

**EFFECT OF COMPUTER ASSISTED TEACHING STRATEGY ON  
STUDENTS' ACADEMIC ACHIEVEMENT AND MOTIVATION IN  
BIOLOGY IN PUBLIC SECONDARY SCHOOLS IN BARINGO COUNTY,  
KENYA**

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**A Thesis Submitted to Graduate School in Partial Fulfillment of the  
Requirements for the Award of the Degree of Master of Education in Science  
Education of Chuka University**

**CHUKA UNIVERSITY  
SEPTEMBER, 2019**

## DECLARATION AND RECOMMENDATION


### Declaration


This thesis is my original work and has not been presented for award of Diploma or Conferment of a Degree in any other University.

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## **DEDICATION**

I dedicate this work to my dear parents, Christopher Chebunye and Lucy Chebunye for laying for me a solid educational foundation which has propelled me to this far.

## **ACKNOWLEDGEMENT**

I would like to acknowledge the guidance of the Almighty God for according me a vibrant health throughout my study period. I am greatly indebted to my devoted supervisors Dr. Mercy Wanja Njagi and Dr. Beatrice Mwarania Mburugu for their necessary corrections and invaluable input in compiling this thesis.

I am also greatly indebted to the Chuka University Faculty of Education and Resource Development for their positive criticism that led to the success of this work. My heartfelt gratitude also goes to my fellow classmates in post graduate school of Education namely: Christine, Joshua, and John Munene for their companionship and encouragement during the study.

Special thanks goes to the schools where the study was conducted. I would like to sincerely thank all the Biology teachers and students who participated in the study, the government through National Commission for Science Technology and Innovation for granting me the research permit and the County Director of Education for granting me permission to conduct the study.

## ABSTRACT

Biology is a branch of science studied at secondary school that lays the foundation for careers in medicine, education, agriculture, environment, and biotechnology important in industrial and technological development. Despite the importance of biology in the society, its achievement in Kenya Certificate of Secondary Education has been low, as indicated by the low academic scores of the students. This low achievement could be attributed by factors that could include inappropriate teaching strategy and lack of mastery of concepts by the students. The purpose of study was to determine the effect of integration of Computer Assisted Teaching Strategy (CATS) on student academic achievement and motivation in Biology in public Secondary schools in Baringo County. The study used Solomon Four-Quasi experimental design. Purposive sampling was used to select eight extra-County Secondary schools in Baringo. Stratified random sampling technique was used in selecting sample schools for the study. The researcher sampled 324 biology students from the stratified selected extra County secondary schools. In selected schools with more than one stream, simple random sampling was used to sample form three biology students and assigning them experimental and control group. The experimental groups were manipulated by exposing them to Computer Assisted teaching strategy while the control groups were taught using the traditional teaching strategy. The research instruments that were used to collect data included; Biology Achievement Test and Biology Motivation Questionnaire. The instruments were piloted to establish the reliability. Reliability of the research instruments was determined by using split half method and correlation coefficient was determined by using Spearman Brown prophecy formula. The Reliability coefficient for the instruments was 0.704 and 0.709 for BAT and BMQ respectively with the overall reliability coefficient being 0.706 that was considered suitable for the study. The data obtained was analyzed descriptively using frequencies, percentages and inferentially using Analysis of Variance and t-test. The hypotheses of the study were tested at 0.05 level of significance. The validity of the research instruments was determined by incorporating the expert judgment from the biology teachers and supervisors. The findings of the study showed that integration of CATS enhances students' achievement in biology. Additionally the findings indicated that the strategy positively influence student motivation in biology. Further the findings shows that there is statistical significance in students' academic achievement based on gender. Similarly, statistical significance was reported in student motivation based on gender when exposed to CATS. From the findings of the study CATS is effective in improving student academic achievement and enhances motivation in biology. The study findings will be beneficial to curriculum developers at Kenya institute of curriculum development in formulation of policy and guidelines for integration, planning and implementation of CAT in school curriculum in order to enhance learning and improve student achievement and motivation. Therefore, biology teachers should incorporate the computer teaching strategy in teaching in order to improve academic achievement and motivation in biology.

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## LIST OF ACRONYMS

<b>ANOVA</b>	Analysis of Variance
<b>BAT</b>	Biology Achievement Test
<b>BMQ</b>	Biology Motivation Questionnaire
<b>CAL</b>	Computer Assisted Learning
<b>CAI</b>	Computer assisted Instruction
<b>CATS</b>	Computer Assisted Teaching Strategy
<b>CDF</b>	Constituency Development Fund
<b>CBL</b>	Computer Based Learning
<b>CMI</b>	Computer Mediated Instruction
<b>EU</b>	European Union
<b>H<sub>0</sub></b>	Null Hypothesis
<b>I.C.T</b>	Information Communication and Technology
<b>IPAR</b>	Institute of Policy Research and Analysis
<b>KCSE</b>	Kenya Certificate of Secondary Education
<b>KNEC</b>	Kenya National Examination Council
<b>KICD</b>	Kenya Institute of Curriculum Development
<b>KIE</b>	Kenya Institute of Education
<b>MOEST</b>	Ministry of Education Science and Technology
<b>NAEP</b>	National Assessment of Educational Progress
<b>SPSS</b>	Statistical Packages for Social Science
<b>TTS</b>	Traditional Teaching Strategy
<b>TIMSS</b>	Trends in international mathematics and science study

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 Background of the Study**

Science education is obligatory at all levels of instruction in secondary school. Science education is essential and fundamental within the curriculum as it provides students with the ability to think critically and practice methods of inquire, develop science concepts that facilitate understanding of biological and physical environment, and develop appropriate attitude and skills essential for democratic leadership (Lemlech 2010). Biology is one of the branches of science that manages the natural phenomena and help to develop biological knowledge and scientific skills that enhances humanity to appreciate the essence of biodiversity, ecological protection and sustainable utilization of resources (UNESCO, 2007).

Biology education is a pre-requisite for professions in health science, environmental science and precursor of biotechnology development. The knowledge of genetics that is a branch of biology has revolutionized determination of paternity disputes and identity of serious crime culprits with precision and certainty through Deoxyribonucleic acid and sequencing and profiling (Institute of Biology 2007).

Biological knowledge plays an important role in most aspect of human life. Its application in genetic engineering has contributed towards meeting the demand of food security, medicine and control of variety of pest and diseases (UNESCO, 2013). Further biological knowledge lays foundation for commercial agriculture the engine for economic growth in Kenya (Government of Kenya, 2003). Research have used biological knowledge to develop high yield, disease resistant and fast maturing food crops and animal to meet the food requirement of ever increasing world population (Burn 2005). Due to the significant role of biological knowledge, therefore there is a concern on the improving academic achievement and motivation in biology in secondary school.

Despite this importance of biology, students' academic achievement in the biology at the national examinations in many countries across the world has remained to be low. According to Trends in International Mathematics and Science Study (2011), 56 countries and other education systems administered TIMSS at grade eight. Less than

half of the countries that participated had an average scale score of below 500. The Scores on the TIMSS mathematics and science tests range from 0-1000. Both tests have an average scale score of 500, with a standard deviation of 100. In Africa, Morocco, South Africa and Ghana participated in the TIMSS (2011) but their scale scores in biology subject were below average, this determines the academic achievement of the learners. According to Chime, (2004) academic achievement is a determinant of a student success that measures the extent to which the learners have achieved their educational goals because of an interactional session between the teacher and the learner.

Academic achievement is a measure of student learning or acquisition of certain skills at the end of teaching and learning activities that is reflected in an examination written by the student after a process of learning (Usman, 2000). Therefore, academic achievement is a measure of value and the amount of success that one has in authority of learning skills and comprehension determined by using the standardized test. This has a great influence on student achievement and motivation. Motivation energies, maintains and coordinates conduct towards a student academic achievement.

In Kenya, Biology is a key science subject in secondary school. Its achievement has been low when compared to other science subjects over the recent years as indicated by the Kenya National examination council report (2011-2017). Academic achievements in biology are determined by using a standardized test or an achievement test. The low performance in science with biology included is a national concern as articulated in the Session Paper Number 1 of 2005 Ministry of Education, Science and Technology (MOEST, 2005).

Table 1 shows the mean score of biology, chemistry, and physics from the period 2011 to 2017.

Table 1: Mean Score of Biology, Chemistry, and Physics from 2011-2017 in Kenya

Subject	2011	2012	2013	2014	2015	2016	2017	Average
Biology	31.05	27.43	32.06	29.57	31.55	35.16	23.45	29.11
Physics	37.04	31.14	35.99	37.84	43.68	40.32	33.89	37.12
Chemistry	25.15	25.76	29.44	26.69	34.36	34.01	32.87	29.75

Source: Kenya National Examination Council Report (2011-2017)

The result in Table 1, shows that mean scores in biology is below average since they range from 27.43% to 35.16% a level that is below average mean score of 50%. According to Waihenya (2002) attributed low achievement to poor teaching methods, lack of mastery of the subject by students, learner's state of mind towards the subject. Application of ineffective teaching approach by the biology teachers with the teacher centered being dominant as opposed to learner centered, lack of mastery of content by a few teachers and deficient instructing and learning assets. In spite of this achievement in the sciences being low, this has ultimately led to the proposal to investigate pedagogical approach to classroom instruction.

In an attempt to mitigate this low academic achievement in science subjects World Bank (2007) suggested in its report that science curriculum has to be taught through the modern strategy such as CATS so that learning can be enhanced and more curiosity and enthusiasm created in the learner. Other researchers have called for adoption of constructivist-based teaching strategy such as CATS as a way of developing globally connected knowledge societies (Bereiter, 2002; UNESCO, 2007; World Bank, 2008). They argue that students should no longer be exposed to learning methods that tend towards passive reception of sanctioned information through memorization and recall but need to be exposed to methods that promote gaining skills through active participation such as information gathering, evaluating source quality, collaborating, problem-solving, and ultimately knowledge creation. Therefore teaching strategy that is a learner centered approach such as computer assisted teaching strategy that makes learners to actively participate in teaching and learning process improves the learner's motivation to learn.

According to Nelson, (2000) learners who are motivated engage themselves more actively in learning activities that would also translate to high academic achievement. Pintrich, (2002) states that motivation is an internal process that initiates and sustains activities that aimed at achieving specific goals. Further Hancock (2004), states that motivated learners perform well since learners finds satisfaction on the subject matter taught depending on the teaching method used by the teacher. Therefore, motivation can be enhanced through teaching strategy that actively involves students (Kerora, Wachanga & Orora ,2006) such as adoption of computer assisted teaching strategy.

A teacher has the ability to influence the student motivation to learn through a variety of teaching decision and approaches (Shihusa & Kerora 2009). Owino (2014) inferred that learner's motivation toward science is positively related to their achievement. Further, Weller (2005) states that motivation is upgraded by the way the teacher sorts out the instructional materials during the lesson, since teacher plays a role as allocator of information as the students takes notes and listen. All together for the learners to be persuaded in any discipline they should take an interest in the exercises that are personally significant and worthwhile (Glynn & Koballa, 2006). It is therefore, hoped that through the use of more interactive methods, teachers can encourage the students to be more motivated to study Biology (Kithaka, 2003) such as computer assisted teaching strategy.

Computer assisted teaching strategy involve the use of software, drills and simulations in teaching. CATS allow the teacher use computers at different times and spaces depending on the subject matter, the students and the available software and hardware. CAI software integrates features that encourage activities beyond the simple drill-and-practice, such as simulations, graphing and even modeling (Yusuf, 2010). Therefore, utilization of CAT offers chances to the learners and instructors to learn at their speed and consolidate dynamic learning. CAI is outwardly intuitive, since it presents ideas by utilizing movements, shading and sounds making a fascination in the student, this catch the student consideration by giving higher maintenance ability to the students, reinforcing the student's academic achievement and motivation towards the subject.

Computer use in education has become more and widespread used in different parts of continent and important in improving learners' achievement in different subjects especially in challenging subjects, more specifically in the sciences. Empirical studies have associated the use of CAL with improved student achievement in different subjects (Ghani, Mahmood, Halim & Rajindra, 2014; ImpaCT2, 2001; World Bank, 2007). ImpaCT2 (2001) for instance showed that teachers in schools where pupils were taught English using CAL tools reported higher mean scores for their pupils which was attributed to the fact that the use of the CAT in teaching and learning have



positive effect on behaviour, motivation, communication and process skills and that it enables pupils to learn more autonomously.

In the sciences, it has been suggested that CAL can be used in instruction of subjects such as physics and biology with the aim of imparting in the students skills such as collecting science information, interacting with resources such as images and video and encouraging communication and collaboration resulting in improved student achievement in the subjects (Ghani *et al.*, 2014). Zhao and Lei, (2012) in the United States of America, CAL has long been considered as a method for addressing school improvement since it offers advantages over traditional instruction that enrich the lesson presentations, self-pacing and instantaneous feedback providing a positive effects on students' academic achievements and motivation

In Kenya, there are studies that were carried out on the effects of CAL on classroom practice. Samuel, (2012) while conducting a study on enhancement of science performance through computer assisted instruction among secondary schools in Kenya, noticed that the change in science performance by the experimental group came about because of the utilization of CAL in science lessons and that the instructional techniques utilized by teacher impact the performance of the students, this encourage scope of testing subjects. Kevogo, Toilio and Mutsotso (2013) on an investigation on the effect on general use of computers on secondary schools students' performance in biology conclude that general use of computer has a positive impact on student academic achievement. Mugambi (2013) found out that students that were taught using computer based learning in agriculture outperformed their counterparts who were taught using the regular teaching approach. Other subjects in which CAL has shown positive impact include accounting (Tanui & Kiboss 2013) and mathematics (Sulungai, Toili & Amadalo, 2011). Therefore, teaching strategy adopted by the teacher affects the students' achievements. (Kibett & Kathuri, 2005). Thus, there is need to consider a new teaching approaches such as integration of computers in teaching that improves the learners academic achievement and motivation in biology. In spite of these constructive outcomes of CAT strategy in enhancing learners achievement and motivation its impact is not clearly understood and in attempt to fill this gap the study investigates the effect computer assisted teaching strategy on student motivation and achievement in biology in Baringo County.

## **1.2 Statement of the Problem**

Student academic achievement in biology is determined by KCSE examination. An analysis of the pattern and trends in achievement in biology in KCSE examination clearly indicates that the achievement is below an average score of 50% this affects the learner's motivation towards the subject. Therefore, this call for appropriate instructional strategy to be used in secondary school for teaching biology and especially on the sub-topic cell division that has remain to be a challenging topic to many candidates in KCSE Biology examination as indicated by the Kneec report. This achievement is attributed to many factors that could be due to poor learning environment, lack of innovative teaching strategy. That leads to lack of interest and motivation in the subject making students to be passive during the teaching and learning process thus low achievement in Biology. Therefore, student centered strategy such as computer assisted teaching strategy can be used by the Biology teachers that may help to improve student learning environment which leads to an improved achievement and motivation in Biology. However, there is limited research that has been carried out on the effect of use of CAT on students' academic achievement and motivation in Biology in Baringo County. Therefore, a knowledge gap exists that prompts for a study to be carried out in Baringo County to ascertain the effect of CAT on student academic achievement and motivation in Biology.

## **1.3 Purpose of the Study**

The purpose of the study was to determine the effect of computer assisted teaching strategy on student academic achievement and motivation in biology in public secondary schools in Baringo County.

## **1.4 Research Objectives**

The study was guided by the following research objectives:

- i. To find out whether there is any difference in student academic achievement in biology between students taught using computer assisted teaching strategy and those taught using traditional teaching strategy in Baringo County.
- ii. To find out whether there is any difference in student motivation in biology between students taught using computer assisted teaching strategy and those taught using traditional teaching strategy in Baringo County.

- iii. To determine the whether gender affects academic achievement in biology when taught using computer assisted teaching strategy in Baringo County.
- iv. To determine whether gender affects student motivation in biology when taught using computer assisted teaching strategy in Baringo County.

### **1.5 Hypotheses of the Study**

To achieve objectives of the study the following hypotheses were tested at  $\alpha= 0.05$  level of significance.

H<sub>01</sub>: There is no statistical significant difference in student academic achievement in biology between student taught using computer assisted teaching strategy and when taught using traditional teaching strategy in Baringo County.

H<sub>02</sub>: There is no statistical significant difference in student's motivation in biology between student taught using computer assisted teaching strategy and when taught using traditional teaching strategy in Baringo County.

H<sub>03</sub>: There is no statistical significant gender difference in student academic achievement in Biology when taught using computer assisted teaching strategy in Baringo County.

H<sub>04</sub>: There is no statistical significant gender difference in student motivation in Biology when taught using computer assisted teaching strategy Baringo County.

### **1.6 Significance of the Study**

The findings of the study will hopefully assist in improving student academic achievement and motivation in biology. This will help in raising the standard of science education in general and Biology as a subject through the integration of computers assisted teaching strategy. Biology teachers would benefit from the recommendations on the best approach on the implementation of CATS in classroom practice. The findings will also be beneficial to teacher training institution in incorporating innovative teaching strategy in training curriculum. The findings of the study may provide valuable information to the Ministry of Education about the benefits of integration of computer in teaching biology. The findings of the study may aid the Quality Assurance Directorate in the ministry of Education to enhance strategies of equipping secondary school with computers and train teachers to be computer literate for integration of computers for instructions. The findings of the

study will also be beneficial to Curriculum developers at Kenya Institute of Curriculum Development (KICD) in coming up with policies that would help in promoting, formulation and dissemination of ICT integration in the school curriculum in order to enhance learning and improve academic achievement and motivation.

