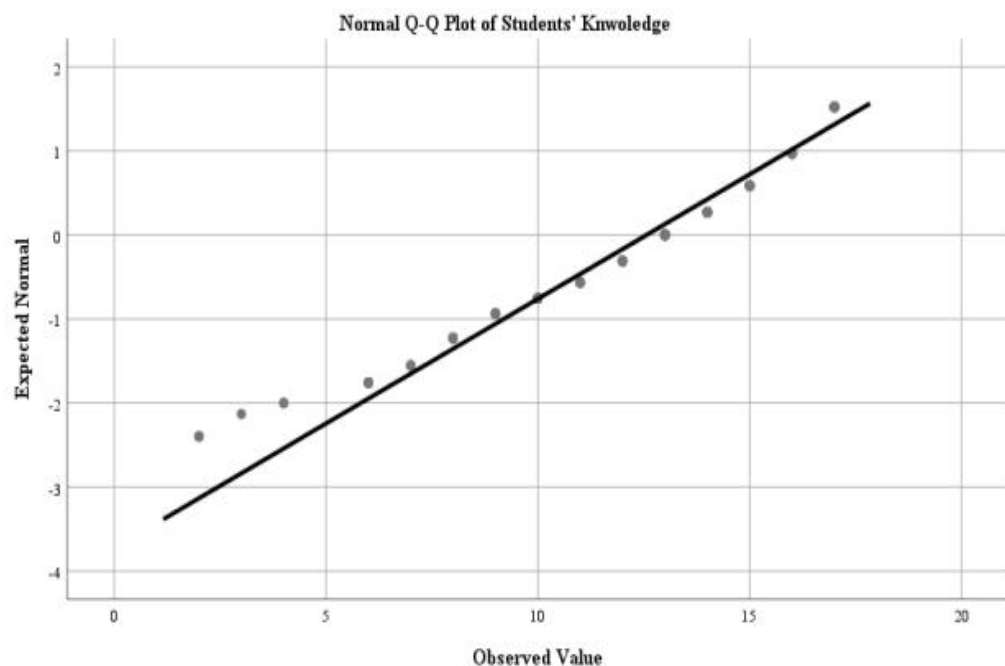


Figure 3: Typical Q-Q Plot

A typical Q-Q plot for student comprehension is shown in Figure 3. The plots in Figure 3 were almost parallel to the straight line, indicating that the normality criterion was met. In addition to the normality measure, the homogeneity of variance inference was also tested. With a p value of .013, Levene's test revealed a violation of the assumption. The unequal test results are presented after this infringement. Table 8 shows the results of the independent samples t-test. Table 8 shows that there is no statistically significant difference in knowledge levels about the use of technology in learning between male ($M = 12.90$, $SD = 3.08$) and female ($M = 12.25$, $SD = 3.62$) students, $(235.11) = 1.49$, $p = .645$. According to the results, both male and female students have a similar understanding of when to use technology in classrooms.

Table 9: Displays the findings of a Gender Independent Samples t-test Differences in Student Knowledge.

Sex	<i>M</i>	<i>SD</i>	Levene's Test for Equality of Variances		t-test for Equality of Means			Mean
			<i>F</i>	Sig.	<i>T</i>	Df	Sig.	Diff.
Male	12.897	3.078	6.324	.013	1.491	235.11	.137	.645
Female	12.252	3.618						

Source: Field survey (2020)

The null hypothesis, "The hypothesis that "there is no difference in outcomes between male and female students' knowledge of using technology

in learning" was not discounted based on the findings, implying that male and female students' perception of how to use technology in the classroom is similar.

Discussion of Results

The research questions were divided into four categories: using technology to improve biology learning and teaching, using technologies to improve biology teaching and learning, using technological equipment to improve biology teaching and learning, issues that prevent the use of technology in biology teaching and learning, tutors and student knowledge on the use of technology in biology teaching and learning, and tutors and student knowledge on the use of technology in biology teaching and learning. To bring the study's results into line, experts from different fields were invited to participate in a discussion. This was done using the research questions 1-4 as a guide.

Using Technology to Enhance Biology Education and Learning

According to Table 2, the majority of respondents believe that tutors often use technology in teaching Biology, which is consistent with the findings of Gikas and Grant (2013), as well as Brush, Glazewski, and Hew (2008), who found that tutors use technology to choose their subjects, schedule lessons, and assist students in solving problems online. Bigler and Hanegan (2011), Dong, Guerrero, and Moran (2008), Peterman, Pan, Robertson, and Lee (2014), and Spornjak, Puhek, and Sorgo (2010) all agree that incorporating technology into teaching and learning increases student engagement, interest, and motivation. College tutors, on the other hand, according to Cheung, Yen, and Tsang (2011), do not find the teaching and learning of Biology, or other subjects,

more interesting with the use of technology tools unless they find a particular technology suitable.

The Use of Technological Equipment to Enhance Biology Teaching and Learning

Table 3 shows the extent to which technology is used to improve biology instruction students have indicated that technology aids in the provision of good and existing textbooks, reference materials, and applications to students. Tutors use technologies to measure students based on originality and acceptable results rather than regurgitation. (Wilson, 2003), Banks, (2010) confirm the result by incorporating technology into instruction which has pedagogical benefits on assortment of teaching that enhance student understanding.

Issues that Prevent Technology from Being Used in Biology Education and Learning

Students face all of the issues associated with using technology to study biology, as seen in Table 5. Many of the survey's technology questions were answered in the same way, indicating that students have difficulty learning biology using technology and that appropriate guidance in how to use technology in the classroom is required. Students have complained that technical resources were only accessible to administrators and that students had trouble accessing the internet. The findings are in line with Schoepp (2005), who described problems as obstacles or gaps between beginning and end that must be bridged in order to achieve a specific research goal. Albirini, (2006, p.6), Young, (2003), Turel and Johnson's review (2012); Albirini, (2006, p.6) (2012). Colleges, according to Batane (2004), are experiencing

difficulties as a result of modern globalization, the process of incorporating technology into teaching, and other factors. Owing to a lack of professional assistance for both tutors and students, there is a fear of losing equipment when teaching and learning.

