EFFECTS OF COMPUTER AIDED INSTRUCTION ON PERFORMANCE AND RETENTION IN ECOLOGY AMONG SECONDARY SCHOOL BIOLOGY STUDENTS IN RINGIM, JIGAWA STATE, NIGERIA

BY

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DECLARATION

I hereby declare that this research work titled: "Effects of Computer Aided Instruction on Performance and Retention in Ecology Among Secondary Schools Biology Students in Ringim, Jigawa State, Nigeria" is the product of my research efforts undertaken under the supervision of Prof. Sagir Adamu Abbas and has not been presented anywhere for the award of a degree, masters or certificate. All sources of data to the best of my knowledge have been duly acknowledged.

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CERTIFICATION

This is to certify that the research work for this dissertation was carried out by Abdulsalam IDRIS with registration number SPS/14/MST/00007 under my supervision, and is approved for its contribution to knowledge and literary presentation.

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APPROVAL PAGE

This dissertation titled “Effects of Computer Aided Instruction on Performance and Retention in Ecology among Secondary School Biology Students in Ringim, Jigawa State, Nigeria” has been examined and approved as meeting the requirements for the award of Master Degree in Science Education M.Sc. (Ed) Biology.

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TABLE OF CONTENTS

Contents **Pages**

CHAPTER ONE: INTRODUCTION

CHAPTER TWO:
REVIEW OF LITERATURE

CHAPTER THREE:
METHODOLOGY

CHAPTER FOUR:
DATA PRESENTATION AND ANALYSIS

CHAPTER FIVE:
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

LIST OF TABLES

Table **Page**

LIST OF APPENDICES

Appendix **Page**

OPERATIONAL DEFINITION OF TERMS

The following terms are operationally defined as used in this study:

Retention: The ability to store information in memory which can be easily recalled later.

Computer Aided Instruction: The use of computer technology such as simulations, multimedia, tutorials, drill and practice in facilitating teaching.

Academic Achievement: The performance of Biology students in a given Biology Achievement Test.

Ecology: Is the branch of biology dealing with the study of living organisms in their natural habitat.

LIST OF ABBREVIATIONS

BATEC	Biology Achievement Test on Ecology Concepts
CAI	Computer Aided Instruction
CG	Control Group
EG	Experimental Group
ICT	Information and Communication Technology
IT	Information Technology
N	Number of Students
NECO	National Examination Council
NPE	National Policy on Education
PPMC	Pearson Product Moment Correlation Coefficient
SD	Standard Deviation
WAEC	West African Examination Council
JERD	Jigawa State Education Resource Department

LIST OF FIGURES

Figure **Page**

ABSTRACT

This study investigated the Effects of Computer Aided Instruction on Performance and Retention in Ecology among Secondary School Biology Students in Ringim, Jigawa State, Nigeria. Quasi experimental research design was employed for the study. A population of seven thousand five hundred and sixty seven students offering Biology at the twenty two co-educational secondary schools in the zone were used in the study. Two hundred SS II students drawn from 2 co-educational schools formed the sample of the study. One hundred and twenty students constituted the Experimental group and eighty students formed the Control group. Simple Random Sampling was used to select intact classes used for the study. The instrument used for data collection is Biology Achievement Test on Ecology Concepts (BATEC) which was validated by six experts and pilot-tested at Government Day Secondary School Majia, a reliability coefficient of 0.83 was established using PPMC. Four research questions were answered and four hypotheses were tested. The data were analyzed using mean, standard deviation and Z-test analysis. The results revealed that Biology students in the Experimental group subjected to Computer Aided Instruction achieved higher and retained the knowledge better than those in the Control group taught through Traditional lecture method, as there is significant different in both the achievement and retention level in favour of experimental group. Both male and female Biology students performed equally well hence no significant difference was found. On the basis of the findings of this study, major recommendations were made some of which are: the teachers should be encouraged on the use of CAI in teaching ecology and other Biology topics in Senior Secondary Schools in Jigawa state, Governments and other stakeholders in education should provide computers and other CAI accessories to all secondary schools in Jigawa state, teachers should be fully trained on how to handle computer programs and software in teaching ecology and other Biology concepts in senior secondary schools in Jigawa state.

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

Science Education may be defined as a process by which individuals acquire scientific skills, knowledge and an attitude which enables them to act, think and solve problems scientifically. Science Education deals with the study of natural inclination to seek meaning and understanding of the world around us, it encompasses the processes of observing, questioning, investigating and reasoning about the natural evidences through which learning is generated (Harlen, 2010). Science Education has become meaningful as it enables individuals to contribute immensely to the betterment of themselves, their societies and the nation as whole (Anderson, 2006).

Biology education as a branch of science education also involves the application of science process skills and methods to bring about meaningful learning; it entails what is life, what life needs to survive and how life forms interrelate with each other. Biology therefore plays an important role on how humans interact with the biotic and abiotic components of their environment (Weber, 2016).

The function of instruction in any course of study is the student achievement in that course. Therefore achievement in teaching and learning Biology depends largely on how students retain the learnt materials appropriately; any effort to improve the students' retentive abilities shall be considered in teaching Biology. Ozono (2013) stated that, to achieve higher students' achievements and good retentive abilities in learning, the instruction shall involve systematic presentations of learning tasks. Effective instruction requires the use of appropriate teaching strategies that stimulate the interest of the learners and enhance better

retention (Ahmad, 2010).

Retention in learning is the interactive performance developed by a learner after the interventions, it is an ability to elicit the acquired knowledge after an interval of time (Haynie, 2003). Biological concepts should be delivered to the students in such a way that it touches their consciousness since retention is the product of sensation and perception that require the function of human mind (Achor, Ogbeba & Samuel, 2014).

However, maximum achievement in Biology at secondary schools has not yet been achieved, this brings uncertainty about the effectiveness of the methods of teaching popularly used by Biology teachers for teaching Biology courses. Lecture method dominated most of Nigerian institutions (Adedeji 2011; Nwangwu, Obi and Ogwu 2014; Nwankwoala, 2015). Lecture method is a method of teaching-learning in which teachers tell the students what to do instead of guiding them to discover for themselves (Deslauriers, Schelew and Wieman, 2011). It is often refers as a single process which lacks the effectiveness of an active learning and lead to the students' poor academic achievements and low retention of the learnt materials (Usman, 2010; Nzelum, 2010 and Al-Rawi, 2013).

The emergence of computer nowadays has modernized the world, for that teaching and learning is shifting to cope. The use of computer and other information and communication technology (ICT) could be a good alternative in classroom to aid effective teaching and enhances good retentive knowledge. Computer Aided Instruction (CAI) is an interactive instructional strategy which involves the use of Computer technology such as simulations, videos, tutorials, drill and practice etc as tools to facilitate instruction (Mudasiru & Adedeji 2010). Research evidence revealed that, computer aided instruction is one of the pedagogy

that makes teaching and learning scientific knowledge easy and effective. Kosoko-Oyedeko and Tella (2010) stated that teaching and learning sector has been achieved with great transformation through computer advancement as it provides effective and functional knowledge to learners and encouraging them in acquiring appropriate skills for the current world work.

Computer Aided Instruction enables science students to view events, processes and activities that otherwise may not have been available to them (Rutten, Van Jooligen and Ven der veen, 2012). Application of computer in teaching Biology motivates students to be active participants in their learning hence they would be provided with a supportive, open, visual and interactive presentations which could help them discover meaningful knowledge in the subject area (Castano-Munoz, Duart & SanchoVinuesa, 2013; Lashley, 2014). Vinita and Shikha (2015) concluded that, students whose subjected to computer assisted instructions are reportedly retained the learnt materials more than those taught using conventional method.

Gender refers to the roles and responsibilities of males or females in our family; it includes the expectations about the behaviors and characteristcs of women and men (UNESCO, 2003). In education, gender is not a factor of valuing males above females. There must be an equal treatment (equality) between boys and girls which require the development of specific and effective measures to ensure that female students are provided with access to the same curricula and other educational opportunities as male students (Murugesan and Muthu, 2011).

For such, this study examined the effects of Computer Aided Instruction on Performance and Retention in Ecology among male and female Biology Students in Ringim, Jigawa State,

Nigeria.

1.2 Statement of the Problem

Over the years, Biology curriculum has been delivered traditionally or by rote learning which makes instruction teacher-centred. It has been found that predominant use of lecture method is one of the problems facing students in learning Biology at Secondary Schools (Lakpini 2012 and Lawal 2010). Vital abstract concepts in Biology are hardly communicated to the learners verbally. Griffiths (2016) discovered that biological concepts such as genetics and ecology are difficult to be learned through traditional method. This is because traditional method of teaching lacks the effective presentation of some events, activities and processes which results in students' poor academic achievements and low retention. The performance of secondary school students in Biology had just been attributed to inefficient instructional strategies used by teachers (Ahmed & Abimbola, 2011; Umar, 2011).

Studies revealed that the achievement of Nigerian students in Ordinary Level Biology was generally and consistently poor over the years (Nwagbo, 2009). The report of West African Examination Council (WAEC) on the Senior Secondary School Certificate Examination on Biology students' performance revealed low academic achievement in Nigeria.

Table 1.1 illustrates the statistics of Biology students' performance in West African Certificate Examination 2009 to 2014.