### **1.7 Scope of the Study**

The study was conducted on selected public secondary schools in Baringo County. The topic on reproduction, sub-topic cell division was covered during the study. Form three students were chosen because the topic is taught in this class and that form three students can express biological concepts scientifically in written form. The sub-topic cell division was chosen because student performance in the sub-topic has been poorly performed in KCSE examination as indicated by KNEC report (2017). The study focused on Form Three Biology students from public secondary schools in Baringo County with ICT facilities that will upgrade CATS.

### **1.8 Assumptions of the Study**

The study made the following assumptions:

- i. Teachers in the selected secondary school used CAT strategy appropriately throughout the study period.
- ii. Students in the selected groups provided genuine information.
- iii. No interruption in the school programme throughout the treatment period.

## 1.9 Definition of Terms

The following terms in the study were defined as follows:

**Academic Achievement:** It is a measure of the degree of success in performing a specific task in a subject, an ability for the learner to recall, comprehends apply, analyze and synthesis. In this study it refers assigned scores learners obtained in the Biology Achievement Test (BAT).

**Computer Assisted Teaching:** The use of computers to present drill, practice exercise and tutorial sequences to students during teaching and learning. In this study, it refers to the use of computers to enhance learning process.

**Effect:** The capacity or potential for achieving results. In the study, it refers to the results achieved on using computer assisted teaching strategy.

**Traditional Teaching Strategy:** A teacher centered teaching and learning strategy is commonly adopted in class in teaching students. In this study, this strategy refers to methods such as discussion, demonstration, and lecture method.

**Motivation:** A psychological process that arouses directs and maintains a given learners behavior. In this study, it implies an inbuilt desire by the student to learn biology. It was measured by the learner Biology motivation Questioners (BMQ) that was constructed using the five Point Likert scale.

**Strategy:** A plan of action intended to accomplish a specific goal, in this study refers to a planned action that is intended to achieve a specific learning objectives. For instance, computer assisted teaching strategy.

**Gender:** Refer to social or cultural construction and representative of being a boy or a girl.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter consists of related literature reviewed under the following sub-headings; teaching strategies in biology, computer assisted teaching strategy, academic achievement in biology, motivation in learning biology, gender difference in achievement in biology and gender difference in motivation in biology. It also presents theoretical framework and conceptual framework adopted for the study.

#### **2.2 Teaching Strategies in Biology**

Teaching strategy is simply defined as a process oriented model that allows teachers to present ideas and concepts at many different levels to meet the needs of a variety of learners (Anderson, 2001). This can be either expository or heuristic. The expository strategy is largely direct instruction with the teacher mostly telling the learner while the learner passively listens and takes notes. Discovery teaching strategy is indirect with the teacher helping the learner to find out by posing questions, guiding, indicating sources of information and sharing ideas, problems, and solutions (Nasibi, 2003).

According to KIE (2002), the goal of teaching biology is to guarantee that learners to communicate biological information in precise, clear and logical manner. This is to enable the learners apply the knowledge gained to maintain the health of the individual, family and the community, relate and apply relevant biological knowledge and understanding to social and economic situation in rural and urban settings and to impart skills to the learners that enable them to apply in the day to day life. These skills include observation, recording, drawing, classifying, communicating, measuring, inferring formulating of hypothesis and identifying and controlling variables. Therefore, teaching biology in schools aims at imparting certain skills to the learners and making him/her to be equipped in order to exploit resources in the environment without causing the destruction.

Teaching strategy are methods by which the teacher endeavors to impart desired learning experiences to learners in classroom. Walhenga (2002), states that the traditional strategy for instructing are utilized in parts of secondary schools in Kenya

this technique incorporates; Demonstration, lecture method, fieldwork, practical technique, project technique discussion, discovery and enquiry. Some of the most commonly used teaching strategies are discussed as follows;

Demonstration, in teaching biology involves the utilization of show or the display completed by the instructor while the students watch. It is mostly used in showing the students the correct use of certain science equipment that is carried out by a single teacher alone, a student, or a group of students. Usman (2000), Demonstration method is one of the teaching methods that involve mental skills for learning by students such as observing, measuring, classifying, formulating hypothesis, experimenting, data collection, data analysis making and conclusion.

Demonstration requires creativity and conceptualization; it needs full incorporation of all skills of demonstrating as well as showing samples and making displays (Mahuta 2013). He went further to say the demonstrator is like a mirror as he shows while students observe. The process of demonstration is a physical display of objects, models, pictures, and diagrams. When students learn through the demonstration strategy of teaching, the comprehension last longer in the child's memory. In biology, certain activities require the use of demonstration such as action of iodine on the green leaf, dissection of animals and manipulation of equipment like the microscope.

Demonstration can be used to carry out expensive or difficult experiments, which may expose students to danger. Less scope is covered since it takes time for the students to get familiar with the procedures, equipment, or material used for the exercises. This strategy has drawbacks that cannot be effective if the teacher does not involve pupils appropriately during the demonstration (Wachanga, 2002). Further in a situation where the class size is very large visibility of the details to the learners of what the teacher is doing is not assured thus become difficult for the students to acquire manipulative skills. Another strategy that teachers used in the teaching and learning of biology is the lecture method.

Lecture, is a one-way flow of communication from the teacher to the students. It is teacher-focused strategy consequently; this implies the teacher completes the teaching while the students are passive listeners just taking down notes subsequently it is

alluded to as talk-chalk technique or didactic approach. This technique is to a great extent teacher centered and comprises of taking care of our information repacked with little or no class involvement. This a method that is used primarily to introduce students to a new subject, but it is also a valuable method of summarizing ideas, showing relationships between theories and practice, and reemphasizing the main points. Many teachers use this teaching method almost exclusively, as it is considered the simplest, and one can cover large amount of material in a short period of time (Abubakar, 2012).

According to university of Pittsburgh (2006), a lecture can be an effective strategy for communicating theories, ideas and facts to students. The main aim of teachers is to make sure that he/she communicates effectively with their students, in order to do so, a lecturer should try to achieve clarity of delivery, clarity of expression and clarity of structure. Mani (2008) postulated some points to be noted if lecture method was to be used which are, used by mature students who could jot down few points about the lecture mostly used in the higher educational institutions. In this method of teaching biology the teacher has to understand the size of the audience, the instructional material to be used, how to maintain an effective class room environment and the interest of the students. The teacher is to organize the instruction to be given to the students so as to avoid complexity and confusion among the students and the presentation of the lessons. Oluoch (1992), contended that lecture strategy is an economical method for transmission of information to huge number of learners since it does not need a lot of facilities, it additionally empower the instructor to exhibit information in consistent and coherent within a short period of time.

Excursion/ Field Trip strategy; this strategy is an important component of science teaching which involves taking the students outside the classroom for the purpose of making observations and also for obtaining some specific information. These enable the learners outside the classroom setting to have first-hand understanding of what occur in our environment or the real life situation. Field trip is an outdoor type of laboratory activity or field work or learning exercise undertaken by teachers and students in certain aspects of a subject, to give students the opportunity to acquire knowledge (Obeka, 2010). Bichler (1978), fieldwork furnishes the learner with the direct proof of first-hand scientific evidence on how they impart on a regular day-to-



day existence. The learner might be given a chance to cooperate with the specialists in a specific aspect in Biology. Wakili (2007) pointed out that it is a method that involves travelling out of school environment to a place designed or selected for learning purpose , such places may be historical town, an educational environment a game reserve, herbariums, botanical garden, zoo, amusement reserve, rivers, lakes and seashores, ponds and forest. Students often have a long lasting memory when they travel and see events and places for themselves. This is usually arranged and conducted by the school in order to improve the knowledge of the students (Mahuta, 2013).

According to Aliyu, (2008) observes that field trip is taking students out of the classroom to places where they can see concrete illustration of classroom theories. It also offers direct observation and interpretation of the substance in their natural surroundings. It requires the use of basic scientific skills that is observation, identification, classification and manipulation of substance in the natural surroundings. Field trips provides real life context for the material being taught make more sense be remembered better if students can actually see where and how they work or take place in reality.

Oyaga and Njuguna (2000), for viable utilization of fieldwork, the teacher needs to set up a definite worksheet or polls and give a clear guideline to the learners already with the goal for them to concentrate on the key ranges of the study. The teacher ought to prepare guidelines to be trailed by the teacher this rules ought to be based on education value of the excursion; a specific rule ought to plainly demonstrate the objectives that are to be met during the visit (Nayak & Singh, 2007: KIE, 2006).

Project work, are organized or planned activities in which the students are permitted to explore or examine without anyone else. According to Roger, (2003) students are expected to observe experiment, collect data, discuss, ask questions and clarifications, manipulate instruments and variables, collect and interpret results during project work. These results are usually discussed with the whole class .As indicated by Valdyia (2001) project work empowers students to particularly involve themselves in the Biological investigation on an aspect of their own interest and thus they learn to

appreciate the basic steps involved in scientific method. However Kellerman (1996), states that combination of steps and process skills in project work which include observation, recognizable proof of problem, discussion, formulation of speculation, design a scientific investigation, data gathering, data analysis, report composing and presentation. The role of the teacher is assigning project to the students, supervising and providing guidance.

Practical work/Laboratory Activity, this strategy involves learning by doing. It is a strategy of teaching where by tools, apparatus and instructional materials are used to enhance, stimulates the process of learning in a place known as laboratory. Laboratory work in biology involves observation, description or drawing, microscopy, dissection and experimental work (Ezeaghasi, 2014). Reid and Shahi (2004) hold that laboratory work gives the student the opportunity to experience science by using scientific research procedures and also to encourage the development of analytical and critical thinking. It also strengthen theoretical knowledge, experiencing the pleasure of discovery and development of their psychomotor skills, increasing creative thinking skills, higher order thinking skills, developing manual dexterity by using tools and equipment, allowing students to apply skills instead of memorization (Ezeaghasi, 2014). Learners are engaged in practical learning activities this includes action oriented learning directed by the students under the direction, supervision of the teacher. The teacher provides the students either separately or in the group with the material and apparatus and additionally the guideline to be followed in performing the practical. The teacher provides his/her students as individuals or in groups with specimen apparatus and the instruction to follow (Maundu, Sambili & Muthwii, 2005). Therefore this strategy encourages self-confidence in scientific investigations and exploration.

Discussion: is another strategy of developing cognitive and affective strategies in teaching biology. This is a two-way interaction strategy. Discussion is a strategy of teaching that involves an interaction where by the teacher, students engage themselves in lively discussion of a topic, and both the teacher and students give their views on the topic. The teacher in a discussion class acts as a moderator. According to Dawuda (2014), discussion is a student centered method of teaching in which students

participate actively in the in the discussion process over a subject matter or a topic from various point of view, while the teacher act as a moderator or guide. This strategy facilitates effectively flow of information from the teacher to the student, from the students back to the teacher and from one student to another (Haas, 2002). Further Obeka, (2010) states that discussion strategy in teaching science help to increase curiosity about the subject; it enhances more positive perceptions of students about value of the subject, to get information on what to contribute during discussion students spend more time readings.

According to Sanusi (2012), discussion is a variety of forums for open ended, collaborative exchange of ideas among a teacher and students or among students for the purpose of furthering students thinking, learning, problem solving, and understanding literary appreciation. Discussion facilitates higher levels of thinking, accommodates conflict, negotiation and consensus, enhance learning and longer retention. This makes students to attend to class more regularly since they usually enjoy the lesson especially when it is less formal thus motivating the learners.

Obeka (2013), states that when using discussion strategy the teacher should ensure that the following must be considered; the teacher should have chosen a learners interest oriented topic, which should also be taught provoking and argumentative, assign role among participants, the teacher should try as much as possible to decide ahead the type of discussion that the learners will take part in. The teacher must lead and guide the learners to stick to a particular point in discussion activities; they should make sure that the learners are effectively motivated to be attentive in the discussion. In addition the teacher should encourage the learners to ask questions in the areas where they have problem. Therefore the objectives of a discussion can only be achieved if the teacher plays his role as a moderator effectively. Although the discussion method is effective, it could be time consuming and the classroom could appear noisy. Further Obeka (2010) stated that if discussion is not well moderated by the teacher the discussion could be dominated by a few outspoken ones and sometimes the teacher may want to impose his own ideas on the class.

Discovery: is a teaching strategy that encourages students to be more active in their learning processes, by answering a series of questions and solving problems. It is a strategy which offers learners the opportunity to discover scientific facts, concepts and principles for themselves rather than being told. It allows learners the opportunity to discover and learn science, (Eneh, 2001). Further Mayer (2003) added that discovery strategy is based on the notion that learning takes place through classification and scheme formation. Further, Gallenstein (2004), argued that discovery is essential as students are actively involved in the process of learning topics that are intrinsically motivating, context are often meaningful than typical classroom exercise. As the study acquires investigative and effective skills, new strategies learned in the context, and students are more likely to remember concept and information if they discover them on their own.

Enquiry strategy, enquiry as used in science teaching that refers to a way of questioning, seeking knowledge or information, or finding out about phenomena. It involves investigation, searching, defining a problem, formulating hypothesis, gathering and interpreting data and finally arriving at a conclusion. This strategy has different names given to it by different scholars; some call it problem solving, critical thinking, reflective inquiry and inductive thinking (Mani, 2008). According to Mahuta (2013) suggested that enquiry strategy provides the opportunity for the learners to seek for knowledge in a systematic and logical way, also provide the students with opportunity to examine ideas events and problems about a particular behaviour events and concepts.

Enquiry strategy of teaching the learner learn with minimum guidance from the teacher, seeks to discover and create answers to a recognized problem through procedure of making a diligent search (Haas, 2002). In this strategy of teaching, the teacher does not provide answers to the learner but he tries to direct and guides the learner to get answers accordingly, questions are raised and the students provide solutions. In enquiry situation, students learn not only theories and principles but also self-direction, responsibility and social communication. It also permits students to assimilate and accommodate information. (Pine, Roth, Jones, Mcphee & Martins, 2006).

### **2.3 Computer Assisted Teaching Strategy**

The computer is a programmable electronic gadget that has capacity to store information, process it, and create an output (Shelly *et al.*, 2000). An electronic device can store, recover, and process both qualitative for instance, dictionary of terms and quantitative information for example, the formulae. It can suit instructional program, which joins incorporate drills and instructional activities. The Computer gives a prompt criticism that lets the learner to know their accomplishments (Barot, 2009). Computer can create word record, do calculation, introduce data oversee information, it can likewise store information and recovery of huge measure of data and furthermore has virtual asset, for example, email and the web that one can learn without stepping in class (Feldman, 2004).

Computer technology has captured the attention of many researchers and educators and computer-based instructional applications are considered effective and alternative to traditional teaching method (Yushau, 2006). The terminology concerning computers as a teaching and learning medium that relates to computer assisted teaching are: Computer-assisted instruction (CAI) and Computer-based learning (CBL) or computer-assisted learning (CAL). Computer is used in teaching new skills or concepts or providing practice for learners, the software in this mode is often referred to as drill practice; and tutorials. Computer assisted Learning (CAL), which includes use of various categories such as simulations and modelling, instructional games. Therefore, CAI uses computers to mediate in the flow of information in the learning process since the information is stored in the computers and made available for the learners that can be utilized in teaching and learning process, this is related to computer-assisted teaching. Computer assisted learning has a powerful advantage to the students since it gives a prompt self-managed learning opportunities empowering the student to learn content to the limit (Barot, 2009) as compared to traditional teaching strategy.

Gonzalez and Birch (2000) ascertain that computer assisted learning has an ability to promote active learning in a wide variety of disciplines from literature to the sociologies and beyond. Danjuma (2015) observed that the use of CAI creates and sustains students' attention and curiosity in the learning process, Therefore computer

assisted instruction is one of the pedagogy that facilitate the impact of scientific knowledge to the learners easily. Yigit (2005) computer-assisted instruction has a positive impact on students' perception as well as on their academic achievement.

Globally, records show that developed and developing countries have endeavoured to support the use of CAL in classroom teaching. Several studies have been carried out on the effect of CAL teaching on different subjects. In Turkey, Kausar (2008) conducted a research on a comparative study to evaluate the effect of computer-assisted learning versus classroom lecture for computer science concluded that CAL proved to be significantly superior to the Classroom lecture. The CAL proved to be very much effective in increasing the evaluation and application skills of students to experimental group, experimental group were motivated and ready to learn each day of experimental duration of CAL treatments than students of classroom lecture treatments. Mahmood (2004) conducted a study on CAL and traditional method of instruction, the study examined the effect of computer-assisted learning on student achievement in general science as compared to traditional method of instruction. The result revealed that the experimental group outperformed the control group in all achievement areas that is overall, by levels of cognitive domain and by type of content and students had interest on CAL program and benefited from it.

In USA, Fedison and Bradic (2007) on a study an investigation on the effect of teaching using computer as a technology tool on motivation and achievement. The study compared the motivation and achievement of middle level student in language and art classes when taught using traditional methods and the use of computers. The findings of the study reveal that students who were taught by use of computers had a higher motivation to learn than those their counterparts who were exposed to traditional methods of teaching. In Turkey, according to Serin, (2011) in a meta-investigation that was performed to determine the general effect of CAL in teaching chemistry, biology and physics and computer, the outcomes demonstrated that CAL positively affects the students achievement where normal learner accomplishment moved from 50 percentile to 87 percentile in learning science when the computer assisted learning was utilized.