On the other hand, Simon, (2014) and Lucido (2007) assume that technical resources could potentially replace tutors, despite their reluctance to try something different. “Tutors will not be replaced by technology,” Sheryl Nussbaum-Beach writes, “but tutors who do not use technology will be replaced by others who do.” p. 59-64 p. 59-64 p. 59-64

Furthermore, the study revealed that when using technology tools for the teaching and learning of Biology, tutors face challenges such as a lack of technology resources, epileptic power supply to move certain tools, and the outdated existence of some tools, which is consistent with the role of researchers who found that, despite the commonly advocated ubiquity, getting materials for lessons is difficult. On the other side, Ogunleye, (2007), Ndudi, and Chinedu, (2016) have a different perspective on the magnitude of challenges faced in using technical tools for biology research arguing that the issue isn't with students studying, but with tutors who can't afford to invest their own money on internet connectivity, and that the majority of existing college buildings aren't equipped to integrate technology into teaching.

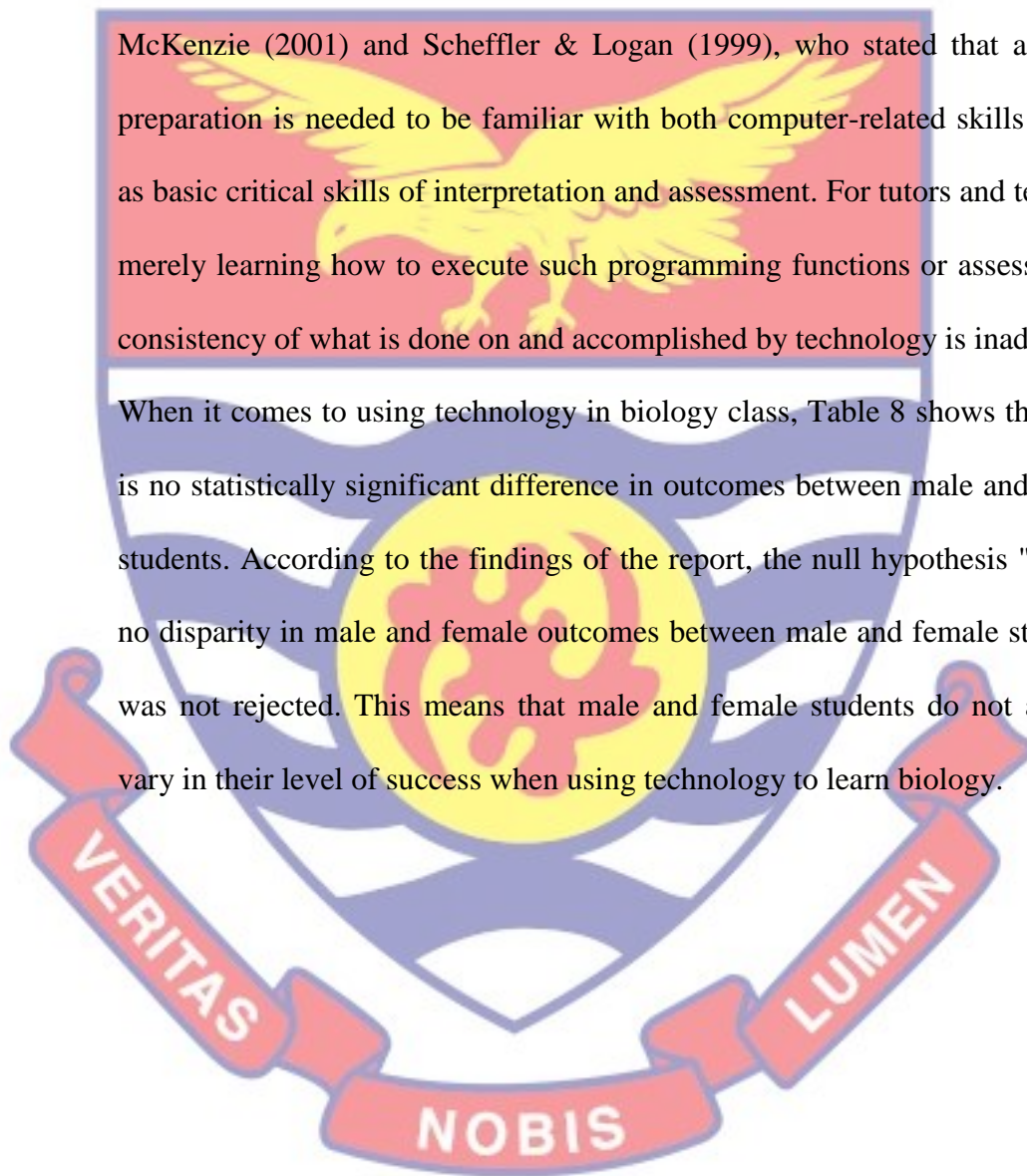
Tutors and students' understanding of how to teach biology using technology

Table 6 shows that both of the tutors are familiar with how to use technology to teach Biology. This is supported by Table 7, which shows that both male and female students have equal knowledge of how to use

technology for learning. The results of this study agree with those of Grabe, (2007), Ghavifekr, and Afshari (2012), who discovered and announced that technology convergence, has become the information transmission highway in most countries, transforming our economies and fully changing the way people live. In contrast to the previous finding, the result agrees with

McKenzie (2001) and Scheffler & Logan (1999), who stated that adequate preparation is needed to be familiar with both computer-related skills as well as basic critical skills of interpretation and assessment. For tutors and teachers, merely learning how to execute such programming functions or assessing the consistency of what is done on and accomplished by technology is inadequate.

When it comes to using technology in biology class, Table 8 shows that there is no statistically significant difference in outcomes between male and female students. According to the findings of the report, the null hypothesis "there is no disparity in male and female outcomes between male and female students" was not rejected. This means that male and female students do not actually vary in their level of success when using technology to learn biology.



CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Overview

The aim of this study was to investigate the perceptions of using technology to improve Biology instruction at Ghanaian colleges of education in the Central Region. Simple random sampling was used to select a sample of 15 tutors and 240 students from the three colleges of education, for a total of 225. Tutors and students were given a questionnaire to fill out based on their gender, tutors' qualifications, the number of decades they had worked at the College, the extent of technology use in teaching biology, the use of technical resources, issues with using technology to teach, and tutors' and students' knowledge of using technology to teach biology.