Table1.1: Statistics of Biology Students Performance in WAEC

Year	No. of Students Sat for WAEC	No. of Students pass with Credit And above	(%)	No. of Students fails Biology	(%)
2009	917041	278122	30.3	638919	69.7
2010	931219	392249	42.1	538970	57.9
2011	835945	253483	30.3	582462	69.7
2012	1261971	421120	33.4	840851	66.6
2013	1285048	436145	34.0	848903	66.0
2014	1364655	390019	28.6	974636	71.4

Source: **WAEC (2015)**

The number of students that passes Biology at credits and above was consistently less than 45% for six subsequent years in Nigeria. Achor, Ogbeba & Samuel (2014) find out that the poor performance in specifically ecology, was traced to past ecology WAEC questions according to the Chief Examiners Report of 2003, 2004, 2006, 2007, and 2008.

The persistent poor achievement of students at senior school certificate examination brings uncertainty about the effectiveness of the teaching methods popularly used by teachers. The use of talk-and-chalk method of teaching encourages rote learning and regurgitation of facts and concepts. There is need to find out the effectiveness of other alternative teaching strategy that will help students to better learn, understand, and retain Biology concepts and promote their future involvement. Therefore, this study intends to examine the effect of Computer Aided Instruction (CAI) on senior secondary students' academic achievement and retention in ecology concepts among secondary schools, Ringim Education zone Jigawa state,

Nigeria.

1.3 Objectives of the Study

The study has the following objectives, viz, to:

1. Find out the effect of Computer aided instruction on Biology students' academic achievement in secondary schools in Ringim Education zone Jigawa State.
2. Find out if there is any gender difference in academic achievement of Biology students in the Experimental group exposed to Computer aided instruction.
3. Investigate the effects of Computer aided instruction on retention of Biology concepts among students in secondary schools in Ringim Education Zone Jigawa State.
4. Find out if there is any difference in the retention of Biology concepts among male and female students in secondary schools in Ringim Education Zone Jigawa State.

1.4 Research Questions

The study is guided by 4 research questions that include the following:

1. What is the effect of Computer aided instruction on Biology students' academic achievement in secondary schools in Ringim Education zone Jigawa State?
2. Is there any gender difference in academic achievements of Biology students in the Experimental group exposed to Computer aided instruction?
3. What is the effect of Computer aided instruction on the retention of Biology students in secondary schools in Ringim Education zone Jigawa State?
4. Is there any gender difference in retention of Biology students in secondary schools in Ringim Education zone Jigawa State?

1.5 Research Hypotheses

The following null hypotheses were tested at 0.05 level of significance.

HO_1: There is no significant difference in the academic achievement of Biology students in secondary schools in Ringim Education Zone Jigawa State.

HO_2: There is no significant difference in the academic achievements of male and female students in the Experimental group exposed to Computer aided instruction.

HO_3: There is no significant difference in the post-posttest mean scores of Biology students taught using Computer aided instruction in Ringim Education Zone Jigawa State.

HO_4. There is no significant difference in the retention of male and female students in the Experimental group exposed to Computer aided instruction.

1.6 Significance of the Study

Biology students, teachers, authors, researchers, curriculum planners, government and the society at large would obtain quite some benefits from the findings of this study. The study would be of great benefits to the students as they can be able to identify various interesting activities they should be involved while studying Biology. These stimulate and retain their interest to learning and bring about personal satisfaction and facilitate purposeful engagement. It would also significant to the students as it offer the students to maintain a dialogue of information between the computer and a learner and provide them with interactive involvement with instructional materials.

The study would be of great significance to the Ministry of Education, as well as Ministry of Science and Technology, as they are the principal determinants in the pedagogic

aspect of computer and secondary school education in Nigeria. The findings of the study would enable them to understand the situation and position of CAI towards quality of education as it offered students various degrees of control over their own learning, enable instruction to be adjusted according to student‘s needs, and enable the ministry to get feedback on student performance and store it for further reference. This would provide the needed arrangement for the provision and full implementation of relevant computer technologies to various levels of institutions thereby enhancing the quality of learning in students.

The result of this study trigger off more researches and innovations in science teaching as the study would enable the researchers know the extent studies have been carried out in this field and also served as a point of reference to them and source of literature review. The Researchers would be fed with the latest information about CAI and its application in teaching-learning process.

The findings of this study would help the curriculum planners to integrate and enhance the skills of search and development of various class activities into the curriculum content and offer them the opportunity to plan for a wide range of fields, including all the main disciplines at all levels of education. Specifically, he study would serve as the basis for curriculum planners to include CAI as a good alternative teaching strategy for effective biology instruction.

The benefits of effective teaching and learning of Biology in the school manifest in the society in a number of ways for instance, the application of the knowledge of the subject in solving health, nutrition and even agricultural problems in the society by the students. This

makes the society a better place. The students could apply the knowledge only when they learn the subject well due to better teaching method like CAI being used to teach them.

1.7 Scope and Delimitation of the Study

The study is delimited and conducted only at Twenty two Govetnment own coeducational senior secondary schools in Ringim Education zone Jigawa state. The research study examined the effects of Computer Aided Instruction to teach Ecology concepts. The study comprises of only SS II students who have the basic knowledge of Biology from SS I and are not engage in external examination preparations level (SS III). The topic Ecology concepts were chosen among other Biology topics due to the fact that it is central concept in Biology. It is perceived as one of the core components that students must understand (Tsui & Treagust, 2010; Nichols, Hanan, & Ranasinghe, 2013). The researcher concentrates mainly on Basic Ecology Concepts, Population and Community, Ecosystem and Symbiosis.

CHAPTER TWO
REVIEW OF LITERATURE

2.1 Introduction

The focus of this study was to determining Effects of Computer Aided Instruction on Performance and Retention in Ecology among Secondary School Biology Students in Ringim, Jigawa State, Nigeria. This chapter is presented under the following sub-headings:

- Theoretical Framework
- Concept of Biology Education
- Concept of Ecology Education at Secondary School
- Concept of Computer and its Classification
- Computer and Interactive Learning
- Computer in Teaching-learning of Biology
- Computer Aided Instruction
- Categories of Computer Aided Instruction
- Drill and practice
- Computer Tutorial
- Problem Solving
- Tool software
- Computer Simulation

- Teaching Ecology with CAI Method selected
- Students' Academic Achievement in Biology
- Retention of Learned concepts in Biological Sciences
- Gender and Computer Utilization in Science
- Review of Empirical Studies
- Implications of the Literature Review for the Present Study

2.2 Theoretical Framework

The theoretical framework underlying this study is the Engagement theory which was first propounded by Kearsley and Shneiderman (1999). This is because, engagement theory support the application of technology and development of skills and knowledge of learners. It is based upon the idea of creating successful collaborative learning in the meaningful learning atmosphere through purposeful learning activities.

Kearsley, and Shneiderman (1999) concluded that, building knowledge occur in a schema of engaged learning activities which took place when active cognitive processes, such as problem-solving, critical thinking, decision making and evaluating, are involved. Engagement theory focuses on the learner as constructor in a meaningful environment while teacher facilitates the learning by preparing the facility as a presentation of the subject matter which allows students to develop knowledge.

The basic principle underlying engagement theory is the students' active engagement in learning activities and interactivity. Such engagement could best occur through the use of technology hence, technology facilitates engagement in ways which are difficult to achieve otherwise. The students are motivated to learn due to the meaningful nature of the learning

environment and activities. Therefore, engagement theory is intended to be a framework for technology-based teaching and learning method.

Engagement is consistent with constructivist approaches as it emphasizes collaboration among learners, promotes student activities and improve interactivity, for such it can be aligned with situated learning theories because its focuses on experiential and self-directed learning (Shneiderman, 1994). An ICT environment can provide a meaningful and genuine knowledge for students; the students can be configured to simulate the kind of situation he/she may face outside of the classroom.

Engagement Theory according to Shneiderman (1999) comprises three components: Relating, Creating and Donating. Relating deals with learning activities that occur in a group context, creating insist on learning activities that are project-based, and donating involve learning activities that have an outside focus.

Relating, that is, team work directs students' expression and clarification of their problems, thereby facilitating possible solutions. Relating involve students' communication, planning, management and social skills. This gives them an opportunity to work with others from quite different backgrounds and this facilitates an understanding of diversity and different perspectives (Kearsley & Shneiderman 1999).

Kearsley & Shneiderman (1999) stressed that, Creating involves student active participation in the development of their assessment tasks. The students have to define the project and focus their efforts on application of ideas to a specific context. "Creating" component makes learning a creative and select purposeful activity were students may get to define the nature of the project and have a sense of control over their learning. This can best

achieve in computer based instruction.

Donating is the act of making a useful contribution while learning, the students feel motivated because they are engaged with an activities they value (Kearsley & Shneiderman 1999). Donating stresses authentic learning context of the project and its contribution outside the school such as community organization, museum, government agency or needy individual. This principle play a vital role on school-to-work programs in many schools systems and colleges, as well as the "service" philosophy of contemporary corporate training efforts.

This study focuses mainly on the application of computer technology in teaching-learning process and as such the engagement theory is very relevant to this study in the sense that students will be engaged in learning practical skills and also engaged in meaningful tasks with authentic learning which are some of the core values of the engagement theory.

2.3 Concept of Biology Education

Biology as a separate science subject concerned with study of living nature, it deals with the structure and functions of living things and their natural communities, their distribution, origin, and development, as well as their relations with each other and with nonliving components (Great Soviet Encyclopedia 2010). Biology is now considered worldwide as a standard subject of instruction at both secondary schools and institutions of higher learning. Ambuno, Egunyomi & Osakwe (2008) stated that Biology forms the basis of disciplines like human medicine, veterinary medicine, Nursing, agriculture, forestry, fishery, pharmacy, food technology, laboratory science technology, ecology, human nutrition and many more.