In a study conducted in India on use of CAI and its effect in development of instructional Strategy for Biology Teaching (Pinkal, 2013).The study concluded that CAI is very useful for the achievement of students in biology subject. The teachers to overcome the problems of Science such as lack of visualization have used CAL as supplementary tool and it may minimize constraint of education. CAI can never replace good teachers but it complements them and helps in easier and faster learning of content as well as improving the student achievement and motivation to learn biology.

In Africa, there are investigations done on the utilization of computer in teaching and learning. However the research findings tend to support the observations by researchers globally, for instance according to Etukudo (2003), in an investigation on impacts of computer assisted learning (CAL) on Nigerian secondary school learners execution in Mathematics, demonstrated that performance of learners presented to CAL were superior to their partners presented to the traditional teaching techniques. In another study directed by Olalare (2006), the performance of learners presented to CAL in teaching biology either independently or agreeable were superior to their partners presented to traditional classroom guideline.

Owusu, Monney and Appiah, (2010) on an investigation on the effect of computer assisted instruction in performance of senior high school biology students in Ghana, claims that utilizing CAL enhances learning through general positive motivational variables that are related to innovation incorporated in the curriculum. This enhances achievement of the students through expanded inspiration by giving a setting to the students that is advancing, challenging and stimulates curiosity. According to Daintith and Wright (2008), the utilization of CAT has turned out to be increasingly far-reaching and important particularly in troublesome subjects, more particularly in the sciences. This is because it has the capacity to give information in form of text, charts, sound, pictures and video that help in reinforcing the learners mastery level as well as improving motivation and learners academic achievement.

According to Kumar (2010) on integration of ICT in Teacher Education tested the effect of CAI for teaching general science at secondary level and found positive

results in favour of CAI as compared with conventional method. Further Hancer and Tuzemen (2008) found CAI to be more effective as compared to traditional method for teaching science at primary school level. Ragasa (2008) on an investigation on comparison of Computer assisted instruction and the traditional method of teaching basic statistics and Basturk (2005) study on the effect of Computer Assisted Instruction in teaching introductory statistics found out that CAI to be more effective than traditional lecture method for teaching introductory economics statistics to students.

Yusuf and Afolabi (2010) in a study on the effect of computer assisted instruction on secondary school students' performance in biology, the study revealed that students exposed to CAI either individually or cooperatively performed better than their counterparts exposed to the conventional classroom instruction. Their observations are supported by Kibos, Ndirangu and Wekesa (2004); Kevogo, Toili and Mutsotso (2013); Kiboss and Tanui (2013); Keraro Wachanga and Orora, (2014) and Amadalo, Wekesa, D., and Wekesa, E, (2013) among others. Siddiqui and Khatoon (2013) maintain that CAL and its various modes such as computer simulations and games have the ability to support new, inquiry-based approaches to science instruction, through virtual laboratories or field learning experiences. Similarly, Linn, Chang, Chiu, Zhang, and McElhaney (2010) suggested that CAL help learners mentally link abstract representations of scientific phenomenon (e.g. equations) with the invisible processes underlying the phenomenon and learner's own observations. These the researchers maintain that students overcome inherent practical and logistical constraints hindering learning of science subject. CAL tools, the researchers believe allow learners to visualize, explore, and formulate scientific explanations for scientific phenomena that would otherwise be impossible to observe and manipulate.

Garanga, Amadalo, Wanyonyi and Twoli (2012) specifically observed that CAL positively influences students' achievement in structure and bonding. Frailich, Kesner and Hofstein (2007) who in an investigation of the influence of integrating a website into chemistry teaching of chemical bonding found that the tool enhanced learner's comprehension of chemistry concepts and increased their awareness of the relevance of chemistry to daily life also support this. Similarly Akçay, Feyzioglu and Tysuz



(2003) in a study of the effect of CAL on achievement and attitude of college students in analytical chemistry found that achievement of experimental groups was significantly higher than the control group. Other areas in which efficacy of CAL have been tested with similar results includes electrochemistry (Hailegebreal, 2012); acids and bases (Dasdemir, Doymus, Simsek & Karaçöp, 2008; Ozmen, 2008). In these studies it indicated that the post-test scores showed a statistically significant difference in favour of the experimental group indicating that integration of CAL enhanced students' understanding of chemical concepts and increased their motivation during the lessons. Similarly, Nduati (2015) found a statistically significant mean difference in achievement of students taught carbon and its compounds using CAL relative to those taught through conventional methods.

According to Heinich, Molenda and Russell (2002) posted that computer is very useful tool in teaching and learning. Okere (2014), in the study on the effects of computer based stimulation module on secondary school students achievement in understanding of magnetic effect of electric current found out that computer stimulation instruction is successful as an instructional method.

Maundu, Sambili and Muthwii (2014) investigated the enhancement of science performance through computer-assisted instruction among selected secondary school learners and the influences of instructional methods on efficiency of content delivery of the learners. The study revealed that learners taught through computer assisted instruction performed significantly better than the learners taught through conventional instructional techniques in Biology chemistry and physics.. Further, Tanui, Kiboss and Nassiuma (2008) on the study on the effects of Computer Based Instruction on student motivation and achievement in secondary schools business education in Kenya. The study showed that the student on experimental group had a higher rating on the nature on double entry account course in business studies than students in the control group. Therefore based on these findings of the study it was concluded that the use of computer assisted instruction improves secondary school learner's performance in science.

## **2.4 Academic Achievement in Biology**

Academic achievement is assigned by the test and the examination scores or the imprints allotted by the subject teacher (Adediwura & Toyo, 2007). Academic achievement is a measure of value and amount of success one has in authority of learning skills and comprehension. Learner's achievement was adopted as a key indicator of quality education during the world conference of Education for All (EFA) in Jomtien, Thailand (UNESCO, 2000). Therefore, academic achievement shows the extent to which the student, teacher, or an institution has achieved over a short or long-term educational goal, measured by examinations or continuous assessments tests. According to Lewin, Wasanga, Wanderi and Somerset (2011), academic achievement at secondary level is not only a pointer of effect of schools but also a determinant of the wellbeing of the youths in particular and the nation in general. However, academic achievement is influenced by factors such as individual differences that are linked to the intelligence and personality differences among students.

According Chimombo (2000) in assessing the impact of related socio-economic factors in Malawi, the study concludes that inadequate provision and conditions of facilities like toilets has negative effects on girl student persistence in school. The study observes that cultural beliefs that look at girls as having less ability than boys if brought to the classroom may lead to marginalization of girls and further demotivate them in their academic performance. Negative attitudes towards the abilities of girls are deeply embedded in all cultures and education for domesticity is the norm. In Malawi, for example, some subservient cultural practices such as kneeling to parents and elders are carried out in the schools by girls only. Subordinate status is impressed upon girls and this is reflected in the structure of schools. Girl-gender bias in schools is often found in teaching pedagogy, subject streaming, teachers' expectations, instructional materials and curriculum content. In Britain, heterosexualized femininity is shaping the landscape of schooling, education and training for the girls gender. An examination of subjects chosen by girls and males, reveals girls are over presented in 'traditional caring-based courses and under-represented on higher status courses (Riddell & Salisbury, 2000).

According to Suman (2011) on a research on influence of parental' education and occupation on academic achievement of students concluded that education and occupation of parents positively influence the academic achievement of children. Femi and Adewale (2012) concluded that education qualification of parents and health status of students are significant factors that affect the academic achievement of students. Parents' education has the highest significant influence on the academic achievement of students. The child from educated family has a lot of opportunities to study hard due to his/her access to internet, newspaper, television and they can also be taught extra lessons at home (Akisanyo, Akayo, & Salomi, 2014) While those students raised from an illiterate family have limited access to.

Femi and Adewale (2012) in his study states that socio-economic and education background of parents is not significant factors in students' performance. Therefore, improving students' academic achievement is necessary for promoting economic growth in a country. Performance of students in any academic task has always been of special interest to the government, educators, parents, and the society (Lydia, Nasongo, Yusuf & Aigun, 2010). This justifies the need for research studies in relation to students achievement in particular subjects in secondary schools, and especially in Biology taking into account the important economic role played by Biology in Kenya.

Children in Kenya are engaged in domestic chores, often to the detriment of their education (Kadenyi & Kamuyu, 2006; Chepchieng & Kiboss, 2004; FAWE, 2003a; Ayoo, 2002). In their study on the influence of family socio-economic status and gender on students' academic performance in Baringo district secondary schools, the study attempt to establish whether there was any gender difference in the influence of domestic chores on students' academic achievement in mixed day secondary schools in Mosoch Division. The study found out that lack of time for study among girls could be attributed to involvement in domestic chores. In contrast, boys were left with a lot of time to study thus were likely to have an edge over girls' school work. This has affected academic achievement among students in schools due to lack of time to work.

Academic achievement in biology subject is influenced by many factors. Dinah (2013), on a research investigating the factors, which influence academic achievement in biology in Kenya. The study concluded that, availability of text books, laboratory apparatus and other learning resources contribute significantly to the performance of students in Biology examination. He added that, students with positive attitude towards the subject register better performance than those who had a negative attitude. Those with positive attitude are motivated to work hard and this is reflected in the good marks scored in the examination.

According to Owino, Osam and Yunguny (2014) on a research investigating the factors that influence performance in KCSE Biology secondary schools in Nyakach, Kisumu County, Kenya found out that good teaching methods used by a Biology teacher, motivates students to work hard since it enhances positive attitudes and interest development among students which influences performance. A teacher's teaching strategy determines the student attitudes that will show towards a certain subject. If the teaching style is complex, students will find it hard to understand thus, develop a negative attitude towards the subject. When teaching style match with the learning style the cognitive operations of the learner teaching and learning becomes more rewarding and productive. (Kinshuk & Graf, 2009).

Gambari (2014) observed a significant difference among students' achievements in Biology in students exposed to animation and narration in comparison to those exposed to conventional teaching method. Similarly, those exposed to animation and text performed better than those exposed to conventional teaching method. Further, those exposed to animation, narration and on-screen text performed better than those taught with conventional teaching method did. Okwo and Asadu (2002), the use of media (video, audio and picture, and audio) are equally effective with no significant difference effect among the means when used for teaching physics. Ajaja (2010) indicated that students exposed to field trip experiences performed significantly better in post biology achievement test than those who were not and that student's process of science test scores influenced their achievement in biology. Taken together, the findings tend to suggest that field experiences may have greatly influenced students' understanding of the concepts taught in the class.

Ajaja (2007) maintained that the scientists look at the world in order to determine how it works and determines principles from observation as done in field trip. Wachanga and Mwangi (2004), in a study to find out effect of various teaching methods on achievement in science subjects in Kenya, the study shows that cooperative class experiment as a teaching method enhances learner's achievement in chemistry. The findings from these studies indicate that the teaching strategy adopted by Biology teachers has an effect on students' achievement in the subject.

## **2.5 Motivation in Learning Biology**

Motivation is a one direction to behavior or what causes an individual to want to repeat a behavior (Elliot & Covington, 2003). Therefore, this sustains and energizes an individual to moving to accomplish a task. Motivation is psychological a force that determines the direction of a person level of effort and a person level of persistence in the face of obstacles.

Motivation is key factor towards learning and achievements of biology students and at the school level that is effective on student learning. It also increases student speed of work in classroom during the lesson and aim at achieving the set goals. Motivation is a fundamental element for a meaningful learning process to take place that will involve active learning strategy used by the student (Jones & Howes, 2000). Therefore active participation of the student during biology lesson will involve students eager to participate in the learning process by being prepared for the lesson and continuously asking biology questions resulting in a better academic performance and increases the learner motivation and better understanding of the biology topic taught.

According to Tuan, Chin and Shieh (2005), students' motivation towards science learning with biology included may be influenced by six factors, namely: self-efficacy, active learning strategies, science learning value, performance goal, achievement goal, and learning environment stimulation. Students' motivation towards science learning has contributed a considerable impact on students' science achievement (Pintrich & Schunk, 2002). Science learning is determined by cognitive factors and affective factors. The cognitive factors include information processing,

reasoning ability and academic achievement (Lawson, Banks, & Logvin, 2006; Yumasak, Sungur, & Cakiroglu, 2007). While for the affective factors that are emphasized in the science education literature are attitude, self-efficacy, anxiety and motivation (Ekici, 2005; Glynn, & Koballa, 2006; Mallow, 2006; Osborne, Simon & Collins, 2003; Uzuntiryaki & Capa Aydin, 2008; Yumasak, Sungur, & Cakiroglu, 2007).

Students will be attracted towards and engaged in activities that are perceived as having the potential to meet some need or desire (Parson, Hindson & Brown, 2001). Depending on the source of this desire that directs behavior, there are mainly two types of motivation; intrinsic and extrinsic. Extrinsic motivation involves engaging in an activity for reasons external to the task. Further Fetsco and McClure (2005) state that learners become extrinsically motivated when they recognize a relationship between their actions and receiving some external reward. A reward may be a good grade in biology, praise from biology teachers or parents, approval of peers, or permission to work on another activity. Extrinsically motivated student perform in order to obtain some rewards or to avoid some punishment external to the activity itself. (Vansteenkiste, 2005).

Motivation without apparent reward on the other hand is called intrinsic motivation; intrinsic motivation is a strong, positive force in people's lives. Intrinsically motivated students want to complete a task successfully due to an internal desire. There is no need for a reward at the end. Learners tend to be intrinsically motivated when they perceive themselves as being both competent and self-determining. The behavior of intrinsically motivated students is internally regulated for example a student is intrinsically motivated to read, he read them simply because he finds pleasure in the process (Deci & Ryan, 2008). However this Intrinsic motivation has been referred by psychologists as non-drive based motivation where if motivation is referred to the terms of energy the student's holds energy intrinsically within themselves the students participates purely in the interest of actively alone (Fetsco & McClure, 2005 ).

Pintrich and Schunk (2002) intrinsic motivation is the motivation to engage in an activity for its own sake; and they emphasize they understand and control their

environments, which becomes more specialized with development and progression in school. Parsons *et al.* (2001) also state that using extrinsic motivators too often may result in decreased intrinsic motivation and interest since learning may be restricted to areas that will earn a reward. The teacher should decide how to use reinforces in the classroom. Therefore, it is very important for biology teacher to motivate students since students learn and perform desired behaviors only if they are motivated, in other words, energized to do so.

Motivated students typically have positive attitudes toward school, cause fewer management problems and describe school as satisfying (Pintrich & Schunk, 2002). Motivated learners approach tasks eagerly and exert high levels of effort and hence all teachers would like to motivate their students for a better achievement. Therefore motivation either intrinsic or extrinsic motivational sustains learners activities that aims at achieving the specific academic goals this goals help the student to recognize academic pursuits that lead to extrinsic personal satisfaction.

## **2.6 Gender Difference on student's Academic Achievement in Biology**

According to Umoh (2003) define gender as psychological term used in describing behaviour and attributes expected of individuals on the basis of being born either male or female. Further, Ekeh (2000) argued that gender is a phrase that categorizes individuals into male and female. In a classroom set up, academic performance in biology subjects varies from one student to another either boys or girls, despite the fact that the students are subjected under the same biology syllabus. However, attitude, learning styles, and motivation towards the subject could be contributing factors towards performance in biology among other factors.

Gender is one of the factors affecting the performance of students in science. Studies on gender have been unresolved on their conclusions (Nussbaum, 2000). Some researchers found that male students performed better than female students (Novak & Mosunda, 2010; Usman 2000). Other studies confirmed the superiority of female students' performance over male student. Yet others found no significant difference between male and female performance (Nussbaum, 2000; Danmole and Addayi; 2004). Dahiru (2004) also reported that there is no significant difference relationship

between gender and selection of science subject. Wachanga *et al.* (2003) also observed that there is a significant difference in the performance of male and female in science. Further Olanrewaju (2004) reported insignificant differences between boys and girls achievement in knowledge of Biological concepts.

According to Chinwe and Chinyere (2010) on the study on the effects of constructivist instructional approach on students' achievement in basic ecological concepts in biology revealed that while there was no statistical difference in the students' achievement tests in the post-test evaluations between boys and girls, the pre-test exams revealed differences in the scores for girls and that of boys. Further Aiyedun (2000) argued that difference in the achievement of male and female students could be taken care of by using good methods, material and appropriate teaching strategies in teaching biology in order to improve the learners' academic achievement in the subject. Okebukola (2002) explained that teachers who understand the academic strength of their learners and strive for instructional variety in instruction methodology will actually value, encourage and achieve academic excellence in the classroom.

Difference in biology achievement due to gender has caused a lot of concern to educationists. According to Wai and Watt, (2009) argued that, girls do not perform better in mathematics and sciences as compared to the boys. Some of these differences are attributed to gender discriminations believed to be exhibited by the nature of teaching materials and environments as well as the dominant patriarchal worldviews in most societies. Some scholars have concluded that girls think and learn differently as well as interact with equipment differently from boys. These differences occur also in the teaching and learning of biology. Studies reveal that girls and boys have different approaches in learning (Eliot, 2003). According to Olumide (2014), on a study investigating on the effect of computer simulation and packages and gender predictors of student achievement in biology. The study reported a significant effect on gender on student academic achievement in biology, the male students attained significantly higher scores in biology than females after being taught genetics using computer simulations.