Summary from the Main Result of the Study

The investigation yielded the following results:

1. Predominant among how tutors use technology in teaching were; to download materials from the net, integrate technology in the teaching of Biology, make presentations in order to make lesson real and authentic. The results showed that through technology, the students correspond with friends on the internet; the tutors also make use of videos and pictures while teaching. The tutors further reported that through technology, they put students into smaller groups when teaching, they give students assessment task through internet, they also engage their students in internet conferencing through technology, and

among others, they also use Google classroom, What App to engage their students.

2. In terms of how technology is used to enhance biology education, it was discovered that technology assists in the advancement of teaching methods and offers sufficient tools for teaching and learning. Students also found that the use of technology helps in providing good and current textbooks to students, and also, technology helps tutors conduct assessment based on originality and appropriate performance rather than regurgitation.

3. Among the problems that tutors encounter in the use of technology in teaching of Biology, tutors reported the limited nature of college facilities, limited accessibility to network connections, lack of effective training on the part of tutors, and lack of technological competence. In addition to what the tutors pointed out as problems with the use of technology in teaching, students also mentioned the problems they face in the use of technology in learning. The limited nature of practical lessons do not permit the use of technology, the loaded nature of the curriculum makes technology difficult to do practical work. The students also indicated inadequate resources for teaching and learning makes technology difficult to use technology in learning, and lack of effective training on the use of technology in studying. The students further reported that facilities for technology use were limited only to administrative staff, and access to internet connectivity was also a challenge for students.

4. The research also showed that the majority of the tutors had excellent knowledge of how to use technology in Biology classes, while only a few had adequate knowledge of how to use technology in Biology classes. The tutors, for example, knew how to strategically improvise teaching sequences and that technology learning should be problem-solving focused. The tutors were aware that technology was used to arrange and administer teaching and learning processes

5. The results also revealed that there was no statistically significant difference in understanding of how to use technology in the classroom between male and female students. Furthermore, the results indicated that both male and female students had an equal understanding of how to use technology in the classroom.

Conclusions

Technological knowledge is essential in all colleges of Education in Ghana of which the study area is part. Technology helps tutors and students to acquire knowledge through research on abstract concepts and problem-solving thereby making teaching and learning of biology interesting. Furthermore, the result from the study indicates that, most tutors have favorable attitudes towards the improvement of technology in their classroom despite the various challenges on the acquisition, implementation, of technological ideas in the classroom.

Finally, tutors and students have ample technological skills, indicating that there is room for improvement in their understanding as to how to use technology in the teaching and learning process.

The study concludes that technology enhances students' interests and knowledge in biology teaching and learning in the Colleges of Education.

Recommendations

Based on the results from the study the following recommendations are not intended to be in chronological order.

The researcher recommends that, proper technological tools should be provided to colleges by buying the required technological tools that require minimal maintenance to improve biology teaching and learning in the colleges of education in Ghana.

Considering student unable to draw, label and identify organisms in biology, technology can make the subject interesting and easy which would enable students to acquire knowledge in biology teaching and learning when abstract content is been taught.

Software training should be introduced in teaching and learning of biology.

The study also recommends that, college principals should fully adopt the use of technology in the teaching and learning process by encouraging tutors and students on the positive impact of technology on their performance in the classroom.

Technological and technical support system should be provided in all colleges so as to ease the problems of technological failures in the colleges. Regarding factors that hinder effective use of technology in teaching and learning of biology.

the researcher recommends colleges to find solutions to some of the issues by engaging experts outside the colleges of Education.

Furthermore, the research concludes that college principals should facilitate the training of tutors to help them gain the latest knowledge on the use of technology in teaching and learning.

Finally, technological training should not be the only means in which biology tutors should be trained however; courses which focus on methods of teaching biology with technology should be integrated into the curriculum.

Recommendations for Further Research

The researcher suggests that further studies should be carried out on factors that improve access to technology in other colleges of education in Ghana as this only covered colleges in central region of Ghana.

However, the study looks at how tutors and students in Ghana's Central Region Colleges of education are using technology to enhance biology teaching and learning. After college, a study on the advancement of computer-aided instruction could be conducted to increase student interest in using technology in their classrooms.

Furthermore, using technology for presentations and hypotheses, separate research is required on the use of technology to teach practical lessons in biology.

This study should be repeated in other parts of the world to gain a greater understanding of how tutors use technology to enhance their teaching and learning in other Educational Institutions.

Finally, technology is here to stay, but more research is required to decide the best way to incorporate technology into teaching and learning processes in Ghana's various regions, so that everybody can benefit from its usage.

REFERENCES

- Albirini, A. (2006). Teachers' attitudes toward information and communication technologies: The case of Syrian EFL teachers. *Computers & Education, 47*(4), 373-398.
- Alden, S. (2000). *Effective programs for training teachers on the use of technology*. Cowen, P. S. (1984) Film and text: Order effects in recall and social inferences. *Educational Communication and Technology, 32*, 131-144
- Banks, K. (2010). Role of instructional technology in education. Retrieved on Brighthub.com/Education/
- Batane, T. (2004). In-service teacher training and technology: A case of Botswana. *Journal of Technology and Teacher Education, 12*(3), 387-410.
- Benzie, D. (1995). IFIP Working Group 3.5: Using Computers to Support Teaching
- Berg, Z., & Collins, M. (1995). *Computer-mediated communication and the online classroom in distance education*.
- Berger, C., Carlson, E., & Novak, D. (Eds). (1998). *Handbook for pre-service technology training*. Ann Arbor, MI: The University of Michigan.
- Bernard, H. R. (1995) *Research Methods in Anthropology: Qualitative and Quantitative Approaches*. Altamira Press, Walnut Creek.
- Bigler, A. M. & Hanegan, N. L. (2011). Student content knowledge increases after participation in a hands-on biotechnology intervention. *Journal of Science Education and Technology, 20*(3), 246–257.