Majority of the biological science are specialized disciplines which are grouped and

named traditionally by the type of organism being studied: botany, the study of plants; zoology, the study of animals; and microbiology the study of microorganisms (Ahmad, 2010). The fields within biology are also classified by (Adeniyi, 2004) on basis of the sequence and method at which living organisms are studied, thus:

- Cytology examines the cell, basic unit of all life;
- Biochemistry examines the fundamental chemistry of life;
- Molecular biology studies the complex interactions of systems of biological molecules;
- Physiology examines the physical and chemical functions of the tissues and organ systems of an organism;
- Ecology examines how organisms interrelate with their environment.

The study of Biology contributes immensely to the everyday life, managing the environment, advances in medicine, microbiology and Biotechnology depend upon understanding of living organisms be of large, intermediate or small (Bichi 2003, Kalu and Ndokwo 2006). Okeke (2007) explained the importance of studying Biology to the existence of life and finally concluded that it would be entirely hopeless to try to sustain the diversity of life on earth in the future without a decent knowledge of Biology. We need to understand about the existence of other living organisms on this planet and also learn about the effect we may have on them and our entire environment. This will guide us to maintain the balance of life on earth.

Biological concepts (Physiology, Ecology, Genetics, Chemical biology and Biochemistry etc.) require sound knowledge of teacher and student-centred method or

strategy to teach for its effectiveness. For example, lecture method can be used alongside indoor laboratory teaching strategy in the teaching of physiology which examines the physical and chemical functions of the tissue and organ systems of an organism. This concept of ecology deals with the study of the interrelationship between organisms and their environment. The teaching and learning of this concept (Ecology) needs strategy that require either direct observation of organisms in their natural surroundings (hardly possible) or a computerized representation of the natural happenings. This strategy is called Computer Aided Instruction (Yusuf and Afolabi, 2010). This Computer Aided Instructional strategy may help the students to use the process skills and study things as in their natural environment. Therefore, the present study investigated the effects of Computer Aided Instruction on Biology students' academic achievement and retention in ecology concept at Senior Secondary School Level.

2.3.1 Concept of Ecology Education at Secondary School

Ecology is the branch of biology dealing with the study of living organisms in their natural habitat. Usman (2008) define ecology as the science of the interrelationship of organisms with one another and with their surroundings, and as such view ecology as being concerned with different species of organisms and their populations. Ajaja (2010) describe ecology as the study of the relationships of organisms with their living and non-living components of their environments. With these definitions, all are pointing to the physical environment in which the organisms live and their biotic and abiotic factors. It indicates that for an organism to live successful life, it must interact with its environment which is literary known as "Ecology".

The certain interest which youngsters have in living things is at once and advantage and a snare to the Biology teacher (Jean 2001). Therefore, when teaching ecological concepts, the teacher must put in mind that the students understand the ecology of the specimens under study, its role in the ecosystem and perhaps its position in the food chain. Nwagu and Nzewi (2008) suggested that, because ecology has to do with interactions of living organisms with nonliving organisms of the environment, it passes the prerequisite to create the knowledge of ecology at the early stage in the life of the students.

The basic ecological concepts to be taught at senior secondary school biology curriculum include the ecological system, niche, environment, biosphere, habitat, biome, food web, food chain, measuring instruments ecological succession etc. The curriculum specified the activities to be carried out in the course of teaching and learning as well as the performance objectives to be achieved for the successful understanding of the concepts being taught (Ugwuadu and Nzewi, 2012).

The present study examined such activities that enhance good learning, and therefore, investigated the effects of Computer Aided Instruction on Biology Students' Academic Achievement and Retention in Jigawa state. It offers supportive, open, visual and interactive presentations that foster good observation and interpretation of organisms and surroundings. This may help the students to understand and retain what they have learned in an interactive engagement thus improving their academic achievement as well as transforming their retention abilities in Biology.

2.4 Concept of Computer and its Classification

Since the beginning of computer technology, and throughout its preliminary development,

computer mainframes have been used in educational institutions. The earliest study of computer usage in education conducted for the National Science Foundation by The American Institute for Research concluded that 13% of the nation's public high schools used computers for instruction, even though the non-users are higher than the users at a ratio of 2 to 1. The study also concluded that computers proved to be popular with students, and its applications began on the early models including administration tools, physics simulator and sports statistics (United Press International, 1971).

Apple Inc. began donating Apple 1 model computers to schools in 1975 and mainframes began to drop their earlier dominance over Academic research. Computer usage continued to grow rapidly throughout this era (Murdock, 2007). In the early 1980, Computer-aided instruction gained prevalent recognition in schools. Drill and practice programs were first developed for exclusive classroom use. Schools became divided over which computer manufacturers they were prepared to support, with grade schools generally using Apple computers and high schools preferring DOS based machines. Hardware shortages in schools became a major issue, leaving many teachers unable to provide adequate computers for students to use (Johnstone, 2003).

Regardless of this, by 1989 computer usage shifted from being a relative scarcity in American public schools, to being present in nearly every school district (Associated Press, 1989). The common computer-based technology is interactive white board, others are modern media technology such as CD-ROMs as well as the development of modern presentation software such as Microsoft Powerpoint. These are modern computer technology and are significantly replacing traditional classroom technology (Associated Press, 1989). The early

1990s marked the beginning of modern media technology such as CD-ROMs as well as the development of modern presentation software such as Microsoft Powerpoint. The laptop computer became widely available to students for education uses. Governments around the world began to take notice of the effectiveness of this policy and began financial initiatives to significantly increase the use of laptop computers in other colleges as well.

Following the outcome of the 32nd ministerial committee conference of the nationwide convention on Education in 1987, the Federal government of Nigeria determined to establish computer education into the country's secondary school structure. The purpose of the committee comprise "planning for a dynamic policy on computer education and literacy in Nigeria as well as devising clear strategies and terminologies to be used by the federal and state governments in introducing computer education" (Nigerian Tribune, April 11, 1988).

The broad-spectrum objectives of the guiding principle include:

- To convey computer literacy to the Nigerian society by the mid-1990s.
- To allow current school children to welcome and use the computer in a variety of facet of life and in upcoming employment. (Report on National commission on Computer Education, 1988).

According to the Policy the first idea is to make certain that the general public welcomes the impact of information and computer education technology (IT) on our society, the significance of its efficient utilization, and the expertise that develop, supervise, and convey the information. The second broad-spectrum goal is to make certain that Nigerians will be acquainted with the knowledge of how to operate and program computers, build up software packages, appreciate the configuration and function of computers and their historical record,

and to understand the profitable, societal and emotional impact of the computer.

2.4.1 Computer and Interactive Teaching

The underlying principle here is to highlight interactive teaching as a means of enhancing students learning. Interaction refers to the different exchanges thought to accomplish broadening thinking and enhancing effective learning (Digregorio & Sobel-Lojeski, 2010). The learner realize understanding through social means by interacting with others and with learning environment where he/she receives knowledge of cultural values and generate a new learning (Burns & Myhill, 2004).

Interactivity in the classroom has been quite remarkable and facilitates teaching and learning (Hennessy & London, 2013). Heemskerk, Kuiper, and Meijer (2014) found that interactive teaching in science lessons is associated with better learning results. The quality and level of interaction between the teacher and the learner is an essential component of effective teaching. Hargreaves, Moyles, Merry, Paterson, Pell and Esarte-Sarries (2010) suggest that effective interactive teaching, which is characterized by stable mutual interface between the teacher and the learner, involves the exchange of opinion and not conventional methods of dictation response and feedback.

Successful application of computer can create a more communicative environment which lead to a more effective learning outcomes in the classroom. Teachers' proper utilization of computer technologies can offer greater interactivity at both a deep and strategic level. The general use of computer and its impact on interactivity within the classroom will be explored. Muijs and Reynolds (2010) differentiate interactive learning on the basis of the nature and effectiveness of interaction between the teacher and the students. They further suggested that

interaction helps the students to put into practice the tasks and master the target skills. It also helps the teacher to present targeted learning support.

A research conducted by (Beauchamp, 2012) concluded that, computer had indeed a positive impact on achieving educational objectives. He further stated that skilful use of computer by a trained teacher is fundamental to high attainment of educational goals and offer a range of key features including speed, automation, capacity, range, provisionality and interactivity. The use of computer and Internet for interactive learning has proven to be an effective tool in enhancing long lasting memory and improving the academic performance of students (Castano-Munoz, 2010; Castano-Munoz, Duart & SanchoVinuesa, 2013).

In a good interactive teaching, teachers' responsibility is to support the students in each aspect of their learning. Therefore, the teachers' interaction and full participation play a significant function in the learners' achievement which is very important in preparing the students for a working place. If it is not so, he will not be useful for the employer and will consequently lag behind the society and today's scientific advancements. However, Ehondor and Omuruyi (2013) outlined barriers that may affect the incorporation of computer in teaching includes teachers beliefs and practices, effects of traditional approaches, teachers training and problems related to lack of time.

2.4.2 Computer in Teaching-Learning of Biology

Ability to work with information and communication technologies (ICT) is recognized as one of the key competencies necessary for success in life and competition in the labour market which every citizen should possess (Recommendation of the European Parliament and of the Council, 2006).