According to Miller, Blessing and Schwartz (2006) claimed that biology as a science subject females are interested in, possibly because they believe biology is a human related science compared to more abstract scientific principles and methods that they find uninteresting. Moreover, they are more interested in health carriers such as medicine, which is consistent with the finding that they are interested in biology. Boys on the other hand, prefer applied science carriers in engineering, computer science, and medicine, but not for helping people while girls are more interested in biology related topics, while boys were interested in physics and chemistry (Miller, Blessing & Schwartz, 2006; Murphy & Whitelegg, 2006). Therefore, this has shown varying achievement in biology between boys and girls.

In United States, the National Assessment of Educational Progress (1986) that was carried out reported that boys out performed girls in sciences achievement and the gender gap increased as students progressed in school. Later assessment was carried out by National Assessment Educational Progress in (2005) revealed that males outperformed females in science achievement in grades Four, Eight and 12 (class Four, Eight and form Three) respectively while females at all levels made relatively little gains in their average science scores. In the final year of secondary school, males had a significantly higher achievement in scientific literacy than females in all participating countries (EU, 2009).

In Africa, on a study carried out in Niger, (UNICEF, 2004) reports that girls and boys have equal access to school, but girls continue to be at a distinct disadvantage due to inappropriate and restrictive curriculum, coupled with the widespread belief that school teaches girls modern ways which are in conflict with local behavioral norms. Further in a study that was carried out in Uganda on an investigation on Gender differences in the performance of Chemistry practical skills among senior six students in Kampala. On a total of 50 students participated (25 boys and 25 girls) there were no differences in the students' ability to manipulate apparatus and report results showed girls had poor self confidence in their ability as most of them believed that boys performed better (Ssempala, 2005). Onsomu (2005) concluded that as boys and girls grow up the differences they have in achievement in other subject diminish except in mathematics. Onsomu, Kosimbei & Nyware (2005), girls perform

increasingly better than boys in school. While it is well known that girls score significantly higher than boys on for example reading tests, there is now increasing evidence that the gender gap in school performance is closing in math and science, subjects thought of as being dominated by boys.

According to Kwesiga (2002), in Uganda Biological Sciences like Home Science are grouped under Cultural subjects and are denied the academic treatment in most schools and are branded as girls only subjects. Many girls' schools do not offer Technical and Applied Science subjects as they are regarded as boys' subjects. There are not enough teachers in these subjects. Business Studies subject was designed for girls, but it's not offered in many poor schools as they do not have the capital to buy typewriters or computers and pay the teachers. Owing to poor and lax grouping of the subjects, many girls tended to choose Arts and Humanities based subjects. Most new girls' schools offered less practical subjects owing to lack of adequate facilities, instead of offering pure Science, they offered General Science. Lack of scholastic materials and facilities hampered performance of girls at O-level, especially in the mathematics, sciences and technical subjects. The types of secondary schools are not conducive to high aspirations by girls.

In Kenya, IPAR (2003) study on the performance of students in KCSE revealed similar results that in science subjects with boys performed better in chemistry and physics than girls who perform better in biology. Jacobs *et al* (2002) found that self-concept of ability and task value in mathematics and science decline for both genders between first and twelfth grades with no real difference between girls and boys over time. By the twelfth grade, girls valued mathematics and science more than boys when controlling for self-concept of ability in mathematics. Further Eccles *et al* (2002) argued that even though women have made great strides in the law, medical, and social science professions, very few can be found in graduate programmes or professions in Mathematics, Computer Science, Physics, Engineering or Information Technology jobs. Many ideas have been put forth on why high achieving women may not be entering these professions including discrimination, gender-typed socialization, and self-concept of ability in these areas, and the value and interest that women have in these professions.

According to UNESCO (2003) whose report Gender and Education for All stated that some teachers portrayed negative or stereotype attitudes about academic potential of girls; that there are few girls' teacher role models and counselors for girls; unequal access to textbooks or writing materials and that girls are harassed by their male classmates. This report also supports findings by Kakonge's (2000) on a study on Gender differences in Science subjects in Secondary schools in Kenya. The study examined that teachers' thinking or level of reflection on gender gaps in education and particularly in science subjects. The study showed that a majority of teachers had perceptions of girls and science that were gender stereotyped and traditional. A smaller cluster of teachers, however, had quite girl-friendly perceptions. Thus studies emanating from the Kenyan context show that textbook, curricula and teachers may be important factors contributing to gender gaps in education and in particular science subjects at the moment. This results in low completion rates in secondary education such that national completion rate in Kenya in 2004 was 91.5% for boys and 87.5% for girls, registering a gap of 4% in favour of boys in secondary schools (Republic of Kenya, 2007). This has led to a case scenario of low transition rate to colleges, low enrolment, retention and completion rate for girls; a case resulting partly from harsh school curriculum on girls. This scenario replicates itself in the performance at Kenya Certificate of Secondary Education (KCSE) examination which has improved steadily for boys who often tend to perform generally better than girls in key subjects such as English, Mathematics, Biology, Physics and Chemistry. Girls are generally more adept than boys in languages and humanities (Republic of Kenya, 2007).

### **2.7 Gender Difference on students Motivation in Biology**

Motivation to learn refers to the disposition of students to find academic activities relevant and worthwhile and to try to derive the intended academic benefits from them (Brophy, 2004; Glynn, Taasoobshirazi & Brickman, 2009). Motivation is a significant important factor for academic learning and achievement across childhood through adolescence (Elliot, 2005) it initiates and sustains the learners and directs students towards achieving specific self-directed goals that encourages students to actively learn difficult concepts in science.

According to Zull (2002) argued from the brain science perspective that motivation to learn comes from learning itself this sustains and directs the learner towards learning activities that perceived them to meet their desired learner's needs. Student learning is influenced by motivation being one of the factors and teachers can affect student motivation in the way that facilitate learning, therefore motivation of learners towards a subjects vary among the students in class. Motivation can either be intrinsic or extrinsic motivation. Extrinsic motivation comes from a person environment, young children are motivated by the parental encouragement by giving praises and gifts. Intrinsic motivation comes from internal forces where a intrinsically motivated student wants to learn because she/he is curious, seek knowledge are interested in self-improvement and learning gives the satisfaction (Pintrich & Schunk, 2002). Ozbas (2016) investigated high school students' intrinsic and extrinsic regulation when learning Biology and found that female students' intrinsic and extrinsic regulation was higher than those of male students.

Students who have high motivation to learn science are having a higher level of achievement in science than those that are less motivated to learn the content (Glynn *et al*, 2009; Patrick *et al*, 2007). This is because a highly motivated person as one who is also developing high levels of internal achievement and excellence and more likely to be engaged in learning in a deeper, more self-regulating fashion (Athman & Monroe, 2004). According to OCED (2007), revealed boys are higher intrinsically motivated to learn science than girls. Women especially value science when it gives them sight into the causes and prevention of illness maintenances of good health, diet, and exercises. Students also would like to engage in relevant ethical and controversial science issues, things that matter to them on daily basis when students were asked what they found most boring in school science topics drawn from physics were mentioned most often by chemistry and then biology (Planet, Science 2003). Nodia (2010) on a gender differences on the variable of extrinsic and intrinsic motivation on academic performance, the study found out that the females are more intrinsically motivated than the males and the males are more extrinsically motivated than the females in learning and specifically biology.

According to Weillington (2002) boys are inclined to like the theoretical and competitive learning environments while girls on the other hand prefer creativity and cooperative learning. Orora, Keraro and Wachanga (2006) conducted a study on using cooperative e-learning teaching strategy to enhance students' creativity in secondary school Biology in selected schools in Nakuru County, Kenya. The findings revealed that the students exposed to Cooperative E-Learning (CEL) teaching strategy were more creative than students exposed to conventional teaching strategy. Further, the study concluded that CEL is an effective strategy that can enhance creativity and innovation therefore should be incorporated in the teaching of school biology. Further Orora, Keraro and Wachanga (2006) argued that creativity is a key pre-requisite in any meaningful learning process since it enhances a learner's capacity to develop a deeper understanding of scientific phenomena. Science educators, therefore, need to develop approaches that can be used to enhance creativity in lessons such as integration of computers in teaching and learning. Therefore, teaching strategy has an effect on motivation in relation to gender.

According to Koul, Roy and Lerdpornkulrat (2009) on an investigation on the relationship between students' perceptions of classroom learning environment and motivational achievement goal orientation towards Biology and Physics as well as the influence of gender. The findings indicated that females adopted significantly higher levels of mastery and performance approach goals towards Biology while males adopted significantly higher levels of performance avoidance goals towards both Biology and Physics. Positive associations emerged between gender and the adoption of specific performance goals, perceived the degree of competition in Biology and Physics classrooms. Further the research findings indicated that there was a significant gender difference in favour of the females on a number of domains of motivation.

According to Cavas (2011) investigated the factors affecting Turkish primary students' motivation towards science. The data were collected using Students' Motivation toward Science Learning Questionnaire. The findings indicated statistically significant gender differences in motivation towards science in favour of females. Shihusa and Keraro (2009) investigated the effect of using advance

organizers on students' motivation to learn Biology from an experimental perspective in Bureti District, Kenya. Data were collected using the Student Motivation Questionnaire .The findings indicated that students taught using advance organizers had a higher level of motivation than those taught using conventional methods. The findings further indicated that following the intervention, there was a significant gender difference in motivation to learn Biology in favour of the males.

Prokop, Prokop and Tunnidifee, (2007) on an investigation on the interest and attitude of students towards biology found out that biology lessons being relatively popular among girls showing significant interest than boys and girls assessed biology as more important and less difficult than boys. Students want science classes that offer more relevance to their everyday lives they would like to learn more about their bodies in biology (Jenkins, 2005), this motivated girls towards learning biology.

## **2.8 Theoretical Framework**

The study adopted constructivism theory and Attention, Relevance, Confidence and Satisfaction model of motivation developed by John Keller. Constructivism theory maintains that learning occurs as an interaction between new information and the experience gathered using computer. ARCS model of motivation by John Keller focus on motivation during the instruction that is important for e-learning since it help to motivate the learner.

### **2.8.1 Constructivist Theory**

This study was guided by constructivist theory. Constructivism is a psychological theory of knowledge that argues human construct knowledge and meaning from the interaction between experiences and ideas. According to Fosnot, (2013) this theory view knowledge and truth as created during the instructional process. As such, concepts are constructed rather than discovered given that is a subjective experience of one's everyday life.

This theory is based on the construction of science knowledge being dependent upon the experiences the students bring into the classroom. Further, it recommends that the role of the teacher is to organize information around various types of problems with a

specific end goal that draw students' interests, propose questions and suggests solutions to students and advancement to students, (De Vries, Zan, Hildebranth, Edmiaston, & Sales, 2002). To achieve this goals, the teacher should adapt a curriculum that help negotiate this goals and the objectives of the learners and prose problems of emerging that are relevance to students.

Constructivist theory holds that from birth to death, individuals build and remake the importance of occasions and the items their observe (Keraro, 2002).It emphasizes on science as an innovative human attempts that is authentic and socially molded that knowledge claims are absolute. According to Kruckeberge (2006), Constructivist theory of learning supports intellectual instructional method for restricting that people have an inborn sense of the world. This space enables them to move from latent eyewitnesses to active learners. Therefore this theory holds that learning is an active process and knowledge is constructed from experiences (Christie, 2005).

According to Kim (2005), the constructivist theory of learning holds that learning is an active process of developing meaning based on individual personal experiences; knowledge is constructed out of sensual and perceptive experiences of the learner; knowledge is the personal understanding of the outside world through personal experience; learning creates knowledge in the context of a situational reality. This theory maintains that students' gets into a classroom with ideas concerning the new problem, therefore learning will occur because of interaction between new information in the learning environment and the experiences gathered because of interaction with it. It emphasizes on student active involvement since knowledge is gained and lost in theory memory.

According to Murphy (2003) argued that constructivism anticipates that people construct their own understanding and knowledge of the world through experiencing things and reflecting on those experiences. Thus this is applied in Computer assisted teaching strategy has been related to constructivism since it provide a constructivism environment where the students are dynamic engaged with the learning process as opposed to being passive, since students take in more by experimentation than by being told what happens, the students are left to make their own references and

making conclusions. Therefore, according to Moustafa, Ben-Zvi-Assaraf and Eshach (2013), scholars have argued that the constructivist-learning environment can be used as a lever for increasing student motivation for science learning. Aubusson and Watson (2003) indicated the existence of a connection between a constructivist-based pedagogic environment and student's motivation.

Constructivist theory of learning has several implications for science learning. According to Tam (2000), the constructivist learning environment provides an interaction between the learners and learners, and learners and the teacher. The collaboration and cooperation among the learners should enhance interaction. The learning environment is interactive to promote higher level learning and social presence and to help develop personal meaning (Heinich *et al.*, 2001). Collaboration also creates learning communities to negotiate and co-construct meaning (Neo & Neo, 2009). Learning environment is an active process keeping learners active doing meaningful activities results in high level processing which facilitates the creation of personalized learning. Asking the learners to apply the information in practical situations makes the learning active and facilitates personal interpretation and relevance (Elliomi & Anderson, 2001).

According to Murphy and Cifuentes (2001), the constructivist learning environment should make the learners to construct their own knowledge rather than mere acceptance of that given by the instructor. Knowledge construction is facilitated by good interaction since the students have to take the initiative to learn and interact with other students and the instructor because the learning agenda is controlled by the student. Constructivist learning environment encourage the learners to use meta-cognitive skills. This can be done by self-check questions and exercises with feedback throughout the lesson to allow them to use metacognitive skills to adjust their learning approach (Elloumi & Anderson, 2001).

Constructivist learning environment encourages the application of knowledge in different and real life situations. Simulation of real life cases should be part of lessons and students should be given time to complete assignments and projects that use real life applications and knowledge. This leads to development of meaning and



contextualization of information (Smart & Cappel, 2006). Constructivist learning environment motivates the students to use their knowledge to solve problems that are meaningful and realistically complex. The problems provide the context for the learners to apply their knowledge and take ownership of their learning. Good problems should stimulate the exploration and reflection necessary for knowledge construction (Tam, 2000). Lastly the constructivist learning environment gives the learners the time and opportunity to reflect on their learning process.

The implication of this theory to the study offer chances to the Biology teacher to analyze student misconceptions and help the students to learn successfully permitting individual learning of Biology ideas since past information and encounters will decide the student's achievement. It also empower the educators to play a critical in helping learners on the best way to learn when Computer Assisted teaching strategy is utilized therefore a meaningful learning will occur. Students are able to refine their thinking by being given as many opportunities as possible and to apply their newly gained knowledge (Tien Wu & Chin-Chung Tsai 2005). Since this theory lays a lot of emphasis on the active role of the student during the time spent developing their own knowledge when computer assisted teaching strategy is utilized as a part of classroom that it empowers an intelligent learning process consequently it is a learned centered. This theory also encourage student's prior knowledge as well as encourages the teacher to spend more time on student favorite topics allowing the teacher to focus on important relevant information making students learn better in hands on environment. Therefore this theory was found fit for the study because CATS is interactive and thus can enable students to control the pace and sequences of learning.

### **2.8.2 ARCS model of Motivation**

Attention, Relevance, Confidence and Satisfaction model of motivation founded by John Keller (1988), was grouped in expectancy value theory. That explains that people will be motivated towards goals if they believe that there is a positive correlation between effort and performance, the outcome of favorable performance will result in desirable reward, a reward from the performance will satisfy an important need to make the effort worthwhile (Vroom, 1964). According to Keller ARCS model is a system for improving the motivational use of instructional materials

by instructor and the way in which lessons or modules and courses are designed that comprises a set of strategies that can improve motivational appeal of instruction.

Many studies have shown the effect of this model when it is applied in the classroom (Chyung, 2001). According to Chyung (2001) on systematic and systemic approaches to reducing attrition rates in online higher education exploring the reasons why students dropped out of an e-course, and tried to find solutions to the problem encountered. Students dropped out of the course for the following reasons: students were not interested in the course content; students were not confident in the e-learning environment; and students were not convinced of the effect of education in an e-learning environment. To overcome these obstacles, Chyung applied the ARCS motivational model to make the course more interesting and relevant to students' concerns, which increased the students' confidence and conviction in the course. The study results showed that the students became more confident and convinced of the relevance of the course, which was reflected in their academic results.

According to Gabrielle (2003) on an investigation on the effects of technology-mediated instructional strategies on motivation, performance, and self-directed learning in military college, the control group was taught using the traditional lecture method, whereas the experiment group used courses designed according to the ARCS model, where educational subject matter included motivational messages and examples from real life. The study results showed a high level of motivation in the experimental group.

The ARCS model is based on four main pillars, the first three of which (attention, relevance, and confidence) are important in creating motivation to learn, and the fourth (satisfaction or conviction) is important to make learners feel confident and satisfied with what they have learned. The ARCS model is most applied guideline for developing effective motivation strategies (Keller, 2001). The four elements form the Acronym of the model stands for Attention, Relevance, Confidence, and Satisfaction (ARCS). This model is based upon the idea of four steps in instructional design process in the learning processes that encourages and sustain learner's motivation.

The first aspect of attention, is defined as student willingness, need, desire and compulsion to participate in learning and to be successful in learning process (Fair Brother, 2000). According to Keller (2010) suggested several strategies to get students' attention and keep it, including instigating unexpected events during the class, or starting the lesson with a problem relevant to the students' lives. This enables the learners gain attention a prerequisite for learning and sustain it throughout the instruction, attention include human characteristics such as curiosity and sensation seeking. In order to draw learners attention specific activities are carried out to avoid boredom, this activities are group into perceptual arousal curiosity or by inquiry arousal.