Brooks, J.G., & Brooks, M.G. (1993). *In search of understanding: the case for constructivist classrooms*. Alexandria, VA: Association for the Supervision and Curriculum Development.

Bruner, J. (1996). *Toward a theory of instruction*. Cambridge, MA: Harvard University Press.

Brush, T.A. (1998). Teaching pre-service teachers to use technology in the classroom. *Journal of Technology and Teacher Education*, 6(4), 243-258.

Bybee, R. W., Taylor, J. A., Gardner, A., Van Scotter, P., Powell, J.C., Westbrook, A., & Landes, N. (2006). *The BSCS 5E Instructional Model: Origins and Effectiveness*. Colorado Springs, CO: BSCS.

Camarao, F. (1991). *Technology education in the Philippines*. National Book Store, Inc.

Campoy, R. (1992). The role of computer technology in the school reform movement. *Educational Technology*, 32(8), 17-22. 112.

Carr-Chellman, A. A., & Dyer, D. (2000). The pain and the ecstasy: Pre-service teacher perceptions on changing teacher roles and technology. *Educational Technology and Society*, 3(2), 47-64.

Castells M (1996). *The Rise of the Network Society. The Information Age. Economy, Society and Culture, Vol. I*. Oxford: Blackwell.

Cheung, S. K. S., Yuen, K. S., & Tsang, E. Y. M. (2011). A study on the readiness of mobile learning in open education. In IT in Medicine and Education (ITME). *International Symposium,1*, 133–136.

Clegg S. and Bailey, J. (2008). *Computer-based learning*. Retrieved from

Coates, D., Humphreys, B. R. et al. (2004). No significant distance between face-to-face and online instruction: Evidence from principles of economics. *Economics of Education Review*, 23, 533-546.

Coates, G. G., & Cronje, J. C. (2004). Computers for Africa: Lessons learned from introducing computers into schools in Mozambique. *International Journal of Learning Technology*, 1(1), 84-99.

Cowen, P. S. (1984) Film and text: Order effects in recall and social inferences. *Educational Communication and Technology*, 32, 131-144

Cradler, J., & Bridgforth, E. (2005). Recent research on the effects of Technology on teaching and learning. Retrieved from <http://www.wested.org>

Cronje, J.C. (2000). *Paradigms Lost: Towards Integrating behaviourism and Constructivism* Retrieved from <http://it.coe.uga.edu/itforum/paper48>

Davis, F. D. (2003). Acceptance of Information Technology. *MIS Quarterly*, 13(3), 319-339.

Dewey, J. (1938). *Experience and Education*. Toronto: Collier-MacMillan Canada Ltd.

Dias, L.B., & Atkinson, S. (2001). Technology Integration: Best Practices.

Diegnueller, K. (1992). Embracing technology as a tool in teacher training. *Education Week*, 11(6), 511-513.

Dong, Y., Guerrero, S., & Moran, M. A. (2008). Using DNA technology to explore marine bacterial diversity in a coastal Georgia salt marsh. *American Biology Teacher (National Association of Biology Teachers)*, 70(5), 279-283.

Donley, J., & Donley, T. (1996). Teachers, technology and training perspectives on school reform and the developing role of the teacher: A new template. *International Journal of Instructional Media*, 23, 1-5.

Drent, M. (2005). In Transited: OP Weg Near Innovative of ICT-gebruik op de PABO [In transition: On the road to innovative use of ICT in teacher education] (doctoral dissertation). Enschede: University of Twente.

Factors affecting Teachers' Use of Information in *International Journal of Instruction*, Vol2. No.1.

Driscoll, M.P. (1994). *Psychology of learning for instruction*. Boston: MA. Allyn & Bacon.

Dunn, R. (2000). Capitalizing on college students learning styles: Theory, practice, and research. Inc R. Dunn & R. Griggs (Eds),

Duran, M. (2000). *Examination of technology integration into an elementary teacher education program: One university's experience*. PhD, Ohio University.

Ertmer, P. (1999). Teacher pedagogical beliefs: The final frontier in our quest for technology integration. *Educational Technology, Research and Development*, 53(4) 25-40.

Flanagan & Jacobsen, M. (2003). Technology Leadership for the Twenty first Century Principal. *Journal of Educational Administration*, 41 (2), 124-142.

Flick, L, and Bell, R. (2000). *Preparing tomorrow's science teachers to use technology: Guidelines for science educators*. *Contemporary issues in technology and teacher education*, 1(1), 39-60

Fullan, M. (2001). *Successful school improvement: The Implementation Perspective and Beyond*. Open University Press, Philadelphia, USA.

Gay, L. R., & Airasian, P. (2003). *Educational research: Competencies for analysis and application* (7th ed.). Upper Saddle River, NJ: Pearson Education.

Ghavifekr, S., Afshari, M., & Amla Salleh. (2012). Management strategies for E-Learning system as the core component of systemic change: A qualitative analysis. *Life Science Journal*, 9(3), 2190-2196.

Gikas, J., & Grant, M. M. (2013). Mobile Computing Devices in Higher Education: Student Perspectives on Learning with Cellphones, Smartphones & Social Media. *The Internet and Higher Education*, 19, 18-26.

Gilbert, P. & Procter, S. (2006). Compassionate Mind Training for People with High Shame and Self-Criticism: Overview and Pilot Study of a Group Therapy Approach. *Clinical Psychology & Psychotherapy*, 13, 353-379.

Grabe, M., & Grabe, C. (2007). *Integrating technology for meaningful learning* (5th ed.). Boston, MA: Houghton Mifflin.

Harel, I., & Papert, S. (Eds.). (1991). *Constructivism*. Ablex Publishing. Abstract. In 1985 the Media Lab was created at MIT [Massachusetts Institute ...

Hassett, James M.; Spuches, Charles M.; and Webster, Sarah P., "Using Electronic Mail for Teaching and Learning" (1995). To improve the Academy 333.

Hawkins, R. J. (2002). Ten Lessons for ICT and Education in the Developing World. In: eds. Kirkman G. Cornelius P. K., Sachs J. D., Schwab K. The Global Information

Hayes, D. (1987). ICT and learning: Lessons from Australian classrooms. *Computers and Education*, 49, 385–395.