The use of computer and other ICT devices in schools is so diverse that it is almost impossible to list all possible applications. Taylor, (2003) recognized three roles of computers in a classroom: as tutor, tool, and tutee. Introduction of ICT in Biology lessons can raise not only level of knowledge but motivate students' attitudes toward biology as well (Kubiatko and Halakova, 2009).

The use and availability of computers in biology lessons affect the students academically. Sorgo, Verčkovnik and Kocijančič, (2010) opined that there is a significant relationship between the availability and accessibility of computers located in a biology classroom or laboratory and student's achievements. Therefore the present study aims at determining the effects of Computer Aided Instruction on Biology Students Academic Achievement and Retention in Ecology Concepts.

2.5 Computer Aided Instruction

Computer Aided Instruction or Computer Assisted Instruction (CAI), is a range of computer technologies that are used in educational processes. It is refers to the application of computer as a tool for instruction. Okundaye (2005) define CAI as an interactive instructional technique in which computer is used to present instructional programme to the learner. Computer Aided Instruction is the application of computer and its accessories in making available learning experiences and self-directed instructions to a learner using tutorial and simulation packages, with limited or no assistance from instructors. The use of computer as a teaching tool has extended to an advanced stage in developed countries (Mudasiru and Adedeji 2010).

Computer Aided Instructions (CAI) as a medium of teaching/learning contributes several

potential benefits to the learner. These include learner controlled instruction, immediate knowledge of result, adaptability of instruction, revision and updating and self-pacing (Igwhe, 2012). With self-paced learning, learners can move as slowly or as quickly as they like through a program. According to Onasanya, Daramola and Asuquo (2006), CAI allows students to progress at their own speed of learning as they offer learners controlled instructions, provide prompt feedback to the learner, allow for adaptability of instructions (presentations mode and instructional content mode) using authoring systems, provides lessons with more than one purpose, random access facilities, and provides facilities for revisions and updating. Self-directed learning allow learners to decide what they want to learn and arrange their order of learning. Basham (2007) outlined four fundamental characteristics of learning through CAI: Active engagement, participation in groups, connections to real-world contexts, frequent interaction and feedback. CAI is a good teaching/learning strategy that transforms education to higher standard. Castano-Munoz, Duart & SanchoVinuesa (2013) consider CAI as an effective educational tool enhancing long lasting memory and improving students' academic achievements.

2.5.1 Categories of Computer Aided Instruction

Computer Aided Instruction consists of information presented on computers in the form of text or in multimedia formats, like photographs, videos, animation, speech, and music that helps teach and encourages interaction (Arnold, 2010). They can incorporate the principles of education in addition to subject matter knowledge into the computer program. Some major categories of Computer Aided Instruction are as follows:

2.5.2 Drill and Practice

Bordy (2010) describe drill and practice as an interactive process on the computer that allows user control, give feedback and reinforcement, and also help learners to develop skills. It provides repeated exposure to facts or information, often in a question or game-type format. Drill and practice software also fit nicely into a behavioral approach to teaching and learning since it measured student performance. Drill and practice software deals primarily with lower-order thinking skills. The program does not get tired of providing students with the practice and feedback they need. Most drill and practice programs also have a tracking device so that students (and teachers) are aware of their progress. In addition, many of the drill and practice programs have sounds and other motivating characteristics that encourage students. Students can progress at their own rate while using the software. Drill and practice applications do not utilize the full power of computers. However, many drill and practice software titles are very good at what they do.

2.5.3 Computer Tutorial

In Computer Tutorial, the subject-matter is virtually taught by the computer programme with oral explanations through audio means and visual presentation of the topic on screen. The student makes many responds on a keyboard or by pointing on the screen. The computer then reacts to each responses made by the student. A kind of dialogue takes place between student and machine. Computer tutorials are based on the principles of programmed learning. The student responds to each bit of information presented by answering questions about the material and then gets immediate feedback on each response. Each tutorial lesson has a series of frames. Each frame poses a question to the student. If the student answers correctly, the

next frame appears on screen. Each frame of tutorial supplies new information or reinforces the information learned in previous frames. The student has to respond to every frame in the exact order presented, and there is no deviation from this presentation, but the student also has the freedom to work through the material at his/her own speed (Mudasiru and Adedeji, 2010).

2.5.4 Problem Solving

According to Sudip, (2016) a problem solving is a type of computer program that is designed to augment critical thinking and problem solving skills. It usually focuses on a specific type of problem solving and provides some guided practice on a number or variety of problems. Problem solving applications does not necessarily utilize realistic scenarios but allows learners to see the results of their reactions to various events. Learners manipulate variables, and feedback is provided based on these manipulations. Problem solving applications foster learning in the classroom, provided they are properly designed to match the curriculum.

2.5.5 Tool software

Tool software is the common computer application used in education nowadays. Arnold (2010) described tool software as any software that can be used as a tool for student learning. Example includes Word processors, deskstop publishing packages, spreadsheets, data bases, graphics programs, telecommunications software and multimedia. Both students and teachers can use this software, the student is using them to help them express their thoughts and show their understanding while teacher is applying them in the process of delivering instruction. Therefore, tool software helps students and teachers to manage information and facilitate

learning. The use of tool software in the curriculum is only as effective as the activity that the teacher develops.

2.5.6 Computer Simulation

Is a form of Computer Aided Instruction that provides a representation of a real situation, phenomenon or process. It is a simplified model of real or natural phenomenon, event or object where learners can observe the results of their actions. A simulation provides the opportunity for students to apply the knowledge in a realistic format without expense or risk associated with the real thing. It offers the students an experiences that otherwise would be denied. It makes good use of what the computer does well. Simulations can mimic physical objects or phenomena, processes, procedures and situations. Best used for application of knowledge, problem solving and thinking skills. A simulation is a very powerful application of computer where students are given the power to manipulate aspects of models or situations. They see the results of their decisions immediately (Burman and Trust, 2016).

2.6 Teaching Ecology with CAI Method Selected

Sometimes it is not feasible to do the real thing as stipulated in the curriculum, such knowledge require a model. A simulation provide a representation or model of a real event, object, process or phenomenon that otherwise may have been denied to the students. The major characteristics of a good educational simulation according to De-Jong and Joolingen (2007) are:

- Model Based: it is based on a model of the real situations.
- Integrated: consists of step by step directions or assignments which break the task down to help students learn effectively.

- Interactive: learner work, interact and learn the task on the model.
- Interface driven: provide feedback and guidance in the form of hints, the learner input the variable and then observes the changes in the output.

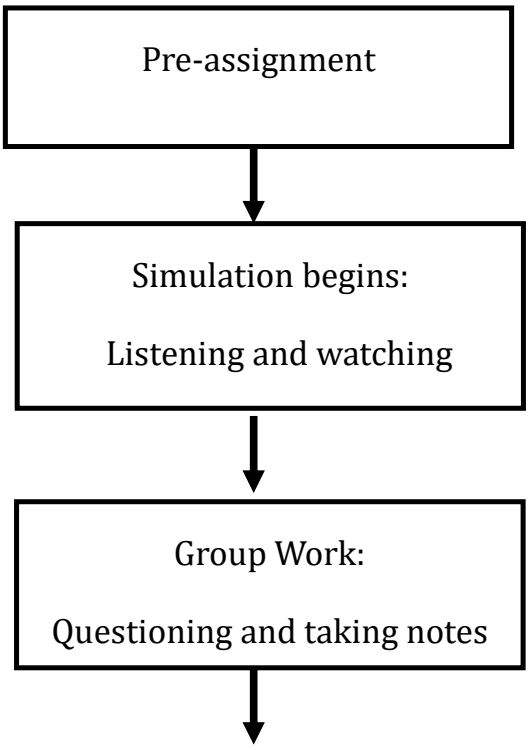
Ecology concerned with the study of the relationships of organisms with their living and non-living components of their environments (Ajaja, 2010). These involves: measuring factors affecting the environment, studying the distribution of living organisms and find out how living organisms depend on one another and their non-living environment for their survival (Ramalingam, 2010). Ecology then analyze the factors that affect population size and how and why it changes through time, it examines how interaction between species such as predation, competition, affect community structure and organization, it also emphasizes energy flow and chemical recycling between organisms and the environment (Campbell, 2008).

The study of ecology requires series of events, processes and phenomena which would normally be unavailable due to physical or economic constraints. Therefore this study used set of simulation which comprises the representations of many ecology concepts such as population, community, biome, biosphere, niche, food chain, food web. It was properly arranged to allow the learners to experience (virtually) processes and phenomena of ecology. Milligan and Thomas (2009) suggested that, simulation offer the learners a virtual understanding of phenomena which was not feasible to be acquired due to physical or economic barriers, and also permit them to examine the system and develop a deep understanding on it.

The computer aided instruction model adopted from Obeka (2009) involves the students

active participation in teaching as they were engaged in hands-on activities which involving the pre-read of textbooks prior to the instruction. Questions are asked by the teacher at the beginning of the lesson, students are then allowed to settle down and start watching the presentations, discuss and generate answers from the simulation while the teacher clarifies their little misconceptions. The steps to be followed involve;

1. Giving the pre-assignment on the topic to be taught.
2. Simulation presentation of the concept where students watch and generate the answers.
3. Group works; questioning and note taking on what they are watching.
4. Plenary session; free-discussion of what have been observed.
5. Evaluating the students by the teacher.