Perceptual arousal curiosity is the first step in attention process attained through using surprises or uncertainty to gain the interest. However, for the inquiry arousal the learner curiosity would be stimulated by changing problems that could be solved in order to grab and hold learners attention using variety of methods. This method include; active participation of learner through games, role play and other hand practices that encourage learners to become active participants in the learning process making them to be interested in the computer assisted teaching content and engaging the learners in a problem solving experiential situation and by using of questionnaires techniques. These motivational strategies help students develop interests in the course and a positive expectation of success. (Keller & Deimann, 2005).

The second aspect is relevance, relevance is a powerful that determining that a person is motivated to learn, according to Keller (2001) relevance of a successful e-learning course design must be established in order to motivate the learner, to accomplish this, e-learning professional are encouraged to use language analogies or stories that relate. Therefore, a successful instructor is able to build bridges between the subject matter and the learners' needs in order to achieve the set goals. Keller suggested the following on relevance that motivates the learners: Linking the previous experiences, allowing learners to establish connection of the new information presented and what they already know from the previous experiences. This is because it gives learners a sense of continuity that keeps the learners being motivated as it makes them realizes that they really expanding their knowledge. Learners should be allowed to make

choices upon their own motivational strategy is another factor that increases motivation this will enable the learners to know exactly what they want to learn and how.

Third aspect of motivation is confidences; instructional designers should instill a sense of confidence in the learners by helping them to believe that they can achieve their goals. Confidence comes from meaningful success but the success is unable to guarantee the learners to enjoy the psychological experiences of challenging difficulties (Molace & Dortaj, 2014). This will help the students understand their likelihood for success, if the learners feel that they cannot meet their goals, their motivation will decrease. The instructional design then should provide objectives and prerequisites in order to enable the students to estimate the probability of success by presenting the requirements and the criteria to be used in evaluation. Learners should be encouraged to take self-steps on immediate feedback from their progress in the learning process by allowing them to asking and answer questions during the lesson that will motivate them by helping them to believe in themselves. (Keller, 2001).

The fourth aspect of motivation is satisfaction, it emphasizes on the contribution of feeling satisfied after learning experiences in order for motivation to continue and make learning to be satisfying in some way. Learners should be proud and satisfied of what they have achieved through the learning process by providing opportunities to use the newly acquired knowledge in a real life setting. According to Keller (2001) strategies should be adopted towards this direction include: praises or rewards, learning process must present the learners with some small kind of rewards whether they may be a sense of accomplishment or praise from the trainers or facilitators.

This theory will be significant to the study since it enable the instructor to understand student personal motives structure that leads to the development of compatible learning environment, it also enables the teacher to set goals for themselves for achievement and liked to control the means by which goals can be obtained. This theory also enable the learner to know what is expected of them thus instills confidence and motivation to engage in learning activities when they perceive improvement in the mastery of the content taught. Further ARCS model offers

teachers for effective operation to promote learning motivation and guide on how to incorporate such strategies into formal curricular and teaching design (Maeng & Lee, 2015).

## 2.9 Conceptual Framework

Student academic achievement and motivation in biology is a dependent variable influenced by the mastery of biology content and managed by the method of instruction that is an independent variable adopted in teaching and learning of the subject. The relationship of the study variables were explained in the conceptual framework shown in Figure 1.

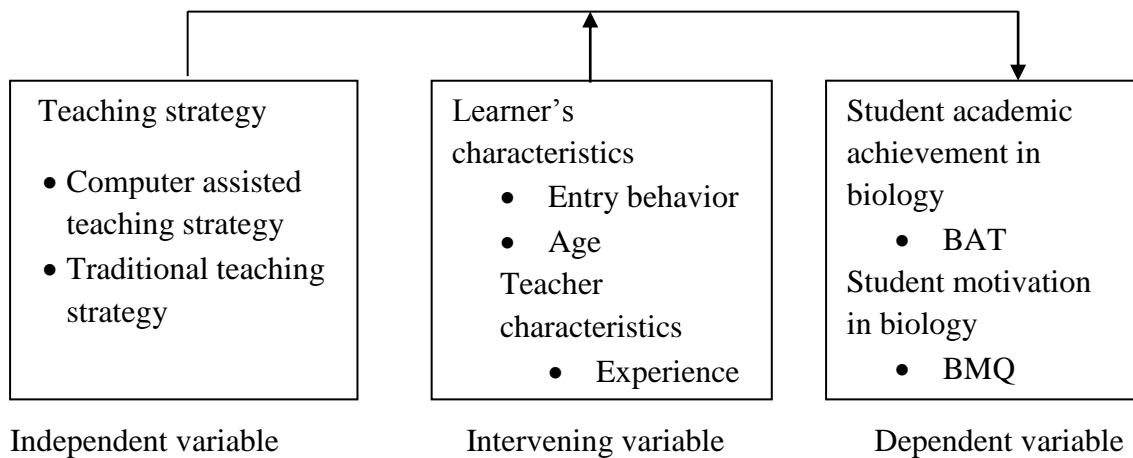


Figure 1: Relationship between Computer Assisted Teaching Strategy and Student Academic Achievement and Motivation

The independent variable include, Computer assisted teaching strategy and traditional teaching strategy, these variables are considered as factors that influenced the dependent variable in the study. The independent variable was manipulated during the study in order to determine its effect on the dependent variable. However, the intervening variables that may influence the independent and dependent variable that the researcher may not be aware of their existence nor has no control over them, these include; student entry behavior, age and teacher experience. Learner's characteristics, the variable on entry behavior were control by selecting schools that had comparable KCSE performance index for initial differences in student entry behavior. Age was control by selecting students of approximately the same age. Teacher characteristics was controlled by using teachers how have been teaching biology in secondary school level for at least three years and competent in using computer.

## CHAPTER THREE

### METHODOLOGY

#### 3.1 Introduction

This chapter deals with the research design, the location of the study, sampling procedure and sample size, research instruments, reliability, validity, ethical consideration, data collection procedures and data analysis.

#### 3.2 Research Design

The research design for this study was quasi-experimental research and in particular Solomon Four Non-Equivalent control Group design. This design was employed for the study because the participants selected were intact classes existing in secondary school, therefore not possible to assign individual participants randomly into experimental and control groups. The design aimed at accomplishing the four primary purposes: To evaluate the impact of experimental treatment with respect to control condition, to survey the communication between pre-test and the treatment condition, to evaluate the effect of pre - test in respect to no pretest and to evaluate homogeneity of the gatherings before organization of the treatment (Mugenda & Mugenda, 2003).

In this study, the experimental and the control group were randomly selected. A pre-test and post - test was administered to the experimental and control groups. This design enabled the researcher to control and measure the main effect of testing. The design is illustrated below:

Group I	(E1)	O <sub>1</sub>	X		O <sub>2</sub>
Group II	(C1)	O <sub>3</sub>	—		O <sub>4</sub>
Group III	(E2)	—	X		O <sub>5</sub>
Group IV	(C2)	—	—		O <sub>6</sub>

Solomon's Four Non-Equivalent Control Group Design:

O<sub>1</sub> and O<sub>3</sub> is the pre-test while O<sub>2</sub>, O<sub>4</sub>, O<sub>5</sub> and O<sub>6</sub> are the post-test and X represents the treatment where learners were taught using computer assisted teaching strategy in the sub topic cell division. Group I was experimental group (E1) that received pre-test,

treatment, and post-test. Group II control group (C1) that received pre-test followed by control condition then post-test. Group III were the experimental group (E2) that received treatment followed by the post-test. Group IV, the control group (C2) that received a post-test only. C1 and C2 were taught using traditional teaching strategies. The experimental groups were taught using computer assisted teaching strategy while the control groups were taught using traditional teaching strategy.

The experimental group comprises of 4 public secondary school randomly selected from 8 extra-county public secondary schools which were purposively selected for the study because the schools had computer for integration of teaching and learning. The schools which took part in the experimental instruction include 2 boys secondary school with participants (n=64) and 2 girls school with participants (n=99) the total number of participants in the experimental instruction group were 163 students. Activities of the experimental group formed the focus of the study. The participants in the experimental group used the computer assisted teaching manual prepared by the researcher to guide in the delivery of the content.

Control group were the participants who took part in traditional teaching strategy, the group comprises of 4 secondary schools which were randomly selected and assigned as control group, this consist of 2 boys secondary school with participants (n=80) and 2 girls secondary schools with the participants (n=81) and a total of 161 students participants. The control group adopted direct instruction strategy like lecture, demonstrations, and discussion.

### **3.3 Location of the Study**

The study was conducted in Baringo County, which is one of the counties in Kenya with a variety of schools; extra-county schools both mixed and single, private schools, county, sub-county, and National schools for the study to be conducted. It has consistently posted poor results in KCSE science especially in biology, which was a representative sample of the whole country. Extra-County schools with computer were chosen for the study

### 3.4 Population of the Study

The population of study comprises of all secondary schools Biology students in Baringo County. The accessible population was Form Three Biology students from 85 extra-county secondary schools in Baringo County. Extra-county schools were preferred because they have a wider catchment area in enrolling students their admission criteria are uniform with comparable academic abilities hence suitable for study. The target population was 7,650 Form Three Biology students because the topic of reproduction is taught in form Three syllabus.

### 3.5 Sampling Procedures and Sample Size

A sample is a small portion of a target population. According to Mugenda (2003 ) define a sample as a small group from the accessible population. Sampling means a given number of subjects from a defined population and a fair representative of that population statement made about the sample (Orodho, 2002). Purposive sampling was used to select extra-county public secondary schools in Baringo County with computer for integration of CATS in classroom. The sample schools were divided into two strata; Boys only and girls only. Stratified random sampling method was used in selecting sample schools. This method was done by balloting that involves assigning numbers to the schools. Numbers were written on a small piece of papers folded and placed in different boxes representing the stratum. The researcher picked randomly the eight schools in equal ratio as of four boys, four girls as shown in the sampling grid Table 2.

Table 2: Sampling Grid Table

School type	Number of school	Sample school	Total population	Student		
				Experiment Group	control group	Total
Boys only	38	4	145	64	80	144
Girls only	47	4	179	99	81	180
Total	85	8	324	163	161	324

In selected schools with more than one stream, Simple random sampling was used to sample Form three biology students, assign them experimental, and control group. This was done to limit biasness and all the selected schools are offered equal time to



participate in the study simple random sampling was used to select a particular stream for data analysis. The respondents who participated in the study were 324, these subjects were in four intact classes in the eight schools that were randomly assigned to experimental and control groups.

### **3.6 Research Instruments**

The instrument that were used for collecting data include, Biology Achievement Test (BAT) that was used to evaluate learners' achievement and Biology Motivation Questionnaires was used to assess learners' motivation towards Biology.

#### **3.6.1 Biology Achievement Test (BAT)**

The Biology Achievement Test was used to assess learners' mastery of content and to measure student achievement in Biology in the sub-topic cell division. The BAT test consisted of items covered in the sub-topic cell division during the study. The content of the test was mitosis and meiosis cell division. Short answered questions and structured questions on the topic covered consisting of 10 items was used. The items tested knowledge, comprehension, and application of the learned material with the total possible score of 30 marks. The test was used interchangeably; the pretest was reorganized and used as posttest that was administered at the end of the treatment. This pretest was administered to the experimental (E1) and the control group (C1) before the beginning of the lesson and posttest was administered to all groups after the course. The pretest sought to test the student mastery and understanding this was the focus of the study. The test was piloted using secondary school, which had similar characteristics as the sample schools from Baringo sub-county this was used to determine the reliability. The items were scored using a standardized marking scheme and the obtained score were recorded and analyzed.

#### **3.6.2 Biology Motivation Questionnaires (BMQ)**

Biology motivation Questionnaires was used to assess student motivation towards Biology when taught using computer assisted teaching strategy. The Questionnaires was made up of 30 items developed utilizing Five point Likert scales extending from strongly Agree with score of 5 points and strongly disagree with a score of 1 points where the Students were required to state whether strongly Agree (SA), Agree (A),

Undecided (U), Disagree (D), or strongly disagree (SD). The higher number of the scale represents an agreement with the item on the scale. In this study a perception of the student was taken to be a measure along the continuum from the strongly negative to a strongly positive effect.

### **3.7 Reliability**

Reliability is concern with the degree to which a particular measuring procedure gives an equivalent result over a number of repeated trials (Orodho, 2003). The test items were piloted randomly in two selected secondary schools in Baringo County with the respondents of similar characteristics. The schools that were involved in the pilot study were not included in the major study in order to prevent contamination of the study subjects. This is to enhance reliability and help to verify the time allocated to the test items and determine any ambiguity in the biology questionnaires. The Split-half method was used to determine the reliability of the instruments. This was done by scoring odd and even numbers of the test items separately for the students who participated in the pilot study, and then a correlation coefficient was determined using Cronbach coefficient alpha that was used to calculate the reliability coefficient of the whole items. The Reliability coefficient for the instruments was 0.704 and 0.709 for BAT and BMQ respectively with overall reliability coefficient being 0.706 this was far above the minimum acceptable reliability coefficient of 0.7. Therefore, the instruments were appropriate for the study.

### **3.8 Validity**

Validity is concerned with the degree to which an empirical measures or several measure of concepts actually represents that particular concepts (Orodho, 2003). Validity is an indication of the extent to which the results obtained during the study will be a true reflection of what is real. According to Mugenda and Mugenda (2012) content validity is concerned with whether or not a test or measuring instrument is a representation of the full content of the concept being measured. In order to achieve this, Content validity of BAT was established by using the table of specification after which the biology teachers were used to ascertain the content validity of biology test. Expert opinions help to establish content validity. The researcher sought assistance from supervisors and experts from faculty of education to

assess the validity of BMQ. Face validity was determined by presenting the research instruments to KCSE biology examiners in secondary school and to judge the extent to which the items purports to measure what is intended to measure.

### **3.9 Data Collection Procedures**

The researcher obtained an introductory letter from Chuka University Ethic committee and a research permit from National Commission for Science Technology and Innovation (NACOSTI). The researcher sought permission from the County Director of Education, Baringo County to be allowed to conduct the study and the intention to carry out the research was communicated to all principals of all sampled school and seek permission and create a good rapport with the school administration and the teachers. The researcher visited selected sampled schools to seek permission, and to be introduced to the students and their teachers. The teachers on the experimental group were trained on how to use CAT using a manual for instructional this is to enable them to master their skills of using CAT as a teaching strategy. The experimental groups were taught using CAT as outlined in the training manual while the control group were taught using the traditional teaching strategy with the both group being taught by the regular teachers.

The topic of instruction was sub topic cell division. All the teachers in the sample school used a common implementation schedule prepared by the researcher. Before the commencement of the study experimental group (E1) and control group (C1) were given a pretest, followed by two weeks intervention of CAT strategy. Treatment was administered to two experimental groups (E1) and (E2) computer assisted strategy while the control groups (C1) and (C2) traditional teaching strategy will be BAT test in all the four groups on the sub-topic cell division and BMQ. Data was collected by using Biology Motivation Questionnaires (BMQ) and Biology Achievement Test (BAT) that was administered to the experimental group and the control group then followed by scoring and coding for data collection and analysis.

### **3.10 Ethical Considerations**

According to Shah (2011) Ethics is a code of conduct or expected behavior while conducting a research. The ethical principle was observed during study, that were

related to the researcher as the person conducting the study, and respondent who were aware of his/her obligations and responsibilities. The second levels of ethics were related to the respondents of the study who need to be aware of their basic rights protected during the research process. There was need to explain the nature of the study to all respondents, once the researcher fully explained the nature of the study, the participants were asked to provide consent of their willingness to participate to the study. The researcher informed the respondents of the right to take part in the study and their freedom to withdraw at any step of the study and also assured them of their confidentiality of the data collected and treated.

### **3.11 Data Analysis**

The data collected was scored, coded, and organized for analysis. Descriptive statistics (mean, standard Deviation and percentage) and inferential statistics (ANOVA and t-test) were used to analyze the data and test the research hypotheses. ANOVA was used to analyze the differences in the four means and help to establish whether there is a significant difference among the four groups. While the t-test was used to get the difference between the two means that are the control group and the experimental group. T-test was also used to test for the different groups and between genders of the students. In both ANOVA and t-test it was pre-determined at  $\alpha=0.05$  significance level in order to reject or accept the null hypotheses that postulated equally or non-significant differences between the groups. The data from the study was analyzed with the aid of Statistical Package for Social Sciences (SPSS) version 24.

The statistical analysis that was used to test the hypotheses are summarized in Table 3.

Table 3: Summary of Data Analysis Technique

Hypotheses	Independent variable	Dependent Variable	Statistical Test
H <sub>01</sub> : There is no statistical significant difference in student academic achievement in biology between student taught using computer assisted teaching strategy and when taught using traditional teaching strategy in Baringo County.	CAT teaching strategy Traditional teaching method	Achievement	t-test
H <sub>02</sub> : There is no statistical significant difference in student's motivation in biology between student taught using computer assisted teaching strategy and when taught using traditional teaching strategy in Baringo County.	CAT teaching strategy Traditional teaching method	Motivation	ANOVA
H <sub>03</sub> : There is no statistical significant gender difference in student academic achievement in Biology when taught using computer assisted teaching strategy in Baringo County.	CAT teaching strategy Traditional teaching method	Achievement	t-test
H <sub>04</sub> : There is no statistical significant gender difference in student motivation in Biology when taught using computer assisted teaching strategy Baringo County.	CAT teaching strategy Traditional teaching method	Motivation	ANOVA

## **CHAPTER FOUR**

### **RESULTS AND DISCUSSION**

#### **4.1 Introduction**

In this chapter, the results, presentation of the discussions and explanations of the research findings on data analysis including questionnaire analysis and summary of information presented in frequency tables. This chapter is organized in sections that include: Respondents demographic information, effect of computer assisted teaching strategy on student academic achievements, effect of computer assisted teaching strategy on motivation to learn biology, academic achievements of boys and girls who were exposed to computer assisted teaching strategy and student motivation of boys and girls who were exposed to computer assisted teaching strategy.