Hein, G.E. (1991). Constructivist learning theory: The museum and the needs of people. Paper presented at the CECA Conference in Jerusalem, Israel.

Hochman, A., Maurer, M., & Roebuck, D. (1993). Buttons and cards and fields, oh my! *Tech Trends*, 38(2), 25-28.

Jonassen, D., Davidson, M., Collins, M., Campbell, J., & Haag, B. B. (1995). Constructivism and Computer-Mediated Communication in Distance Education. *American Journal of Distance Education*, 9, 7-26

Keengwe, J. (2007). Faculty integration of technology into instruction and students' perceptions of computer technology to improve student learning. *Journal of Information Technology Education*, 6, 169-180.

Kombo, K. D and Tromp, L.A.D. (2006) Proposal and thesis and thesis writing: an introduction. Nairobi: Pauline publications Africa

Kozma, R.B. (2005). Technology and classroom practices: An international study. *Journal of Research on Technology in Education*, 36(1), 1-14.

Kulik, J. A. (1994). Meta-analysis study of findings on computer-based instruction. In E. L. Baker, & H. F. O'neil (Eds.), *Technology assessment in education and training*. Hillsdale, NJ: Lawrence Erlbaum.

Laffey, J., Tupper, T., Musser, D. & Wedman, J. (1998). A computer-mediated support system for project-based learning. *Educational Technology Research and Development*, 46, 1, 73–86.

Lucido, P. (2007). *Educational technology 2: Selection, production and utilization of appropriate technology tools for instruction*. Lorimar

Publishing, Inc.

Lunenburg, Eaton, E. F. Ted. (1998). *Waste Not, Want Not: Omega Publishing, Eisnor, Wilfred. Pictorial History of the Shire Town of Lunenburg.*

Mann, C. (1994). New technologies and gifted education. *Roeper Review*, 16(3), 172-176.

McCormick R, Scrimshaw P (2001) Information and Communications Technology, Knowledge and Pedagogy. *Educ. Commun. Info.* 1 (1): 37-57.

McKenzie, B. et al., (2001). Preparing for the Future with Technology: Extending Past the Classroom. *Journal of Information Technology for Teacher Education*, 5 (1/2), 83-92.

McLaughlin, M. W. (1990). Strategic dimensions of teachers' workplace context. 090-119L. Stanford University: Center for Research on the Context of Secondary School with academic excellence (R90-2). Stanford University: Center for Research on the Context of Secondary School Teaching

Mugenda, O. M., and Mugenda, A. G. (2003) *Research Methods, Quantitative and Qualitative Approaches*. ACT, Nairobi.

O'Neal, C. (2007). How online simulations work in the classroom. Retrieved from www.edutopia.org/online-simulations-classroom

Ogunleye, B. O. (2007). Teachers' perceived barriers to successful implementation of ICT in the teaching and learning of science subjects in Nigerian Secondary Schools. *Nigerian Journal of Computer Literacy*. 200-215.

Orodho, J. A. (2004): Elements of Education and Social Research Application in Education and Social Sciences, Masol Publishers, Nairobi Kenya

P Attwell, J. Battle (1999). —Home Computers and School Performancel. The Information Society. no. 15, pp. 1-10

Peterman, K., Pan, Y., Robertson, J., & Lee, S. G. (2014). Self-report and academic factors in relation to high school students' success in an innovative biotechnology program. *Journal of Technology Education*, 24(2), 25–51.

Plomp, T., Ten Brummelhis, A.C., & Rapmund, R. (1996). Teaching and Learning training for the future. Report of the committee on Multimedia in Teacher Training (COMMITT). Don Haag: SDU.

Polit, D. and Hungler, B (1996), Nursing Research: Principle and Method, 6th ed.; Philadelphia: Lippincott Company P.P. 416-417

Presto, M. (2009). Using audio as a teaching tool. Retrieved on from http://ccnmtl.columbia.edu/enhanced/primers/audio_as_teaching_tool.

Reeves, T. & Jonassen, D., (1996). Learning with technology: Using computers as cognitive tools. In D. Jonassen (Ed.), Handbook of research educational on educational communications and technology (pp. 693-719). New York: Macmillan.

Resnick, M. (2002). *Rethinking Learning in the Digital Age*. In: G. Kirkman (editor). *The Global Information Technology Report: Readiness for the Networked World*. Oxford: Oxford University Press. Pp. 33-37.

Rosenthal, I.G. (1999). New teachers and technology: Are they prepared? *Technology and Learning*, 19(8), 22.

Salomon, G. (2004). Technology and pedagogy: Why don't we see the promised revolution? *Educational Technology*, 42, 71-75.

Schacter, J. (2001). *Teacher performance based and accountability: Why, what, and how*. Milken Family Foundation.

Scheffler, F.L., & Logan, J.P. (2001). Computer technology in schools: What teachers should know and be able to do. *Journal of Research on Computing in Education*, 31(3), 305-326.

Schifter, D. (1996). *Reconstruction of professional identities*. New York: Teachers College Press.

Sergiovanni, T. J. (2001) *Leadership: What's In It for Schools*, London, Routledge Falmer Parsons M. B., Reid D. H. Training basic teaching skills to paraeducators of students with severe disabilities: A one-day program. *Teaching Exceptional Children*. 1999; 31:48-54.

Spernjak, A., Puhek, M., & Sorgo, A. (2010). Lower secondary school students' attitudes toward computer-supported laboratory exercises. *International Journal of Emerging Technologies in Learning*, 23-26.

Stepich, D. (1996). *Instructional technology for teaching*. Upper Saddle River, NJ: Prentice Hall.

Tinio V. L. (2003). *Technology in Education*, E-Primers for information economy society and policy.

Todd, N. (1993). A curriculum model for integrating technology in teacher education courses. *Journal of Computing in Teacher Education*, 9(3), 5- 11.

Turel, Ofir; Serenko, Alexander; and Giles, Paul. (2012). "Integrating Technology Addiction and Use: An Empirical Investigation of Online Auction Users," *MIS Quarterly*, (35: 4) pp.1043-1051.