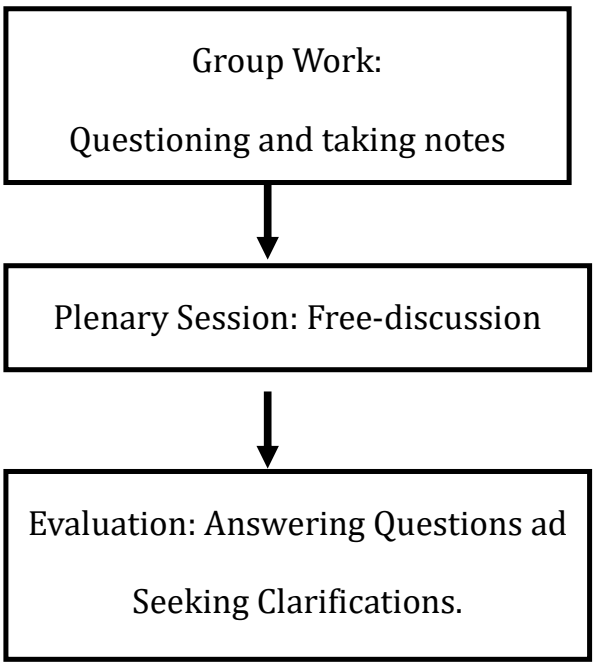


Figure 2.1: Computer Aided Instruction Model Adopted from Obeka (2009)

2.7 Students' Academic Achievement in Biology

Achievement means obtaining or succeeding in something important as a result of your efforts. Academic achievement refers to the learning outcomes which include the knowledge acquired, the skills developed and the retention ability of student in a course of study within or outside the classroom situations (Epunam, 1999). Academic achievement according to Lavin Theory (1965) is a process of expressing student's academic standing. This can be regarded as course or subject grade, an average for a set of that course or subject in a program of study example ecology. The theory further emphasizes that academic achievement measured in two dimensions each of which is experienced by students in one form or the other, they are: good achievement which leads to success, and poor achievement which leads to failure.

Science Educators recount poor academic achievement of Nigeria students in science

(Ajagun 2001 and Lakpini, 2012). Biology is among the science subject reported the failure too, and it is even more surprise compared to chemistry and physics despite the fact that Biology is the popular science subject among students (Ogunleye 1999). In Science Curriculum, Biology is one of the major science subjects whose pass at credit level determines the admission chance of student to study major professional science based courses at the university (Lawal 2010). These has continued to be the major cause of alarming dismay to curriculum planners, society, parents and the entire stakeholders.

Teaching and learning science in Nigerian secondary schools is faced with identified factors such as: lack of effective interactive teaching approaches (Bajah, 2002), lack of appropriate learning atmosphere under which science intervention can occur (Bichi, 2009), rote learning and inappropriate use of teaching strategies (Usman, 2008). One of the measures of minimizing the rate of failure in Biology is that, teachers should secure various teaching strategies to be used alongside lecture method for teaching various Biological concepts. Therefore, this study will examine the effects of computer aided instruction on biology students' academic achievement and retention in ecological concepts in Jigawa state.

2.8 Retention of Learned Concepts in Biological Sciences

Retention is the remembering of things that happened previously. Momoh (1997), viewed retention as the iterative performance developed by a learner after the interventions having ability or attempt to elicit the acquired knowledge after an interval of time. Momoh further stressed that, although retention decreases rapidly with time, it later become stable and permanent knowledge and it is affected by different factors which include the nature of original learning, the method of learning, the method of evaluation and the interval at which

retention is measured after the intervention.

According to (Haynie, 2003), retention learning is the learning which its quality last beyond the initial testing and it is evaluated with tests administered two or more weeks after the task has been delivered and tested. Haynie further explained that retention of learning is measured with two tests namely: the initial test which usually administered at the time of instruction, and the delayed retention test which is employed weeks after the initial testing. The purpose of delayed retention test is to measure how often the students retain the original learning.

Frank, Ritter, Gordon, Jong, Kim & Sowmyalatha (2010) outlined three stages of retention process as declarative, associative and Procedural stages. Declarative stage concern with leaning and forgetting, knowledge in declarative mind is devalued with lack of use, learning and forgetting are justified by the activation mechanism where declarative memory declines leading to increased response time and decreased retention and performance accuracy. In the Associative stage, learning task are represented by a mix of declarative and procedural memory, lack of use (declarative) knowledge are forgotten while procedural knowledge are immune to decay however, training may be required to keep the declarative knowledge active and also to support further proceduralization because the activation of declarative memory is required to generate procedural rules. The third stage of retention learning according to Frank, Ritter, Gordon, Jong, Kim & Sowmyalatha (2010) is procedural where the task knowledge is presented in both declarative and procedural forms, but procedural knowledge predominantly drives performance, the learner then can perform the task and not forgotten them with time.

Nussbaum (2000) conducted a study examines differences in retention of learned material using lecture based and small group-based teaching methods in a continuing medical education course. The result revealed a significant difference in favour of lecture based classes. They retained information better than the small group classes. OKoli (2006) separated second year gastrointestinal medical students in to two groups one attended teacher-centered lecture based classes and the other student-centered small group-based classes. The finding suggests that the small group-based classes retained the learnt materials than lecture-based classes. In another study, Fred (2007) suggested that outdoor educational trip presents biological concept being studied in its natural environment for such it has been recognized as a good teaching device. Maikano (2010) conducted a comparism between outdoor and indoor laboratory teaching strategies on secondary schools students' academic achievement and retention in ecology.

The result revealed that, the experimental group taught ecological concept using the outdoor laboratory approach achieved greatly higher than the control group subjected to indoor laboratory treatment. Also another study by Harrison (2006) tested medical students, by comparing knowledge retention after one year interval between groups assigned to attend either lectures or self-study classes. On both the original final examination and retention examination, there were no statistically significant differences between the two groups' performance. However, the present study set to investigate the effects of computer aided instruction on biology students' academic achievement and retention in secondary schools.

2.9 Gender and Computer Utilization in Science

In the present scenario, there are very few places where women are denied a formal right

to education. However, as is already established, formal equality is inadequate to ensure and guarantee equality of rights between men and women. Even when the state provides girls with access to education, gender discrimination can be reinforced by practices such as a curriculum which is inconsistent with the principles of gender equality, by arrangements which limit the benefits girls can obtain from the educational opportunities offered, and by unsafe or unfriendly environment which discourage girls‟ participation. True equality in education requires the development of specific and effective measures to ensure that female students are provided with access to the same curricula and other educational and scholarship opportunities as male students (Murugesan and Muthu, 2011).

Many factors have been identified as hindrances to the use of computer in schools. Among these are cost of purchase, irregular electricity supply, computer illiterate teachers and gender attitudes (Ssewanyama and Bosler, 2007). Studies have shown differences in the attitudes of male and female students upon the use of computer in schools. In a study carried out by Spotts, Bowman and Mertz (1997) in USA on gender and use of instructional technologies males rated higher than females with knowledge and experience with some innovative technologies. For frequency of use, no significant differences were found with the exception of video, where females indicated use that is slightly more frequent. Both rated technologies as important to instruction. Few decades ago, the computer was observed to be male dominated and its usage belonged to teachers comprised mostly of men (Huynh, Lee and Schuldt 2005). In their studies, they found that there is no statistically significance validating gender differences in pattern of online interaction between male and female students.

The research conducted by Mitra, Lenzmeier, Avon, Qu and Hazen (2000) on gender and computer use in an academic institution examined the nature of the relationships between gender, computer utilization and attitudes. The students were provided with network access and laptop computers over a four year period. The results indicated that the attitude and the level of Computer utilization of women were less positive and less frequent compared to men.

There is a slight change in the females participation compared to the earlier days of computing when research had indicated that men were more positively disposed toward computers than women. Achuonye and Olele (2009), in their study on Internet using patterns of Nigerian teacher-trainees, found that more female students were personally connected to the internet than their male counterparts; but that male students surf the internet more than females. Yusuf and Afolabi (2010) concluded that gender has no influence in the academic performance of male and female students exposed to CAI either individually or co-operatively. This study therefore investigated not only the effect of gender on the use of computer but also the effect of computer use on students' academic performance.

Similarly, Achuonye (2011) conducted a study on Using computer in science class: The interactive effect of gender. The result showed that there is no significant difference in the performance of male and female students in the use of computer in the learning of Science - Biology. Specifically, gender does not influence the use of computer in the learning process. Mishra and Kiran (2015) Concluded that application of computer bring new information resources that open new communication channel which serve as a new avenue for bridging the gender gap and promoting gender equality.

2.10 Review of Related Empirical Studies

Many research studies were conducted globally on the relationship between computer aided instructions and student achievement. In Turkey Koseoglu and Efendioglu (2015) determined the effects of multimedia-based biology teaching (MBio) and teacher-centered biology (TCBio) instruction approaches on Biology learners' achievements, as well as their views towards learning approaches. An experimental design with two groups, TCBio and MBio were used.

The results of the study proved that the MBio approach was more effective than the TCBio approach with regard to supporting meaningful learning and academic achievement, Moreover; the TCBio approach is ineffective in terms of time management, engaging attention, and the need for repetition of subjects. The finding determined that an analysis of covariance (ANCOVA) was performed between the post-BA scores of the students and the result reveals that there is a significant difference between the postBA scores of the students in the MBio and TCBio groups. The result further determined that average post-BA scores of the students in the MBio group are significantly higher than those of the students in the TCBio group. The study does not find out the effect of computer aided instruction on the retention of Biology students, it does not determine gender differentials of the students exposed to MBio teaching strategy. This is a gap which will be bridged in the present study.