#### **4.2 Respondents' Demographic Information**

In this section, the researcher analyzed the demographic information of the respondents. This included the gender of the students. The reporting on the distribution of the respondents by gender was collected from the control and experimental groups and the results are presented in table as per the experimental and control groups.

Table 4: Gender of the Respondent

Gender	Experimental		Control	
	F	%	F	%
Male	64	39.3	80	49.7
Female	99	60.7	81	50.3
Total	163	100.0	161	100.0

The Table 4 indicates that 39.3% of the sampled students exposed to treatment were male, and 60.7% of the respondents were female. On the other hand, 49.7% of the students exposed to the traditional strategy of teaching were male and the remaining 50.3 % of the sampled students were female.

#### **4.3 Effect of Computer Assisted Teaching on Academic Achievement in Biology**

Objective one of the study sought to determine the effect of Computer assisted teaching strategy on academic achievements among the participants in different categories. The researcher issued Biology Assessment Test (BAT) questions in

subtopic cell division in order to ascertain the knowledge of students, comprehensiveness, and application of the learned skill in the topic in answering the questions.

The respondents were first given a pre- test. The respondents were then assigned into control groups and experimental groups and taught the subtopic cell division using CATS for the experimental groups and traditional method for the control groups. The experimental group one and control group one pretest was administered this was necessary because it enable the researcher to assess the similarity of the groups before administration of the treatment and to assess the effects of the pretest relative to the no pretest. Finally, their mastery of the topic was assessed using a post- test. The pretest and posttest results of the group participants were analyzed and presented by use of descriptive statistics of mean and standard deviation values. The pretests mean score on BAT for experimental and control groups one results were presented in Table 5

Table 5: Student Pretest Mean Score on BAT for Experimental group one and control group one

Pretest Group	N	Mean	Std. Deviation
Experimental (E1)	82	5.96	3.760
Control (C1)	74	11.34	6.779

The results indicated the performance of control group one and experimental group one before the treatment was administered. The results indicate that the pretest mean score of experimental group one was 5.96 with a standard deviation of 3.760. The control group one had a pretest mean score of 11.34 with a standard deviation of 6.779.

To test whether the pretest mean score were significantly different, a t-test was used. The results are shown in the Table 6

Table 6: t-test of Pre-test scores on BAT for experimental group one and control group one

Pre test group	T	df	Sig. (2-tailed)
Experimental (E1)	14.364	81	.121
Control(C1)	14.296	73	.118

The results presented in table 6 shows no significant difference in the pretest mean scores of control group one (C1) and experimental group one (E1),  $t(81) = 14.364, p=0.121 > 0.05$ ,  $(C1), t(73) = 14.296, p=0.118 > 0.05$ . The  $p(0.121)$  and  $p(0.118)$  is greater than 0.05 hence the difference in the pretest mean score is not significant. This means that these groups had comparably close means thus contained learners with similarly comparable characteristics suitable for the study. Therefore the academic achievement in biology prior to the administration of CATS were similar for experimental and control groups. The two groups were equivalent hence suitable for the study.

Further the researcher sought to ascertain the mean difference in student academic achievement BAT by comparing the posttest mean score for both experimental and control group one. The student posttest mean scores on BAT are presented in Table 7.

Table 7: Posttest Mean Score on BAT for Experimental group one and control Group one

Group	N	Mean	Std. Deviation
Experimental group	82	15.23	3.325
Control group	74	11.20	2.321

The results indicated the performance of control and experimental groups after the treatment was administered. The results indicated that the posttest mean score of experimental group was 15.23 with a standard deviation of 3.325. The control group had a posttest mean score of 11.20 with a standard deviation of 2.321. From the findings, it was evident that the mean score of students under experimental group one



was higher than that of control group one after the treatment was administered to the experimental students.

A t-test analysis was carried out on the disparity brought out by the computer assisted teaching strategy on the student's performance in biology subject. This helped the researcher to bring out the statistical difference of the posttest mean scores between the two groups of the students. The results were presented in the Table 8.

Table 8: t-test of Posttest Scores on BAT for Experimental group one and Control Group One

	T	Df	Sig. (2-tailed)
Experimental group one (E1)	27.129	81	.000
Control group one (C1)	17.896	73	.000

\*denotes significance at  $\alpha=0.05$

The results presented in table 8 shows a significant difference in the posttest mean scores of control group one (C1) and experimental group one (E1). The obtained t-value (E1)  $t(81) = 27.129$ , (C1)  $t(73) = 17.896$  and  $p=0.000$ . The  $p(.000)$  is less than 0.05 this means that the difference in the posttest mean scores is significant. Therefore, the hypothesis  $H_{01}$  was rejected that states that there is no statistical difference on student academic achievement in biology when taught using computer assisted teaching strategy (CATS). This means that there is statistical significance on student academic achievement when taught using CATS since the mean score of students taught using computer assisted teaching strategy of instruction tend to perform better than those exposed to traditional method of teaching.

Findings of the present study are consistent with those of Kibos, Ndirangu and Wekesa (2004), on the effect of computer mediated stimulation on biology on student learning outcomes. The study showed that the mean scores of the participants in the treatment group in the treatment group that were exposed to computer-mediated stimulation were significantly higher than those who were exposed not exposed to computers. The results from the study indicate the mean difference between the experimental and the control group were statistically significant in favor of the experimental group therefore the study concluded that the use of computers mediated

stimulation programme was effective than traditional teaching method. This findings are in consistent with those of Yusuf and Afolabi (2010); Kevogo, Toili and Mutsotso (2013); Kiboss and Tanui (2013); Orora, Keraro and Wachanga (2014) and Wekesa, D., Wekesa, E. and Amadalo (2013). Their findings concluded that the use of computer assisted learning positively impacts learner's achievement.

Findings of the study agree with the findings of Serin (2011) on the effect of computer-based instruction on achievement and problem solving skills of science and technology students in Turkey. The results from the study indicated a statistical significant increase in the achievement and problem-solving skills in students in the experimental group that received computer based science and technology instruction. Therefore computer assisted teaching strategy has proven to improve student achievement.

Zupanec (2013) also reported similar findings on a study conducted to investigate the effect of computer assisted learning in biology teaching in primary school in Serbia. The experimental group that learned biology content (Chordata) using CAL, while the pupils in the control group learned the same content using traditional teaching method. The analysis of the result of the posttest and retest showed that pupils from the CAL group performed significantly better than the control group.

Another study agreeing with the findings of the study was carried out by Pinkal, (2013), on a study conducted in India on use of CAI and its effect in development of instructional Strategy for Biology Teaching. The experimental groups were taught using the CAI while the control groups were taught using conventional method. The results from the study reveal that the experimental group performed better than the control group. Therefore, the study reveals that the use CAI improves academic achievement of students in biology subject compared to conventional strategy.

Findings of the present study are consistent with Kausar (2008) on a study conducted on a comparative study to evaluate the effect of computer-assisted learning versus classroom lecture for computer science. The study concluded that, the experimental group taught using computer assisted learning performed better than the control group

taught using classroom lecture method. Therefore CAL was proved to be very much effective in increasing the evaluation and application skills of students to experimental group, experimental group were motivated and ready to learn each day of experimental duration of CAL treatments than students of classroom lecture treatments.

Mahmood (2004) also reported similar findings on a study conducted on CAL and traditional method of instruction, the study examined the effect of computer-assisted learning on student achievement in general science as compared to traditional method of instruction. The result revealed that the experimental group outperformed the control group in all achievement areas that is overall, by levels of cognitive domain and by type of content and students had interest on CAL program and benefited from it.

Another study agreeing with the findings of this study was carried out by Etukudo (2003), in an investigation on impacts of computer assisted learning (CAL) on Nigerian secondary school learner's execution in Mathematics. The results from the study reveals that experimental group that learned mathematics content using CAL performed better than the control group that were taught using the traditional techniques of teaching. The experimental group posted a higher mean score than the control group this results indicated the mean difference between the experimental and control group. Therefore the results demonstrated that performance of learners presented to CAL were superior to their partners presented to the traditional teaching techniques.

Findings similar to the present study was reported by Owusu Monney and Appiah, (2010) on an investigation on the effect of computer assisted instruction in performance of senior high school biology students in Ghana .The experimental group learned science concept cell cycle through the use of CAI whereas the control group were taught the same concept by conventional approach, the result indicated that students that were instructed by conventional approach performed better on posttest than those instructed by CAI, however the performance of lower achievers within the experimental group improved after being instructed by CAI.

The finding of the study corroborates that of Akçay *et al.* (2006) who assessed the effect of CAL on achievement and attitude of college students in analytical chemistry and found that achievement of experimental groups was significantly higher than those from the control group. Similarly, Garanga *et al.* (2012), Dasdemir *et al.* (2008), Hailegebreal (2012), Frailich *et al.* (2005) and Nduati (2015) showed that when CAL is used to teach acids and bases, electrochemistry and carbon and its compounds respectively, the post-test scores were statistically and significantly different in favour of experimental group indicating that integration of CAL enhances students' understanding of chemistry concepts thus enabling students exposed to the teaching method to perform better. It also agrees with Ozmen (2008) who postulates that teaching-learning of topics in chemistry related to chemical bonding can be improved by the use of computer-assisted teaching materials.

The findings of the present study also agree with the findings of Nduati (2015), on the effect of CAL on secondary school student achievement in chemistry. The findings showed that when CAL is used to teach acids and bases, electrochemistry and carbon and its compounds respectively, the post-test scores were statistically and significantly different in favour of experimental group indicating that integration of CAL enhances students' understanding of chemistry concepts thus enabling students exposed to the teaching method to perform better than those taught using conventional methods. These results augur well with observations of researchers such as Okere (2014), Jesse, Twoili and Mandu (2014) on a study carried out on enhancement of science through computer assisted instruction among selected secondary school learners in Kenya the findings showed that CAI improves learners performance in science in secondary schools in Kenya.

#### **4.4 Effect of Computer Assisted Teaching Strategy (CATS) on Students' Motivation in Biology**

Objective two of the study sought to determine whether there is an effect of using computer assisted teaching strategy on motivation in biology among students. In the study motivation referred to the desire and interest that the learners have in biology. In order to measure motivation in biology the students were asked to respond to items in BMQ questionnaires. The BMQ had 30 items with each item rated on a five point

Likert scale ranging from: Strongly Agree(SA)=5, Agree(A)=4, Undecided(U)=3, Disagree(D)=2, and Strongly Disagree (SD)= 1.

#### 4.4.1 Students' response on Learning Biology using Computer Assisted Strategy

The questionnaires were administered to the experimental group to find out their response on student's motivation in learning biology using computer assisted teaching strategy. The researcher issued questionnaires to experimental group only. The responses that were specifically on student motivation on the use of computer assisted teaching method were selected and analyzed. The results were presented in Table 9

Table 9: Students' Responses on Computer Assisted Teaching Strategy

Statement	Mean	Interpretation
Learning biology using computer is Fun	2.6125	Not sure
Learning biology was enjoyable when using computer	2.7346	Not sure
I find biology easy to understand when using computer	3.2342	Not sure
Learning biology was exciting when using computer	3.5864	Agree
I understand everything that the teacher teaches when using computer	3.7516	Agree
Learning biology is stimulating when computer was used	1.6460	Strongly disagree
I easily remember what I learn Biology when computer was used.	4.3134	Strongly Agree
Biology lesson was pleasing when computer was used	2.3890	Disagree
I can follow biology lesson easily when computer is used	1.3921	Strongly disagree

Source: Researcher (2018)

Key: 1-1.79-strongly disagree, 1.8-2.59-Disagree, 2.6-3.39- Not sure, 3.4-4.19-Agree, 4.2-5.0, strongly agree.

The findings from the table reveals that, the students were not sure as to whether learning biology using computer assisted teaching method was fun, enjoyable and easy to understand. On the other hand, the students agreed that learning biology using computer assisted teaching method was exciting and it was easy for them to understand what was taught. They also strongly agreed that when taught using computer assisted teaching method they could easily remember. The students strongly

disagreed learning biology using computer assisted teaching method was stimulating and they could easily follow the lesson.

#### 4.4.2 Post-test mean Scores on BMQ

After intervention, the BMQ was administered to all the four groups as a post-test. The posttest Mean scores and standard deviation of four groups on motivation in Biology were summarized in Table 10.

Table 10: Posttest Mean Score Results on BMQ

Type of Group	E1	C1	E2	C2
N	82	74	81	87
Mean Scores	8.36	7.89	8.87	8.26
Std. Deviation	2.125	2.045	2.316	1.980

The results in the Table 10 indicates that the means score for posttest score of the experimental group one and group two were 8.36 and 8.87 respectively. The standard deviation for the experimental group one was 2.125 while the experimental group two had a standard deviation of 2.316. The two mean scores were compared and it was evident that experimental groups had a higher mean as compared to control groups one and two.

To further test for significance difference of their posttest, mean score, a one way ANOVA analysis was carried out to test the null hypothesis that stated that there is no statistical significant difference in student's motivation in biology when taught using computer assisted teaching strategy in Baringo County. The results were presented in Table 11.

Table 11: One Way ANOVA for Posttest Mean Scores on BMQ

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	20.591	3	6.4520	24.345	.000
Within Groups	75.714	321	1.244		
Total	98.673	324			

The obtained  $F = 24.345 < 2.00$ , and  $p < 0.05$ . The  $p$  (.000) is less than 0.05 so the difference is significant.  $F$ -critical (3,324) = 2.630 is greater than the obtained value.

Therefore, the null hypothesis  $H_0$  was rejected, that states that there is no significant difference in motivation in biology when taught using CATS strategy. This indicates that there is a statistically significant difference in student's motivation in biology when taught using computer assisted teaching strategy in Baringo County. This implies that CATS strategy is more effective than traditional teaching strategy in enhancing student motivation.

Findings from the study are consistent with the findings of Tanui, Kiboss and Nassiuma (2008) on the effects of Computer Based Instruction on student motivation and achievement in secondary schools business education in Kenya. The study showed that the student on experimental group had a higher rating on the nature on double entry account course in business studies than students in the control group.

Fedison and Bradic (2007) carried out a study on the effect of teaching with computer as a technology tool on motivation and achievement. The findings of the study concur with the findings of the present study. The study compared the motivation and achievement of middle level student in language and art classes in USA when taught using traditional methods and the use of computers. Findings of the study reveal that students who were taught by use of computers had a higher motivation to learn than those their counterparts who were exposed to traditional methods of teaching.

In another study, the findings of the present study concur with the findings of Owusu, Monney and Appiah, (2010) carried out a study on the effect of computer assisted instruction in performance of senior high school biology students in Ghana. The finding of the study reveals that with the utilization of CATS enhances learning through general positive motivational variables.

#### **4.5 Effect of Computer Assisted Teaching Strategy on Student's Academic Achievement Based on Gender**

Objective three of the study sought to determine whether there is effect on student academic achievement in biology based on gender when taught using computer assisted teaching strategy in Baringo County. The researcher used the Biology

achievement test to determine the achievement in biology based gender when exposed to CATS.

The researcher also compared the mean score of student's performance by gender before and after administering the treatment. This was to determine the significant difference in student achievement in Biology based on gender when taught using computer assisted teaching strategy Baringo County. The researcher administered a BAT pre-test to experimental and control groups involved in the study. The aim of the pretest was to ascertain whether the students selected to participate in this study had comparable characteristics before intervention. The findings from the analysis of pretest mean scores were presented in the Table 12.

Table 12: Pretest Mean Score Obtained by Students in BAT by Gender

Group	Gender	N	Mean	Std. Deviation
Experimental Pretest	Male	44	7.87	2.001
	Female	38	6.43	1.861
Control Pretest	Male	36	3.81	1.112
	Female	38	4.48	1.231

The results indicated the pretest mean score of biology based on gender for control and experimental group one category. Experimental group one (E1) mean score for boys was 7.87, standard deviation of 2.001 and that of girls was 6.243 with a standard deviation of 1.861. On the other hand, the pretest mean score of biology per gender on control group one (C1) pointed out that boys had a mean score of 3.81 with a standard deviation of 1.112. Girls had a mean score of 4.48 with a standard deviation of 1.231. The researcher also sought to compare the experimental and control group posttest mean scores results of students so as to ascertain the effect of the CAT strategy of teaching compared to the performance of students based on gender. The findings from the analysis were presented in Table 13.

Table 13: Posttest Mean Score Obtained by Students in BAT by Gender

Group	Gender	N	Mean	Std. Deviation
Experimental Posttest	Male	64	5.81	1.93
	Female	99	9.00	2.99
Control Posttest	Male	80	5.23	3.59
	Female	81	6.16	3.64



The result from Table 13 indicated the experimental and control group posttest mean score of biology based on gender. Experimental group (E1 and E2) the mean score of boys was 5.81 with a standard deviation of 1.93 and that of girls was 9.00 with a standard deviation of 2.99. On the other hand, the posttest mean score of biology based on gender for control group (C1 and C2) pointed out that boys had a mean score of 5.23 with a standard deviation of 3.59. Girls had a mean score of 6.16 with a standard deviation of 3.64.