Twoli, N. Maundu, J. Muindi, D. Kiio, M & Kithinji, C. (2007). *Instructional methods in education: A course book for general teaching methods. Nairobi: Kenya Institute of Education* Woolfolk, A. (2007). *Educational psychology*. Boston: Pearson.

Valasidou A, Sidiropoulos D, Hatzis T, Bousiou-Makridou D (2005). *Guidelines for the Design and Implementation of E-Learning Programmes, Proceedings of the IADIS International Conference IADIS E-Society 2005, 27 June- 30 June, Qawra, Malta.*

Volman, M. (2001). Gender-related effects of Information and Computer Literacy Education. *Journal of Curriculum Studies*, 29(3), 315-328.

Wagner AD (2001). *IT and Education for the Poorest of the Poor: Constraints, Possibilities, and Principles*. Tech KnowLogia, July/August, 48-50

Walker, M. (2000). Educational multimedia and teachers need for new competencies to use educational multimedia. *Education Media International*, 37(4), 235-241.

Wang, Y. & Holthaus, P. (2000). Facing the world: Student teachers' computer use during practicum. *Journal of Educational Technology Systems*, 27(3), 207-223.

Webb, M., Cox, M., Abbott, C., Blakely, B., Beauchamp, T., & Rhodes, V. (2004). *ICT and pedagogy: A review of the literature*. London: British Educational Communications and Technology Agency.

Webber, C. F. (2003). New technologies and educative leadership. *Journal of Educational Administration*, 41(2), 119-123

Webber, C. F. (2003). New technologies and educative leadership. *Journal of Educational Administration*, 41(2), 119-123

Wilson, B., & Cole, P. (2003). *A review of cognitive teaching models*. Educational Technology.

Windschitl, M., & Sahl, K. (2002). Tracing teachers' use of technology in a laptop computer school: The interplay of teacher beliefs, social dynamics, and institutional culture. *American Educational Research Journal*, 39(1), 165–206.

Woessmann, L. & Fuchs, T., (2004). *Computers and Student Learning: Bivariate and Multivariate Evidence on the Availability and Use of Computers at Home and at School*, CESifo Working Paper. No. 1321. Munich: CESifo.

Wong, S., Colarco, P.R. & Dessler, A.E. (2006). Principal component analysis of the evolution of the Saharan air layer and dust transport: Comparisons between a model simulation and MODIS and AIRS retrievals. *Journal of Geophysical Research*

Young Learners. In J. D. Tinsley & T.J. van Weert (Eds.), (2003) *World Conference on Computers in Education VI: WCCE' 95 Liberating the Learner* (pp. 35-42). London: Chapman & Hall.



APPENDICES

APPENDIX A

QUESTIONNAIRE FOR TUTORS

UNIVERSITY OF CAPECOAST

QUESTIONNAIRE FOR TUTORS AND STUDENT IN COLLEGES OF
EDUCATION IN CENTRAL REGION OF GHANA

QUESTIONNAIRE FOR BIOLOGY TUTORS IN THE COLLEGES OF
EDUCATION IN CENTRAL REGION

INTRODUCTION

This questionnaire is to find out how to enhance the teaching of biology using technology in the three colleges in central region of education in Ghana. It is for academic purpose only; your assistance in providing accurate information is kindly requested by completing the attached questionnaire. There is no wrong or right answer. Please be assured that the information that you provide in this survey will be treated confidentially.

PLEASE DO NOT WRITE YOUR NAME ON THE QUESTIONNAIRE

Please tick [] the space provided with your response to the personal profile information below

SECTION A: PERSONAL PROFILE

1. Sex: Male [] Female [
2. Age of Respondents
 - a. Below 30 years [
 - b. 31-35 years [
 - c. 36-40 years [
 - d. 50 years and above. [

3. Years of teaching Experience
- a. 2-5 years []
 - b. 2- 10years []
 - c. 10years and above []
 - d. 11 years and above []

4. Educational Level
- a. O/A Level []
 - b. Diploma []
 - c. Degree []
 - d. Masters []

5. Professional Qualification
- a. Masters of Science education
 - b. Masters in biology
 - c. Master (Specify Your Major area)

Please indicate the extent of your agreement or disagreement with the statement by ticking [√] strongly Agree (SA), (1) Agree (A), (2) Disagree (D), (3) and Strongly Disagree (SD) (4) (please select only one) to reflect your opinion.

Statement	SA	A	D	SD
Enhancing the Teaching of Biology using Technology				
The use of Online Tutorial Sites				
Integration of technology in the teaching of biology				
The internet is the main source of Accessing educational materials				
Presentation makes biology lessons real and authentic				

The use of Technology enhances students learning of biology				
Teachers benefit from the use of technology in the classroom				
The use of Google classroom make teaching interesting				
Tutors make use of videos and pictures while teaching student are asked to visit profonline.com				
Student learn through the internet with a guide				
Students Correspond with friends through the internet				
Tutors Down loading materials from the net				
Internet conferencing is encouraged in teaching				
Tutors Put students in to smaller groups when teaching				
Less work is given to weaker students in the course of teaching				
Coaching of student is prefer than lecturing				
Technology used in class Make students cooperative				
Tutors give students assessment in the Classrooms				
Students are Engage actively in the course of teaching				
Problems on the use of Technology in the Teaching and Learning of Biology				
The colleges facilities on technology is limited				
Tutors have Limited accessibility to network connection				
Tutors use technological tools as personal level as well as for teaching in the classroom.				