Vinita and Shikha (2015) carried out the research in India titled: The retention effect of computer assisted instruction (CAI) on students' academic achievement for teaching the chemistry topics of class VIII students. Quasi-experimental research design were employed. The population comprises of all students in class VIII of the schools, 80 students were structured as both control and experimental groups. Traditional instruction method is used for

control group while experimental group was subjected to computer assisted instruction. Chemistry achievement test was administered after the experiment. T-test was used in finding the significance of difference between means of the 2 groups. (Experimental and control groups). The results of the study shows that students whose subjected to computer assisted instructions have high learning retention for a long period of time than those taught using traditional lecture method.

The study investigated the impact of Computer assisted instruction on learning retention of the class VIII chemistry students. The effect of CAI method on students academic achievements and gender differentials were not examined in the study. While the present study will determine academic performance, gender differential and learning retention of senior secondary schools students.

Similarly, Muchiri and Nephat (2015) carried out a research in Kenya on the Effect of computer assisted teaching strategy on students' motivation to learn agriculture in secondary schools. The research was conducted in eight county secondary schools in Tharaka Nithi County, Kenya, form one students were selected because the topic on Livestock Production (Common livestock breeds) is taught at their level. Stratified random sampling technique was used to select 4 girls' and 4 boys' secondary schools. A total of 163 boys and 164 girls participated in the study. The study employed Solomon Four-Quasi-experimental design. Data was collected by a Motivation towards Agriculture (MTA) questionnaire. The findings indicated that Computer Assisted Technology (CAT) strategy enhanced motivation to learn agriculture hence there was a significant difference on motivation to learn agriculture for the four groups after exposure to CAT strategy, with a significant difference from the two groups

that received treatment.

The study is delimited to secondary school students' motivation, gender differences in motivation has not been examined. The study also did not find out the effect of computer assisted teaching strategy on students' achievement and retention which are very vital in transforming teaching and learning and hence it is a gap which need a further study.

Olalekan and Oludipe (2016) carried out a research in Ekiti state university on the effects of Computer Simulation Instructional Strategy on Biology Students' Academic Achievement in DNA replication and transcription. The study employed pretest posttest quasi-experimental control group design. A total of fifty (50) undergraduate 300 level biology education students (25 students each for experimental and control) were involved in the study. All the selected students were assigned numbers from 1 to 50 and divided into 2 group using even and odd numbers. The even numbers make up the experimental group while the odd numbers make up the control group. The sample includes 14 males and 36 females. All students have the same background in genetics. Experimental group are exposed to experimental treatment that is, teaching using computer simulation instructional strategy, while control group are taught using lecture method.

The result revealed that Students taught DNA replication and transcription using computer simulation instruction strategy recorded the higher mean score than those taught using lecture method, which showed that there is a significant difference in the academic achievement of the two groups. indicating that they understood the concept more than those taught using lecture method. Also from the finding, the mean achievement scores of male and female students for computer simulation instruction strategy showed that there was no

significant difference in the performance of male and female students.

Sasikala and Tanyong (2016) determine the utility of simulation methods in biology teaching for nursing students and academic success. Pretest posttest Experimental group design were used,100 students (50 control, 50 experimental) participated in the study. The result revealed that the experimental group who were taught by simulation method performs significantly better than the control group who received traditional method of instruction. The results further implied that, experimental students who taught by using simulation method were satisfied with simulation-based biology education. The study does not examine the effects of Computer Simulation Instructional Strategy on retention of the students as well as the gender difference in their retention abilities.

Another research was conducted by Cyril (2014) on the Effects of Computer-Assisted Instruction and Demonstration Method of Teaching Automobile Technology in Federal Colleges of Education (Technical) in North-Eastern Nigeria. Federal colleges of Education (Technical) Yobe and Gombe were selected for the study. The researcher adopted pre-test and post-test non-equivalent quasi experimental design. Automobile Technology students of Federal college of Education (Technical) Potiskum were taught using computer assisted instruction while that of Gombe were taught using demonstration method of teaching. The result reveals that the application of computer-assisted instruction in teaching automobile technology resulted in a higher students achievement than demonstration method of teaching.

However, the study does not examine the effect of computer assisted instruction and demonstration method of teaching on learning retention and gender differential of the learners (if any), this is a gap which the present study intended to fill.

Research was also conducted by Atadoga, Mari and Danjuma (2016) In Niger State, Nigeria on the Effects of Computer Assisted Instruction on Academic Achievement of Nigeria Certificate in Education Physics Students. The study adopted pretest and posttest quasi experimental control group design. Two hundred and eleven (211) consisting of 129 male and 82 female NCE II students from the two colleges of education in Niger State were used as research sample. The two groups were pretested using Mechanics and Properties of Matter Achievement Test (MPMAT) before treatment. The experimental group was taught using Computer-Assisted Instruction (CAI) while the control group was taught using lecture method. After the treatment, Posttest was administered to the subjects of the two groups.

The result reveals that students exposed to the use of the Computer Assisted Instruction were found to be significantly better in their performance than those who were taught with the conventional lecture method. The result also reveals that there is no significant difference in the academic achievement of male and female students in the experimental group exposed to CAI in physics at NCE level.

The study was delimited to NCE students, their academic performance and gender equality were examined. However, further study can still be conducted to determine variables like students' retention and motivation hence, the present study attempt to examine students' academic achievement, students' retention as well as gender equality.

In another research conducted in Nigeria by Kareem (2015) on the effects of computer-assisted instruction (CAI) in Biology compared to the traditional method of teaching on senior secondary school students' achievement and attitude. The study covered co-educational senior secondary school II students in three secondary schools one in each

senatorial districts of the Osun state. All the SS II students were offering Biology in their schools. One-group pretest-posttest experimental design was used. Students' pre- and posttest examination scores were used to assess the effect of the instruction.

From the findings, the treatment was statistically significant on the students achievement. The introduction of computer-assisted instruction into SS II has showed from the findings to improved students' academic achievement in Biology. However, the result showed non-significant effect of gender on students' academic achievement. The study also shows no significant effect of students' attitude towards computer-assisted instruction.

The study emphasized on students attitude and achievement but does not examine the effect of Computer Assisted Instruction on students' motivation as well as retention level. This is a clear weakness which may have led to a limited implication of the study to science education.

2.11 Implications of the Literature Review for the Present Study

From the review of empirical studies, it is clear that Computer aided instruction effect the students' performance positively hence a remarkably improved achievements was found. The use of computer facilitates instruction thus improving understanding of the content of the subject and therefore improves students' academic achievement. Computer Aided Instruction reduces gender inequalities and filling out the gender gaps. This may be due to the computer aided instruction produces the same learning effect on both genders.

The study has identified pedagogical and technological features of teaching biology through computer. The study has implications for practice and further research in Jigawa state, Nigeria. The study has provided review of the activity based approach of instruction and has

added literature to the use of computer in the teaching and learning biology. The current biology curriculum recommends the application of technology and development of skills and knowledge in creating successful collaborative learning in the meaningful learning atmosphere. This encourages students to learn better through engaging meaningful activities organized by the teacher.

The related literature reviewed focuses mostly on the effects of Computer Assisted Instruction on students' academic achievements, students' motivation, and gender influence if any. Although little of the researchers suggest no significant effects of CAI on students' performance, but majority revealed that Computer Assisted Instruction positively affects students Achievements, increases students' motivation and encourages gender equality respectively. However, there were inadequate literatures on the effects of Computer Assisted Instruction on Biology Students retention of learned Biology concepts as well as gender issues on retention of learned Biology concepts. The little literature available shows significant effects of CAI on retention abilities of learned Biology concepts without gender differentials.

Therefore, the present study bridges such gap by providing an added literature on the effects of CAI on Performance and Retention of male and female Biology students in Secondary Schools were significant effects was found.

CHAPTER THREE
METHODOLOGY

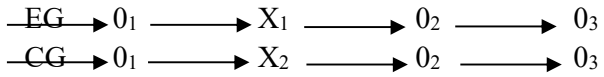
3.1 Introduction

This chapter describes the method, procedures and techniques used in the conduct of the study. Specifically, it discusses the research design, population, sample and sampling technique, selection of topics, data collection instrument, validity and reliability of the

instrument, item analysis, data collection procedure as well as procedure for data analysis

3.2 Research Design

The study adopted a Quasi-experimental research design where students from SS 2 classes were involved. The design is illustrated thus:



Where:

EG = Experimental Group
CG = Control Group
O_1 = Pre-test
X_1= Treatment 1 (Computer Aided Instruction)
X_2= Treatment 2 (Lecture method of teaching)
O_2= Post-Test
O3= Post-posttest (Retention Test)

Figure 3.1 Research Design

3.3 Population and Sample Size of the Study

3.3.1 Population of the Study

The population of this study consists of all Senior Secondary School students in Ringim Education Zone. According to Jigawa State Ministry of Education Science and Technology, there are thirty (30) Senior Secondary Schools in the Zone. Among these schools are six boarding secondary schools of which four are only girls and two are only boys, one day girls' Secondary School, one day boys' Secondary School and twenty two (22) co-educatiomal Schools. But because gender is a major variable of this research study, twenty two (22) co-educational Schools consisting seven thousand five hundred and sixty seven (7567) students were considered as the population of the study. The students are from SS II with average age of 16 to 17 years males and females and majority of them are Hausa by tribe.