Based on the findings, there was a significant difference in performance based on gender. The mean score of boys in the experimental group was 5.81 higher than that of boys in the control group of 5.23. On the other hand, the mean score of girls under experimental group was 9.00 higher than that of girls under control whose mean score was 6.16. This implied that those students exposed to CATS perform better than those exposed to traditional teaching strategy do. However, this requires a substantive justification. Therefore, in order to accept or reject the stated hypothesis that there is no statistical significant difference in student academic achievement in Biology based on gender when taught using computer assisted teaching strategy in Baringo County, a t-test was carried out. The results of analysis are presented in the Table 14.

Table 14: t-test Results of Posttest Mean Score Obtained by Students by Gender exposed to CATS

	N	Mean Difference	SD	t-value	Df	p-value
Males	163	14.81	6.016	1.531*	161	0.201
Females	161	11.39	4.429			

\*denotes the smallest value of  $\alpha=0.05$

The Table 14 indicated the significance test of the mean difference of mean score of students exposed to computer assisted teaching strategy (CATS) and traditional method of teaching. The posttests mean score for boys is 14.81 while for girls is 11.39. The findings indicated that the t-value = 1.531,  $p>0.05$  which is indicative of that there is no statistically significant difference in the achievement in Biology subject between boys and girls when exposed to Computer Assisted Teaching Strategy. Therefore the study null hypothesis  $H_{03}$  was accepted, which states that

there is no statistical significant difference in student academic achievement in biology based on gender when taught using computer assisted teaching strategy.

Findings of the present study also concur with the findings of Gambari (2014), on a study on effect of computer animations and geometrical instructional model on mathematics achievement and retention among the junior secondary school students in Minna, Nigeria. The study examined the influence of gender on achievement of students taught geometry with computer animation packages and geometry instructional model respectively. The findings from the study showed that there was no gender effect on the achievement of males and females students taught geometry using computer animations and geometry instructional model. Therefore, this implies that irrespective of the instructional method, male and females students benefit equally.

The findings of the present study contradict the findings by Olumide (2013), on a study on computer simulation and packages and gender predictors of student achievement in biology. The main objective of the study was to determine the student academic achievement in biology when exposed to computer simulation packages in teaching of genetics in secondary school. The study reported a significant effect on gender on student academic achievement in biology when taught using computer assisted teaching strategy. Male students attained significantly higher scores in biology than females after being taught genetic using computers simulations.

Findings from the present study also contrast the findings with those of Kiboss, Ndirangu and Wekesa (2004) on effect of computer mediated simulation program in school Biology on pupils learning outcomes in cell theory. The study findings showed no relationship between the participant's gender and the learning outcomes. This finding also concurs with those of Chinywe and Chinyere (2010) who reported that there was no gender effect on academic achievement in basic ecological concept in biology.

#### 4.6 Effect of CATS on Students' Motivation in Biology based on Gender

Objective four sought to determine whether there was effect on student motivation in biology based on gender when taught using computer assisted teaching strategy in Baringo County. In order to measure motivation in biology based on gender the students were asked to respond to items in BMQ questionnaires. The BMQ had 30 items with each item rated on a five point Likert scale ranging from: Strongly Agree (SA)=5, Agree(A)=4, Undecided(U)=3, Disagree(D)=2, and Strongly Disagree (SD)=1. BMQ mean scores for male and female students were computed and compared to determine whether there were significant differences. The mean rating score of all the responses were used to calculate the mean score of a particular group based on gender. The information was analyzed and findings presented in the Table 15.

Table 15: Pretest Mean Score Obtained by Students in BMQ by Gender

Group	Gender	N	Mean	Std. Deviation
Experimental Pretest	Male	64	8.92	3.026
	Female	99	7.55	2.990

The results indicated the pretest mean score of BMQ by gender for the experimental group. Experimental group mean score for boys was 8.92 with standard deviation of 3.026 and that of girls was 7.55 with standard deviation 2.990. The researcher also sought to compare the pretest mean score experimental group with posttest experimental and control group in order to ascertain the effects of CATS on student motivation based on gender. BMQ posttest result based on gender was analyzed and findings presented in table 16.

Table 16: Posttest Mean score obtained from BMQ results based on gender

Group	Gender	N	Mean	Std. Deviation
Experimental Posttest	Male	64	5.81	1.93
	Female	99	9.00	2.99

The findings from Table 16 indicated that the mean score of boys exposed to CATS (Computer Assisted Teaching Strategy) was 5.81 with a standard deviation of 1.93 and that of girls was 9.00 with 2.99. It was therefore evident that girls were highly motivated in biology as compared to their counterpart boys when exposed to CATS. However, this finding was not sufficient to make a conclusion on the stated

hypothesis that there is no statistical significant difference in student motivation in Biology based on gender when taught using computer assisted teaching strategy Baringo County .The mean scores and standard deviation was used to provide distinct difference, which a one-way ANOVA test would qualify or disqualify.

In order to determine the whether there was a statistical significance in the mean difference, a one way ANOVA test was carried out and results presented in Table 16.

Table 17: A One Way ANOVA of Student Motivation Based on Gender

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2.624	1	3.426	0.786	.000
Within Groups	3457.246	162	28.985		
Total	3459.870	163			

The obtained  $F=0.786 < 2.00$  and  $p < 0.05$  and significance 0.000. F critical value (1,162) = 3.060 which is greater than obtained value this was an indication of statistical significant difference in student motivation in Biology based on gender when taught using computer assisted teaching strategy (CATS). Therefore, the null hypothesis  $H_{04}$  was rejected, that states that there is no statistical significant difference in student motivation in biology based on gender when taught using computer assisted teaching strategy, therefore this suggest that there is no significant effect on motivation in biology using the CATS based on gender.

Findings of the present study are consistent with the findings of Muchiri (2015), on a study on the effect of computer assisted teaching strategy on student achievement by gender in agricultural education in Tharaka Nithi County, Kenya. The study showed a significant difference in posttest mean scores in motivation to learn agriculture in boys and girls compared to pretest mean scores. The boys had a higher pretest mean score in motivation than girls this lead to significance difference existing between the two groups therefore there was statistical significance difference in boys and girls in motivation to learn agriculture.

Findings from the present study concur with the findings of Keraro, Wachanga and Orora (2006) on investigation on the effects of using the cooperative concept mapping

(CCM) teaching approach on secondary school students' motivation in biology. According to their study, there was no statistically significant gender difference in motivation towards the learning of biology among secondary school students exposed to CCM.

Findings of the present study contradict the findings with those of Koul, Roy and Lerdpornkulrat (2009) on an investigation on the relationship between students' perceptions of classroom learning environment and motivational achievement goal orientation towards Biology and Physics as well as the influence of gender. The findings indicated that there was a significant gender difference in favour of the females on a number of domains of motivation. Findings of the present study also contradict with the findings by Cavas (2011) on an investigation on factors affecting Turkish primary students' motivation towards science. The data were collected using Students' Motivation toward Science Learning Questionnaire. The findings of the study indicated statistically significant gender differences in motivation towards science. The female students were significantly more motivated than the male students in learning science with biology included.

Findings from the present study also contradict the findings with those of Shihusa and Keraro (2009) investigated the effect of using advance organizers on students' motivation to learn Biology from an experimental perspective in Bureti District, Kenya. Data were collected using the Student Motivation Questionnaire. The findings indicated that students taught using advance organizers had a higher level of motivation than those taught using conventional methods. Further the findings indicated that following the intervention, there was a significant gender difference in motivation to learn Biology with the male students having a higher level of motivation than the female counterparts.

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Introduction**

This chapter presents summary of main research findings, conclusions and recommendations for further research as discussed under the research objectives.

#### **5.2 Summary of Research Findings**

A summary of the findings of this study is based on the results in chapter four presented. The study findings showed a statistically significant difference in academic achievement in biology between the students exposed to CAT strategy and those taught using the traditional teaching strategy. Therefore, this indicates that CAT strategy is more effective than the traditional teaching strategy in improving the student academic achievement in biology. Student taught biology using CATS had a higher score in BAT as compared to those taught using traditional teaching strategy

The findings of the study showed a statistical significant difference in motivation in biology between the student taught using CATS and those taught using traditional teaching strategy. The results showed that CATS is beneficial in improving student motivation in biology. Students who were taught using computer assisted teaching strategy had a higher score on motivation towards biology than those taught using the traditional teaching strategy. There was a significant difference between the mean score on BMQ of student exposed to CATS and those exposed to TTS.

Results of the findings revealed that there was no significant difference on student academic achievement based on gender when exposed to CATS. Posttest mean score obtained from BAT indicated that there was no significant difference in achievement between male and female student who were exposed to CATS.

Findings of the study revealed that there was statistical significant gender difference in motivation in biology among students exposed to computer teaching strategy. A comparison of the posttest mean scores indicates that girls were highly motivate to learn biology as compared to the boys therefore this indicates there was a statistical significant differences in motivation in biology, further one way ANOVA tested

indicated that there was no gender difference in the level of motivation to learn biology at the end of CATS intervention.

### **5.3 Conclusions**

Results of the study indicated that the CATS strategy is beneficial since it improves students' academic achievement as compared to the traditional teaching strategy. Therefore, CATS can be used to supplement the traditional teaching strategy since it produces higher academic achievement than the use of traditional teaching strategy alone and students learn the instructional content faster and can retain what was learned better than the traditional teaching strategy. Therefore, there is a difference in achievement in biology between the student exposed to CATS and those exposed to traditional teaching strategy.

Findings of the study indicated that student taught using CATS had a higher motivation to learn biology than those taught using traditional teaching strategy. Therefore, when better method of instruction is applied, students' performance changes in positive as well.

The results of the study revealed that gender does not affect student achievement in biology when taught using Computer assisted teaching strategy. This indicates that CATS was effective in enhancing motivation of boys and girls.

The findings of the study indicated there was no gender difference in motivation to learn biology when students were taught using CATS; this means that the teaching strategy was equally effective in motivating both boys and girls.

### **5.4 Recommendations**

Based on the findings of the study, the following recommendations are made:

- i. Biology teachers should be encouraged to incorporate the use of CAT strategy in teaching biology in order to enhance teaching biology and improving academic achievement in biology. If biology teacher adopt the use of CAT strategy in their teaching this may improve performance in biology in KCSE.

- ii. Biology teachers should embrace the use of CAT strategy as a way of motivating students in order to have interest in the subject and improve academic achievement in biology

### **5.5 Suggestions for Further Research**

- i. A Study to determine the relationship between academic ability of the student and motivation to learn in relation to other subject after exposure to CAT strategy should be carried out.
- ii. A study into other science subjects (chemistry and physics) to determine effects of CATS.
- iii. A comparative study to be conducted on student academic achievement in teaching science subject in secondary schools in Kenya using CATS versus when taught by conventional strategy.



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## **APPENDIX A**

### **TRAINING MANUAL FOR TEACHERS**

#### **1.0 Introduction**

Kenya vision 2030 is the country's long term development blue print that aims to create a globally competitive and prosperous country providing a high quality of life to all citizens by transforming it into a newly industrializing middle income country. It aspires to transform Kenya into a newly industrializing middle income earner by 2030. This has been achieved through the three Fiber Optic Cables which connect Kenya with the world. The millennium development goals on the information and communication technology skills play an important role in education through the use of ICT skills in order to support the dynamics and sustainable economic growth and facilitate the education institution with ICT resources in the form of computers, hardware, software and ICT teachers. Therefore, encouraging the use of computers in teaching and learning which provides an important impact on student access to and the use of information instruction and research skills in ICT to apply in the technology world. Educational technology is concerned with the use of various forms of instructional modes that aid in simplifying abstract concepts during the teaching and learning process. This instructional aid used in class includes the use of whiteboards, blackboards, charts, television, radio and computers.

Computer Assisted teaching involves the use of a computer as an instructional material in the teaching learning process to enhance efficient delivery and learning concepts. During the process, the teacher gives learners computer directions in a programming language, using the computer as a tool using in-built software such as word processors and spreadsheets or as a tutor the learners take drills, practice, tutorial, use exploration tools or simulation, and at times test using the computer in learning new concepts in Biology enabling the learner to grasp complex information in an easier way because of the embedded visual element in such instructions. Computer use in learning biology helps the learners to visualize objects that could be difficult or impossible to be viewed. For example, a computer can be used to display a mammalian blood circulating system, mammalian breathing mechanisms and the internal parts of an animal and a plant cell. This makes it easier for the teacher to explain difficult concepts.

as well as motivating the learner towards the subject it also improves the learner retention.

### **1.1 Role of computer in Teaching Biology**

Computers can offer a number of advantages to the biology teachers in teaching and learning in that it offers:

Individualized learning situations, self-paced learning opportunities, immediate feedback to the student and the instructor, lack of distractions and increased attention span, automatic adjustment to ability levels of students, continuous interaction, and flexible time scheduling for the students and the instructor. Computers are also very flexible when it comes to interfacing (connecting and operating) with other types of equipment. For example, computers can be connected (with the appropriate hardware and software) to videotape and videodisc players, slide projectors and cassette players, laboratory equipment (for direct display of equipment readings), video cameras (color and black and white), and digitizing pads and tablets.

Computer used in teaching biology encompasses a wide range of computer-based activities that can include: learning units and tutorials, demonstrations of biological concepts, simulations of biological diagrams, dialogues (between the students and the computer), and interaction with an electronic biology textbook. Most of the biology KCSE secondary school in topics lack adequate resource therefore becomes difficult for biology teachers to explain the biological concepts during teaching and learning process this topic include:

1. Ecology
2. Photosynthesis
3. Nutrition in Mammals
4. Human reproductive system
5. Human circulatory system
6. Gaseous exchange in Mammals
7. Animal and plant Cell
8. Cell division
9. Mammalian skeleton system
10. Function of Mammalian Kidney

## **1.2 Implementation of CAT strategy**

The student and biology teacher assemble in Computer laboratory for biology lesson. The teacher should ensure that the computers are working and in good condition for learning. The teacher assists the students to switch on all the computers and organizes the students into groups per computer before introducing the lesson of the day by providing the learners with the objectives of the lesson to capture their attention and encourage the students actively participate in the lesson.

The teacher should help the students to explore the topic accessing the photographs of stages of cell division by clicking the Form Three biology icon on the computer desktop, on clicking on the icon the files open in the files it contains various photographs showing stages of mitosis and meiosis cell division arranged as per the biology syllabus. The teacher will then select stage of cell division for the lesson with explanation of different stage of the cell division displayed on the screen. The learners will use this for class discussion, after the discussion the teacher concludes the lesson by giving a summary of the main learning points of the lesson and giving assignment to the learners on the chalkboard.

## **1.3 Role of the teacher in the Implementation of CAT Strategy**

The teacher will play a major role during the implementation of CAT by:

Providing guidance to the learners in making observations from the photographs

Supervising the learners in class

Assigning responsibilities to the groups

Maintaining class control

Encouraging the learners to exchange ideas during the lesson

## **1.4 Role of the learner during the implementation of CAT strategy**

The learners will play a major role during the lesson by:

- i. Making observation of the photographs in the computer
- ii. Following the teacher proceedings of the lesson
- iii. Participating during the lesson by;
- iv. Asking questions during the lesson
- v. Answering questions during the lesson

- vi. Discussion with other members of the group
- vii. Taking notes
- viii. Taking assignments at the end of the lesson

## **APPENDIX B**

### **IMPLEMENTATION SCHEDULE**

#### **TEACHERS GUIDE FOR COMPUTER ASSISTED TEACHING STRATEGY**

This manual contains guidelines for biology teachers on how to conduct biology lessons based on computer assisted strategy. It has a total of 8 lesson plans on the sub-topic cell division. The objective of each lesson has been clearly stated with the guidelines on how to introduce the lesson. Computer assisted teaching strategy is an instruction where a computer is used to present the information that is arranged in a logical sequence to the learners where the learners will read the text material that is presented or by observing the graphical information that is displayed. Computer simulations developed using power point and linked hypertext mark language for display on a computer screen. The following instructions will serve as a blue print for implementation of computer assisted teaching strategy.

#### **INSTRUCTIONS**

- (a) Use the following module in teaching the sub-topic cell division.
- (b) Provide the learner with the objectives of the lesson and the level of performance before the lesson.
- (c) Ask the students provoking questions that enable them to reflect on the observation made on cell division.

#### **LESSON 1**

SUBJECT: Biology

CLASS: FORM THREE

DURATION: 40 minutes

NUMBER OF STUDENTS IN CLASS:

TOPIC: Reproduction in plants and animals

SUBTOPIC: Cell division

Reference: Biology Form Three Student Book Page 80-81

Behavioral objectives: By the end of the lesson the learner should be able to:

- Define the term reproduction
- state the importance of reproduction

Teaching Aid: A computer simulations showing the types of reproduction

Introduction (5minutes)

The teacher introduces the lesson by previewing the previous topic taught by way of questions and answer method.

- The teacher provides the objectives of the lesson and the level of performance
- Teacher encourages the student to actively participate in the lesson

Lesson Development (30 minutes)

Presentation:

The teacher presents the lesson in the following steps:

Step I: The teacher introduces the new topic Reproduction in plants and animals

Step II: The teacher explains the importance of reproduction in plants and animals

Step III: The teacher guide the learners in reviewing the parts of a cell responsible for cell division

Conclusion (5minutes)

- The teacher gives the summaries of the main learning points of the lesson
- The teacher let the student participate in the lesson by asking questions on the topic taught in order to test their level of understanding

Assignment

- Learner to state the importance of reproduction.