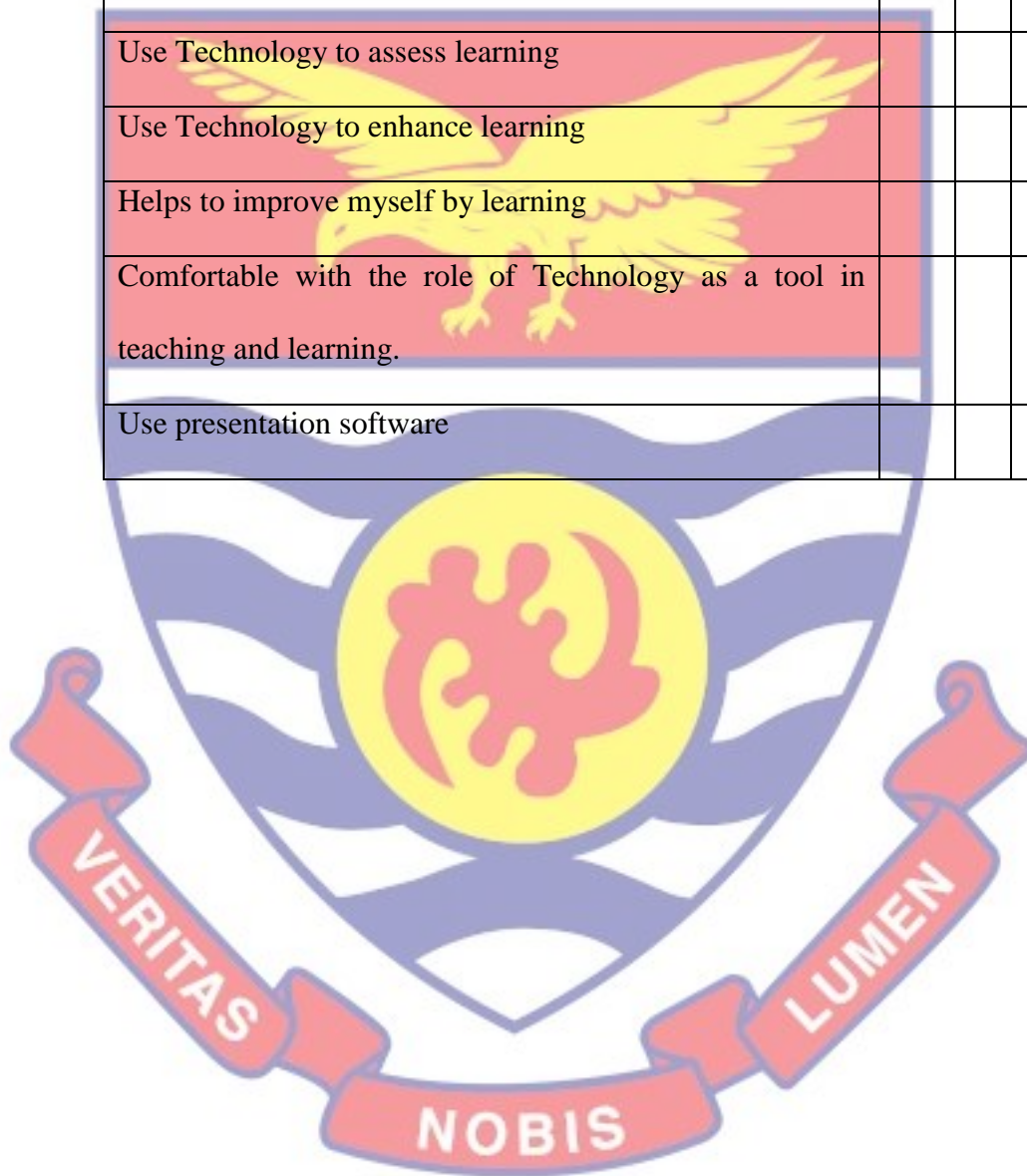
Tutors have negative attitude toward the use of technology				
Most tutors Lack competency in technology				
Biology lessons uses Limited time for practical lessons				
Lack of effective training on the part of tutors				
Knowledge of Biology Tutors in the use of Technology				
Tutors understands: how to strategically improvise sequences of teaching				
Instruction is given based on problem solving				
Tutors able to organize and manage materials for teaching				
Tutors consider timescale of potential investigations of problem solving				
Students are given test to bring them to technology performances				
Tutors recognize flaws in students 'learning approaches				
Hands on learning activities are provided for all students				
Student are directed to use multiple resource in class				
Tutor serve as a mentor and motivator in the course of teaching				
The physical arrangement of changes to facilitate learning in classroom				
Students are guided to choose from multi-option assignment				

Students produce video-tapes and role-play when asked to do so				
physical arrangement of changes to facilitate learning in classroom is considered				
Students monitor their own learning active and investigation in the classroom				
Opportunity is given to students to follow daily events outside the classroom.				
Tutors are comfortable with the role of Technology as a tool in teaching and learning process				
Tutors use presentation software to teach				



Statement	SA	A	D	SD
Problems of the use of Technology in the Teaching and Learning of Biology				
Lack of training on the part of biology tutors				
Less Biology cluster meetings to collaborate ideas on biology teaching				
Inadequate tutor professional development on biology practical				
Inadequate resources for teaching and learning in the colleges				
Loaded curriculum that make practical work difficult				
Students' engagement in classrooms is less as class size is large				
Hands on learning activities are not provided for the students				
Students work in individually instead of group work				
Multiple resources are not available for lessons				
Tutor serve as a mentor and motivator in the course of teaching				
Students not allow to choose from multi-option assignment				
It makes access to information easier.				

It gives students the opportunity to follow daily events. In classroom				
It makes access to information easier.				
Using search engines (social, Google etc)				
Excites me to reach the world from home and school.				
Use Technology to assess learning				
Use Technology to enhance learning				
Helps to improve myself by learning				
Comfortable with the role of Technology as a tool in teaching and learning.				
Use presentation software				



APPENDIX B

QUESTIONNAIRE FOR BIOLOGY STUDENTS

INTRODUCTION

This questionnaire is to find out how to enhance the teaching of biology using technology in the three colleges of education in central region of Ghana. It is for academic purpose only; your assistance in providing accurate information is kindly requested by completing the attached questionnaire. There is no wrong or right answer. Please be assured that the information that you provide in this survey will be treated confidentially