Table 3.1 indicated the names of Schools, their status as well as the number of students enrolled in to each school.

Table 3.1: Population of Secondary Schools in Ringim Zone, Jigawa State

S/N	Names of Schs.	Status	No. of SSI Students	No. of SSII Students	No. of SSIII Students	Total
1.	GDSS Gujungu	Co-educational	108	87	98	293
2.	GDSS Kiri	Co-educational	80	72	50	202
3.	GDSS Suntilmawa	Co-educational	45	34	42	121
4.	GDSS Chai-Chai	Co-educational	49	40	41	130
5.	GDSS Kwalam	Co-educational	137	120	88	345
6	GDSS Garki	Co-educational	114	176	126	416
7.	GDSS K/Babba	Co-educational	136	116	122	37
8.	GDSS G/Gudinya	Co-educational	52	57	62	171
9.	GDSS Babura	Co-educational	269	218	270	757
10.	GDSS Jigawa	Co-educational	146	130	140	416
11.	GDSS Taura	Co-educational	197	140	138	475
12.	GDSS Yandutse	Co-educational	48	42	38	128
13.	GDSS Doko	Co-educational	44	45	41	130
14.	GDSS Sankara	Co-educational	109	99	92	300
15.	GDSS Maje	Co-educational	86	80	84	250
16.	GDSS Majia	Co-educational	94	73	75	242
17.	GDASS Dabi	Co-educational	99	90	104	293
18.	GDASS S/G ya'ya	Co-educational	89	66	59	214
19.	GDASS A/Masallachi	Co-educational	373	356	360	1089
20.	GDASS Taura	Co-educational	170	151	134	455
21.	GDASS Babura	Co-educational	161	79	110	350
22.	GDASS Garki	Co-educational	190	226	---	416
	Total		**2796**	**2497**	**2274**	**7567**

Source: Jigawa state Ministry of Education Science and Technology (2017)

3.3.2 Sample Size of the Study

The target sample of this study consists of two hundred (200) SS II students offering Biology at the selected secondary schools. Two (2) Co-educational secondary schools were randomly selected to represent the sample of the study. One (1) school serves as the control group while the other one (1) served as the experimental group. The Experimental group

consists of 120 students of which 92 are males and 28 are females. While the Control group consists of 60 male and 20 female students

Table 3.2: Sample Size of the Study

Schools	No. of Male Students	No. of Female Students	Total No. of Students
GDSS Kwalam	92	28	120
GDSS Maje	60	20	80
Total	**152**	**48**	**200**

3.3.3 Sampling Technique

Simple Random Sampling Technique was employed in identifying the sample of this study and intact classes were used so as the normal organizational settings of the classes were not interrupted. In simple random sampling each population element has the equal chance of being selected for the sample (Battaly, 2017). All the SS I Biology students of Ringim Education Zone are believed to have preliminary knowledge of ecology concepts, SS III students were highly engaged in preparation for external examinations while SS II students were being taught the main concepts of ecology, hence the researcher chose SS II students as the main focus of the study. The selection of control group and experimental groups from the two sample schools was carried out through balloting. The reason for choosing one control and one experimental group is that twenty two secondary schools in Ringim Education Zone are co-educational hence gender is a major variable in this research study.

3.4 Selection of Ecology Concepts to be Taught

Four Ecology topics were chosen for this study. The four topics chosen to be taught are from Biology syllabus used in senior secondary schools. The selected topics were basic ecological concepts, population and community, Ecosystem and Symbiosis. Ecology is a content of biology syllabus meant for senior secondary students at SS II. It is considered as abstract in nature and difficult to understand which has resulted in poor performance among students (Danmole and Femi-Adeoye, 2004; Nichols, Hanan, & Ranasinghe, 2013).

Table 3.3.3 Table of Specification of the Instrument Based on Topics Selected

S/N	Topics Selected	Items	Total
1.	Basic Ecological Concepts	1, 2, 3, 4, 5, 13 and 25	7
2.	Population and Community	6, 7, 10, 19, 20 and 24	6
3.	Ecosystem	8,11,12,15,16,18 and 22	7
4.	Symbiosis	9, 14, 17 ,21 and 23	5
	Total		**25**

3.5 Data Collection Instruments

Biology Achievement Test on Ecological Concepts (BATEC) was the instrument used for collecting data on students' academic achievement for this study. The test contains twenty five items of multiple-choice questions type developed around the learning areas under the topic ecology (Basic ecological concepts, Population and community, Ecosystem and Symbiosis). The test items were adopted from the WAEC and NECO past questions.

Biology Achievement Test on Ecological Concepts (BATEC) administered as Post-Test were reframed or restructured and administered three weeks after Post-Testing to generate the data

on retention abilities of the students.

3.6 Validity and Reliability of the Instrument

3.6.1 Validity of the Instrument

To validate is to make sure the instrument measures what it supposed to measure. The researcher takes a copy of the instrument to the supervisor for approval and then takes the copies to six experts for validation. Content and face validity were ascertained by one senior lecturer from the Department of Science and Technology Education, three senior lecturers from Biological Sciences Department, Bayero University Kano, one senior lecturer from the Department Biological sciences, Federal College of Education Kano and one Biology teacher from Jigawa State Ministry of Education Science and Technology. The judgment and assessment of the above chosen experts determined that the instrument is well structured and cover the area of the study domain.

3.6.2 Reliability of the Instrument

The researcher conducted a pilot testing to twenty (20) SS II students at Government Day Secondary School Majia hence they are not part of the sample but have similar characteristics with selected sample. Test re-test method was used and Pearson Product Moment Correlation Co-efficient statistics was used in calculating the co-efficient of the test items which was 0.83. This shows that the test items are reliable and can be used for the study.

3.6.3 Item Analysis

Item analysis is the statistical methods used to assess the quality of the test items (Si-Mui and Raja 2006). The most common statistics reported in an item analysis are the Difficulty index (P) and Discrimination index (D).

Difficulty Index

Difficulty index is a method used to ascertain the number of respondents with correct responses. It is a measure of the proportion of examinees who answered the item correctly. It can be obtained using the formula;

Difficulty Index $(P) = \frac{N_1}{N}$ where:

N_1 is the number of correct responses on the question.

N is total number of students who attempted the question.

Si-Mui and Raja (2006) recommend the items of 0.3 to 0.8. In this study the range 0.30 to 0.75 were maintained. This indicates that items below 0.3 considered being difficult while above 0.75 considered too cheap. See appendix G page 110.

Discrimination Index

Discrimination index is a method of assessing the standard of the test items by measuring the differences between the students in the upper and lower groups (Rahim and Jaleel 2012). The Discrimination index can be calculated using the formula:

Discrimination $(D) = \frac{U_p - L_p}{U}$ where:

U_p is the upper group

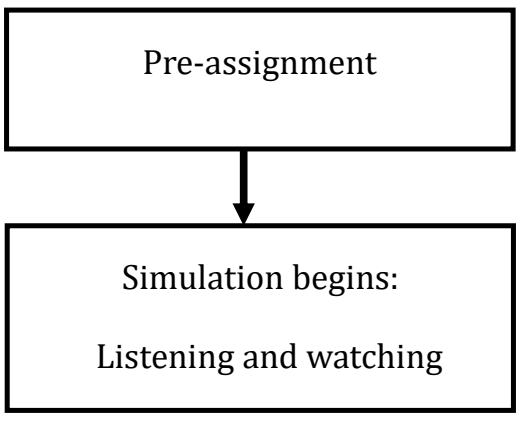
L_p is the lower group

U is the number of test takers in the upper group

The Discrimination Index calculated for this instrument used in this study ranges between 0.43 to 0.71. According to Mitra, Nagaraja, Ponnudurai and Judson (2009) the items with Discrimination index of 0.4 and above is considered good and acceptable. See appendix H page 111.

3.7 Administration of Treatment to Experimental Group

The Experimental group exposed to Computer Aided Instruction, the students were firstly grouped into smaller groups which consist of six mixed students, and then the researcher as a facilitator allows the students to settle down followed by a pre-class assignment which enhanced their performance and prepared them for an active participation in the class instruction. Each group was provided with a computer which contained a representation of ecology concepts such as population, community, biome, biosphere, niche, ecosystem, food chain, food web, symbiosis etc. It was properly organized to allow the learners to experience processes and phenomena of ecology. The teacher asked the students to log-in where the topics appears on the screen, the students engaged in note taking and questioning, then click on the next bottom where lessons was automatically started for the students to listen, watch and take notes on their own. The researcher directed the students to repeat the activities until they fully understand the concepts and then allowed them to engage in a free discussion on what they have seen and learned. The researcher further evaluate the students by asking questions to the students while, the students responded to the questions, take corrections and seek clarification on what they don't understand. During the lesson the students participated actively while the researcher gave a limited assistance to them. The flowchart of the treatment as proposed by Obeka (2009) is shown in Figure 3.2.