## **LESSON 2 AND 3**

SUBJECT: Biology

CLASS: FORM THREE

DURATION: 40 Minutes

NUMBER OF STUDENTS IN CLASS:

TOPIC: Reproduction in plants and Animals

SUBTOPIC: cell division

Reference: Biology Form Three Student Book Page 80-81

Behavioral objectives: By the end of the lesson the learner should be able to:

- (a) State the types of cell division
- (b) State the stages of cell division

Teaching Aid: A computer simulations showing the state of cell division

Introduction (10 minutes)



- The teacher introduces the lesson by previewing the previous topic taught by way of questions and answer method.
- The teacher provides the objectives of the lesson and the level of performance.
- Teacher encourages the student to actively participate in the lesson.

Lesson Development (50 minutes)

Presentation:

The teacher presents the lesson in the following steps:

Step I: The teacher introduces the sub-topic cell division.

Step II: The teacher explains the stages of cell division.

Step III: The teacher guides the learners in identifying the stages of cell division.

Discussion (15 minutes)

- The teacher and the learners discuss the stages of cell division; this is done by way of question and answer
- The teacher also guides the learners through the discussion and arrives at the observation made on the stages of cell division.
- Learners taking down brief notes

Conclusion (5 minutes)

- The teacher gives the summaries of the main learning points of the lesson
- The teacher let the student participate in the lesson by asking questions on the topic taught in order to test their level of understanding

Assignment

- Learners to state the stages of cell division.

## **LESSON 4**

SUBJECT: Biology

CLASS: FORM THREE

DURATION: 40 minutes

NUMBER OF STUDENTS IN CLASS:

TOPIC: Reproduction in plants and Animals

SUBTOPIC: cell division

Reference: Biology Form Three Book Page 81

Behavioral objectives: By the end of the lesson the learner should be able to:

- State the stages of mitosis
- identify the places where mitosis takes place in plants and animals

Teaching Aid: A computer simulation showing the stages of mitosis cell division

Introduction (5 minutes)

The teacher introduces the lesson by previewing the previous topic taught by way of questions and answer method.

- The teacher provides the objectives of the lesson and the level of performance
- Teacher encourages the student to actively participate in the lesson

Lesson Development (30 minutes)

Presentation:

The teacher presents the lesson in the following steps:

Step I: The teacher introduces the sub topic cell division

Step II: The teacher explains the stages of mitosis

Step III: The teacher guide the learners in describing the stages of mitosis

Conclusion (5 minutes)

- The teacher gives the summaries of the main learning points of the lesson
- The teacher let the student participate in the lesson by asking questions on the topic taught in order to test their level of understanding

Assignment

- Learner to state the stages of mitosis.

## **LESSON 5 AND 6**

SUBJECT: Biology

CLASS: FORM THREE

DURATION: 40 minutes

NUMBER OF STUDENTS IN CLASS:

TOPIC: Reproduction in Plants and Animals

SUBTOPIC: First meiotic division

Reference: Biology Form Three Student Book Page 84

Behavioral objectives: By the end of the lesson the learner should be able to:

- (a) State the stages of the first meiotic
- (b) Describe the stages of first meiotic division

Teaching Aid: A computer simulation showing the stages of first meiotic division

Introduction (10 minutes)

- The teacher introduces the lesson by previewing the previous topic taught by way of questions and answer method.

- The teacher provides the objectives of the lesson and the level of performance.
- Teacher encourages the student to actively participate in the lesson.

Lesson Development (50 minutes)

Presentation:

The teacher presents the lesson in the following steps:

Step I: The teacher introduces the sub-topic first meiotic division

Step II: The teacher guides the learners in examining the states of meiotic division

Step III: The teacher guides the learners describing the first meiotic division

Discussion (15 minutes)

- The teacher and the learners discuss the stages of first meiotic division; this is done by way of question and answers.
- The teacher also guides the learners through the discussion and arrives at the observation on the stages of first meiotic division.
- Learners taking down brief notes

Conclusion (5 minutes)

- The teacher gives the summaries of the main learning points of the lesson
- The teacher let the student participate in the lesson by asking questions on the topic taught in order to test their level of understanding

Assignment

- Learners to describe the stages of first meiotic division.

## **LESSON 7**

SUBJECT: Biology

CLASS: FORM THREE

DURATION: 40 minutes

NUMBER OF STUDENTS IN CLASS:

TOPIC: Reproduction in Plants and Animals

SUBTOPIC: second meiotic division

Reference: Biology Form Three Student Book Page 87

Behavioral objectives: By the end of the lesson the learner should be able to:

- State stages of second meiotic division
- Describe the stages of second meiotic division.

Teaching Aid: A computer simulation showing the stages of second meiotic division

Introduction (5 minutes)

The teacher introduces the lesson by previewing the previous topic taught by way of questions and answer method.

- The teacher provides the objectives of the lesson and the level of performance
- Teacher encourages the student to actively participate in the lesson

Lesson Development (30 minutes)

Presentation:

The teacher presents the lesson in the following steps:

Step I: The teacher introduces the meiotic cell division

Step II: The teacher explains the stages of second meiotic cell division

Step III: The teacher guide the learners in describing the second meiotic division

Conclusion (5 minutes)

- The teacher gives the summaries of the main learning points of the lesson
- The teacher let the student participate in the lesson by asking questions on the topic taught in order to test their level of understanding

Assignment

- Learners to describe the stages of second meiotic division.

## **LESSON 8**

SUBJECT: Biology

CLASS: FORM THREE

DURATION: 40 minutes

NUMBER OF STUDENTS IN CLASS:

TOPIC: Reproduction in plants and Animals

SUBTOPIC: Significance of meiosis

Reference: Biology Form Three biology Page 88

Behavioral objectives: By the end of the lesson the learner should be able to:

- (a) State the significance of meiosis in plants and animals
- (b) State the differences between meiosis and mitosis

Teaching Aid: A computer simulation showing the stages of meiosis

Introduction (10 minutes)

- The teacher introduces the lesson by previewing the previous topic taught by way of questions and answer method.
- The teacher provides the objectives of the lesson and the level of performance.
- Teacher encourages the student to actively participate in the lesson.

Lesson Development (50 minutes)

Presentation:

The teacher presents the lesson in the following steps:

Step I: The teacher introduces the sub-topic significance of meiosis

Step II: The teacher guides the learners in examining stages of meiosis

Step III: The teacher guides the learners in identifying the difference between meiosis and mitosis.

Discussion (15 minutes)

- The teacher and the learners discuss the difference between meiosis and mitosis; this is done by way of question and answers.
- The teacher also guides the learners through the discussion and arrives at the observation both meiosis and mitosis.
- Learners taking down brief notes

Conclusion (5 minutes)

- The teacher gives the summaries of the main learning points of the lesson
- The teacher let the student participate in the lesson by asking questions on the topic taught in order to test their level of understanding

Assignment

- Learners to state differences between mitosis and meiosis

**APPENDIX C**  
**QUESTIONNAIRES FOR BIOLOGY STUDENTS**  
**BIOLOGY MOTIVATION QUESTIONNAIRE (BMQ)**

School.....

Adm NO.....

Class.....

Gender:      Male[    ]                  Female[    ]

The purpose of this questionnaire is to find out what you think about biology subject.  
Please indicate what your view is about

**INSTRUCTION**

1.      Read the statement carefully and indicate how you feel by ticking against the point to express your interest.
2.      The choices are SA=Strongly Agree, A= Agree, D=Disagree, SD=strongly disagree U= undecided.

**ITEMS**

ITEM	STATEMENT	SA	A	U	D	SD
1	Learning biology using computer is Fun					
2	Biology lesson was interesting					
3	Learning biology was enjoyable when using computer					
4	I find biology easy to understand when using computer					
5	Learning biology was exciting					
6	The lesson was well organized					
7	I understand everything that the teacher teaches					
8	I always do biology assignments					
9	I do well in biology					
10	The teaching method used by the teacher was enjoyable					

11.	Learning biology is stimulating					
12.	Biology lesson was challenging					
13.	Biology is my favorite subject					
14.	What I learn in Biology was important					
15.	I easily remember what I learn in Biology					
16.	I feel confident about Biology subject					
17.	I feel confident about biology subject					
18.	Learning biology is rewarding					
19.	I will always try to answer biology lesson					
20.	Biology lesson was pleasing					
21.	I like reading biology					
22.	I would like to pursue a course related to biology					
23.	I would like to be a biology teacher					
24.	I am always attentive in biology lesson					
25.	I will study hard for my biology lesson					
26.	I can follow biology lesson easily					
27.	I will perform well in biology					
28.	I will like to keep my biology work neat					
29.	I will perform well in biology					
30.	I will discuss biology problem with other student					

**APPENDIX D**  
**BIOLOGY ACHIEVEMENT TEST (BAT)**

Time: 1 hour

Name.....

School.....

Adm NO.....

Class.....

Gender:            Male[   ]                      Female [   ]

**INSTRUCTION**

1.     Answer all the questions in the space provided
2.     Read the questions carefully to ensure that you understand before writing your answers.

For examiners use only

Question	1	2	3	4	5	6	7	8	9	10
Marks										

1. State two types of cell division (2mk)

.....  
.....

3. Define a chromosome (1mk)

.....

4. Define mitosis (1mk)

.....

5. state two significance of mitosis (2mks)

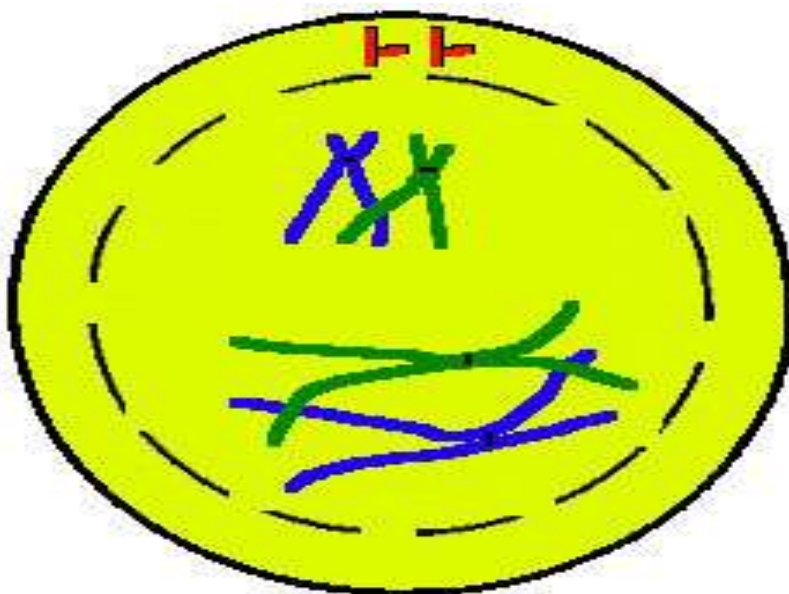


.....  
.....  
6. State four differences between mitosis and meiosis. (4mks)

Mitosis

Meiosis

7. Use the diagram shown below to answer the questions that follow.



(a) Identify the steps of cell division shown above (1mk)

.....

(b) Give the reason for your answer above (1mk)

.....

(c) State the significance of the stage shown above (1mk)

.....

8. State the event of mitosis cell division in an organelle (5mk)

.....

.....

.....  
.....

9. State two similarities between mitosis and meiosis (2mk)

.....  
.....

10. Identify five places where the process of mitosis takes place (5mks)

.....  
.....  
.....  
.....  
.....

11. Briefly describe what takes place during the prophase stage of mitosis (5mks)

.....  
.....  
.....  
.....  
.....

**APPENDIX E**  
**MARKING SCHEME FOR BIOLOGY ACHIEVEMENT TEST (BAT)**

Time: 1hour

Name.....

School.....

Adm NO.....

Class.....

Gender:            Male[ ]                            Female [ ]

**INSTRUCTION**

Answer all the questions in the space provided

Read the questions carefully to ensure that you understand before writing your answers.

For examiners use only

Question	1	2	3	4	5	6	7	8	9	10
Marks										

1. State two types of cell division (2mk)

.....Mitosis.....  
 .....Meiosis.....

2. Define a chromosome (1mk)

...Are thread like structures that carry genetic information

3. Define mitosis (1mk)

A type of cell division that occurs during growth leading to increase in number of cells

4. State two significance of mitosis

(2mks)

Ensures each daughter cell has same number and kinds of chromosomes as daughter cells

Gives rise to new cells (responsible for growth)

5 State four differences between mitosis and meiosis.

(4mks)

Mitosis

Maintenance of chromosome  
Number (diploid)

Takes place in somatic  
cells/growth

No crossing over/no variations

Results into 2 daughter cells

No pairing/no synapsis/no  
bivalent formed

A one division process of four  
stages

Meiosis

Reduction/halving of chromosomes  
(haploid)

Occurs in reproductive  
cells/gonads/produces gametes

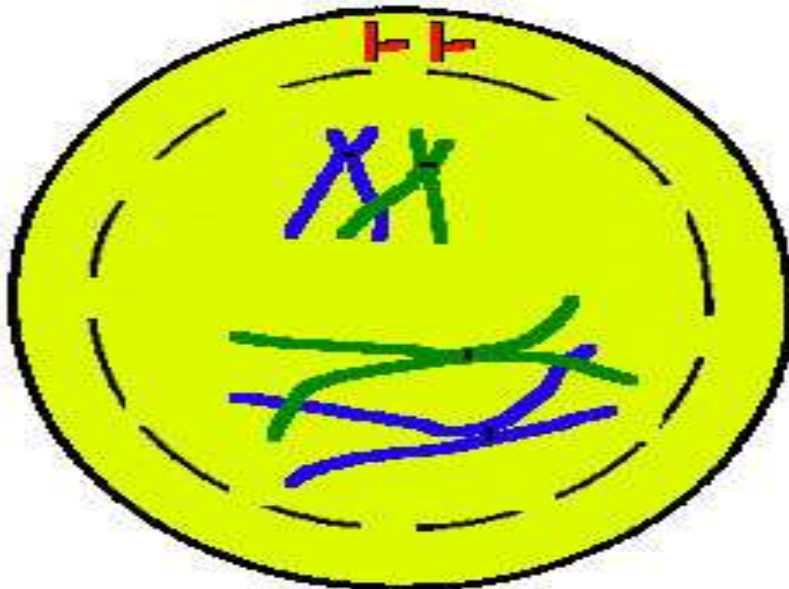
crossing over takes place/variation  
occurs

results into 4 daughter cells

there is pairing/synapsis/bivalent

a two division process of four

6 Use the diagram shown below to answer the questions that follow.



(a) Identify the steps of cell division shown above

(1mk)

Prophase 1

(b) Give the reason for your answer above (1mk)

Crossing over of homologous chromosomes takes place

(c) State the significance of the stage shown above (1mk)

Exchange of genetic information takes place

7. State the event of mitosis cell division in an organelle (5mk)

Interphase

Prophase

Metaphase

Anaphase

Telophase

9. State two similarities between mitosis and meiosis (2mk)

Both take part in cells

Both involve division (cell multiplication)

10.(a) Identify five places where the process of mitosis takes place (5mks)

Tip of the stem

Tip of the roots

Between the xylem and phloem in the stem

Bone marrow

Skin

(b) Briefly describe what takes place during the prophase stage of mitosis (5mks)

Stage of dehydration

Chromosomes shorten and thicken

Chromosome replicates into two chromatids

Chromatids joined at centromere

Formation of spindle fibers

**APPENDIX F**  
**TABLE OF SPECIFICATION FOR BAT**

Behavioral objectives	Content (subtopic)					
	Types of cell division	Mitosis	significance	meiosis	differences	TOTAL
Knowledge	4	1	2	1	2	12
Comprehensiveness	2	2	4	2	2	12
Application	1	-	-	-	-	1
Analysis	-	-	-	-	-	-
Synthesis	-	3	2	-	-	5
Evaluation	-	-	-	-	-	-
<b>TOTAL</b>	<b>7</b>	<b>6</b>	<b>6</b>	<b>3</b>	<b>4</b>	<b>30</b>

**APPENDIX G**  
**RELIABILITY STATISTICS TABLE**

Groups	Cronbach's Alpha
Control Group one	.661
Experimental Group One	.735
Control Group two	.756
Experimental Group Two	.673
Overall Alpha	0.706

**APPENDIX H**  
**NACOSTI RESEARCH AUTHORIZATION**



**NATIONAL COMMISSION FOR SCIENCE,  
TECHNOLOGY AND INNOVATION**

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P.O. Box 30623-00100  
NAIROBI-KENYA

Ref. No. **NACOSTI/P/18/56649/23435**

Date: **10<sup>th</sup> July, 2018**

Gilbert Cheruiyot Langat  
Chuka University  
P.O. Box 109-60400  
**CHUKA.**

**RE: RESEARCH AUTHORIZATION**

Following your application for authority to carry out research on "*Effectiveness of computer assisted teaching strategy on students' academic achievement and motivation in biology in public secondary schools in Baringo County, Kenya*" I am pleased to inform you that you have been authorized to undertake research in **Baringo County** for the period ending **6<sup>th</sup> July, 2019**.

You are advised to report to **the County Commissioner and the County Director of Education, Baringo County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

**DR. STEPHEN K. KIBIRU, PhD.**  
**FOR: DIRECTOR-GENERAL/CEO**

Copy to:

The County Commissioner  
Baringo County.

The County Director of Education  
Baringo County.