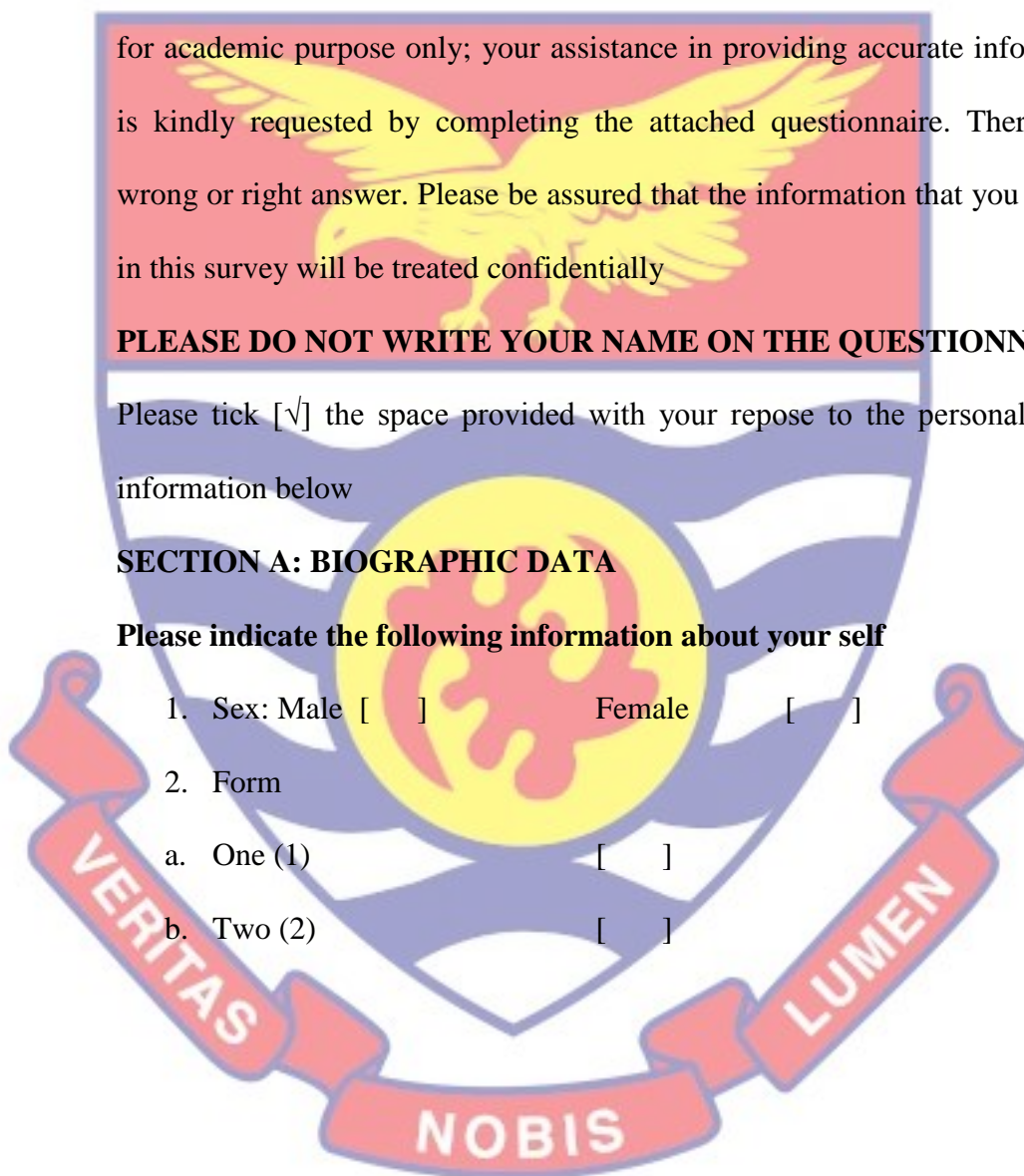
PLEASE DO NOT WRITE YOUR NAME ON THE QUESTIONNAIRE

Please tick [] the space provided with your response to the personal profile information below

SECTION A: BIOGRAPHIC DATA

Please indicate the following information about your self

1. Sex: Male [] Female [
2. Form
 - a. One (1) [
 - b. Two (2) [



The following statements are factors, tutor's knowledge in using technology, problems of using technology to teach biology in the colleges of education in central Please indicate the extent of your agreement or disagreement with the statement by ticking [√] strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD) (please select only one) to reflect your opinion.

Statement	SA	A	D	SD
Enhancing the teaching of biology using technology	1	2	3	4
little practical on a learned concept				
Difficult nature of the subject				
Subject not applicable to other areas				
Content is too broad				
Subject is too much of reading				
overloaded curriculum				
Varied teaching approaches in lesson delivery				
Inadequate qualified biology tutors with technological mind				
Inadequate technology laboratory equipment				
Lack of current text books				

	SA	A	D	SD
The use of technology to improve the teaching of biology in the colleges of education	1	2	3	4
Teaching is more of theory than practical work				
Applications aspect of the subject Matter is less emphasized				
emphasis is placed on theories and talking				
Less use of technology in teaching biology content				
Improvement in teaching approaches				
More competent Biology tutors				
Adequate resources for teaching and learning				
Provision of good and current text books				
Assessment based on originality and appropriate performance rather than regurgitation				
Students' engagement in classrooms is less				
Students' knowledge in the use of technology				
Hands on learning activities are provided for the students				
Students work in cooperative groups				
Student use multiple resource in class				

Tutor serve as a mentor and motivator in the course of teaching				
The physical arrangement of changes to facilitate learning in classroom				
Students choose from multi-option assignment				
Students produce video-tapes and role-play				
Student investigate and solve problems				
Students monitor their own learning active and investigation				
Student use multiple resource in class				
Tutor serve as a mentor and motivator in the course of teaching				
The physical arrangement of changes to facilitate learning in classroom				
Students choose from multi-option assignment				
Students produce video-tapes and role-play				
Student investigate and solve problems				
Students monitor their own learning active and investigation				
It offers new opportunities like distance learning to students.				
Excites me to reach the world from home and school.				
Problems that hinder the use of technology in the teaching and learning of biology				

access to information from the internet is difficult				
Students have less opportunity to follow daily events in the classroom				
Limited time for practical lessons				
Uses search engines, (social media, Google etc.) in the classroom to learn				
Facilities of technology use is limited to administration				
Lack of effective training on the use of technology to study				
Inadequate resources for teaching and learning				
Loaded curriculum that make practical work difficult				
Students are engagement in the classroom				
Hands on learning activities not provided for the students				
Students work individually with less supervision of tutors				
Tutors serve as a mentor and motivator in the course of teaching				
Tutors teach large class size without technology				