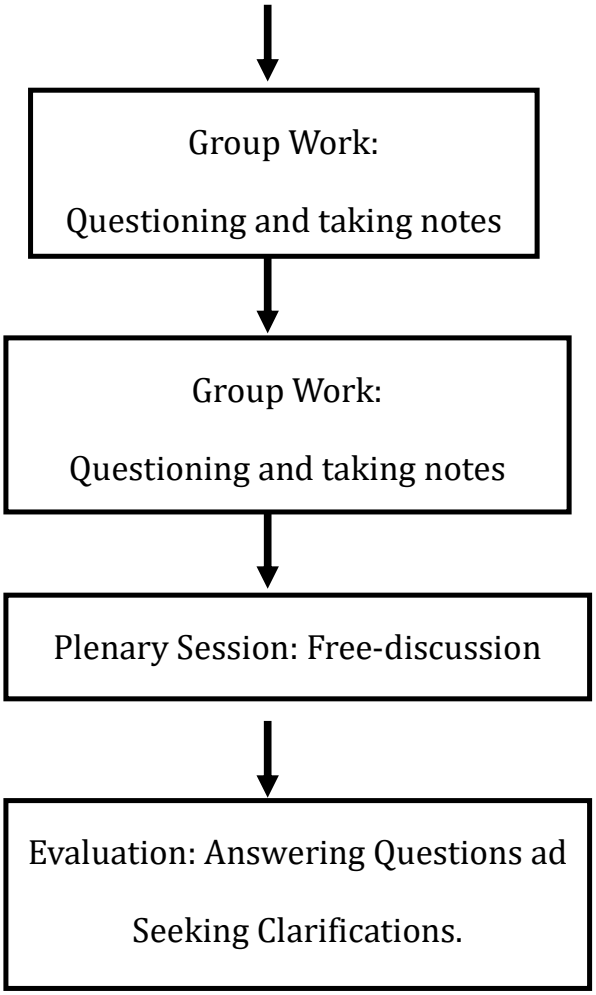


Figure 3.2: Flowchart of the Simulation Process Adapted from Obeka (2009)

The teacher give the students a pre-assignment on the topic to be taught which were asked at the beginning of the lesson, then allowed them to settle down and generate the answers through listening and watching at the simulation presentation. The teacher gives room for the students to take notes and clarifies their misconceptions during group works and free-discussion. The teacher then evaluates the students by asking them questions based on what they have observed and learnt.

3.8 Data Collection Procedure

The researcher collected the introductory letter from the supervisor and takes it to Jigawa State Ministry of Education Science and Technology for permission to carry out the research on the selected Schools. The Ministry granted the permission and directed the researcher to Ringim Education Zonal Office and then to the selected Schools. The data of this study were gathered through the administration of Biology Achievement Test to both experimental and control groups as Pre -Test and Post-Test. The scripts were collected and marked using the marking scheme; each correct answer was awarded four marks. The data collected were recorded based on school, gender, experimental and control groups.

The Post-Test were restructured and administered to students after two weeks, the scores obtained were used for the data analysis to determine the students' retention abilities of the groups.

3.9 Data Analysis Procedure

After the data were collected, the statistical package used for data analysis was the Statistical Package for Social Science (SPSS). The descriptive statistics such as mean and standard deviation were used in answering research questions 1-4; while the inferential

statistics was used in testing hypotheses 1-4 at Alpha value $P \leq 0.05$ level of significant. Thus:

HO_1: There is no significant difference in the academic achievement of Biology students in secondary schools in Ringim Education Zone Jigawa State.

Z-Test statistics was used in testing Hypothesis 1 at 0.05 level of significant.

HO_2: There is no significant difference in the academic achievements of male and female students in the Experimental group exposed to Computer aided instruction.

Z-Test statistics was used in testing Hypothesis 2 at 0.05 level of significant.

HO_3: There is no significant difference in the post-posttest mean scores of Biology students taught using Computer aided instruction in Ringim Education Zone Jigawa State.

Z-Test statistics was used in testing Hypothesis 3 at 0.05 level of significant.

HO_4. There is no significant difference in the retention of male and female students in the Experimental group exposed to Computer aided instruction.

Z-Test statistics was used in testing Hypothesis 4 at 0.05 level of significant.

CHAPTER FOUR
DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This study investigated the effect of Computer Aided Instruction on Performance and Retention in Ecology among Secondary Schools Biology Students in Ringim, Jigawa State, Nigeria. This chapter deals with analysis of data and discussion of the results in relation to the research questions and hypotheses stated. The data were analyzed using computer Software Package for Social Sciences (SPSS). The hypotheses were either retained or rejected at 0.05 level of significance. Specifically, this chapter discusses Data Analysis and Result Presentation, Answering Research Questions, Hypotheses Testing, Summary of findings as well as Discussion of Findings.

4.2 Data Analysis and Result Presentation

4.2.1 Answering Research Questions

Research Question 1: What is the effect of Computer aided instruction on Biology students' academic achievement in senior secondary schools in Ringim Education zone Jigawa State?

To answer this research question, the post-test scores of the experimental and control groups were subjected to descriptive statistics. Means and standard deviations were computed and used to draw Table 4.2.1

Table 4.2.1 Mean and Standard Deviation of Post test scores of Experimental and Control Groups

Variable	N	Mean	SD	MD
Experimental	120	63.00	10.16	7.50
Control	80	55.50	8.42	

Table 4.2.1 shows the mean scores and standard deviation of post-test administered to the experimental and the control groups. The result revealed the mean value of 63.00 for the experimental group and 55.50 for the control group; also, the experimental group has standard deviation value of 10.16, while the control group standard deviation was 8.42. This shows that students taught Ecology Concepts using CAI techniques performed better than those taught using lecture method of teaching.

Research Question 2: Is there any gender difference in academic achievements of Biology students in the Experimental group exposed to Computer Aided Instruction?

To answer this research question, the post-test scores of the experimental group were sorted out according to gender and subjected to descriptive statistics. Mean and SD were computed and used to draw Table 4.2.2.

Table 4.2.2 Mean and Standard Deviation of Post-test Scores of Male and Female Students in the Experimental Group

Variable	N	Mean	SD	MD
Male	92	62.39	10.62	
				0.11
Female	28	62.28	13.35	

Table 4.2.2 presents the mean scores and standard deviation of post-test administered to male and female students in the experimental group. The result shows the mean score of 62.39 for male students and 62.28 for female students; also, the standard deviation of 10.62 for males and 13.35. Based on this result it is apparent that there is no difference in the achievement of male and female Biology students when exposed to computer aided instruction in senior

secondary schools in Ringim Education zone, Jigawa state.

Research Question 3: What is the effect of Computer aided instruction on the Retention of Biology students in secondary schools in Ringim Education zone Jigawa, State?

To answer this research question, the mean and standard deviation of the Post-posttest scores were computed and used to draw Table 4.2.3.

Table 4.2.3 Mean and Standard Deviation of Post-posttest Scores of Experimental and Control Groups

Variable	N	Mean	SD	MD
Experimental	120	61.22	10.60	8.52
Control	80	52.70	9.42	

The result in Table 4.2.3 shows the mean retention scores of the experimental group as 61.22 while that of control group is 52.70; also, standard deviation of 10.60 for the experimental group and 9.42 for the control group. It means the students in the experimental group retain the learnt material higher than those in the control group. This shows that there is positive effect of computer aided instruction on the retention of Biology students. Hypothesis three will further determine whether there is significant difference or not.

Research Question 4: Is there any gender difference in retention of Biology students in secondary schools in Ringim Education zone Jigawa, State?

To answer this research question, the mean and standard deviation of the Post-posttest

scores of male and female Biology students were computed and used to draw Table 4.2.4.

Table 4.2.4 Mean and Standard Deviation of Post-posttest Scores of Male and Female Students in the Experimental Group

Variable	N	Mean	SD	MD
Male	92	61.43	11.58	1.26
Female	28	60.17	11.16	

Table 4.2.4 presents the mean and standard deviation of the post-posttest scores of male and female students in the experimental group exposed to computer aided instruction. The male students got the mean score of 61.43 with standard deviation of 11.58, while the female students got the mean score of 60.17 with standard deviation of 11.16. On comparing the two means, there is slight difference between mean scores of male and female students. To know whether the difference is significant or not, null hypothesis four was formulated and tested.

4.3 Hypotheses Testing

Four null hypotheses were formulated to give statistical validation to findings of the study. The hypotheses are tested to determine its acceptance or rejection thus:

HO_1: There is no significant effect of Computer aided instruction on Biology students' academic achievement in secondary schools in Ringim Education zone Jigawa State.

To test this hypothesis, the mean scores of students in experimental and control groups were compared using z-test at 0.05 level of significance. The results obtained are presented in Table 4.3.1

Table 4.3.1 Summary of z-test Analysis of Post-test scores of Experimental and Control Groups

Variable	N	Mean	SD	Df	Z-value	P-value	Decision
Experimental	120	63.00	10.16	198	4.23	0.000	H_0 Rejected
Control	80	55.50	8.42				

The results in the Table 4.3.1 shows significant difference in the academic achievement of experimental and control groups. The experimental group has higher mean of 63.00 than that of control group with mean score of 55.50. The calculated Z-value is 4.23 with P-value 0.00 at 0.05 alpha level and 198 degree of freedom. Therefore the null hypothesis which states that there is no significant effect of Computer aided instruction on Biology students' academic achievement in secondary schools in Ringim Education zone Jigawa State was rejected. The result obtained revealed that teaching ecology concepts with CAI is positively effective in enhancing students' academic achievement.

HO_2: There is no gender difference in academic achievements of Biology students in the Experimental group exposed to Computer aided instruction.

To test this hypothesis, the mean scores of male and female students in experimental group were compared using z-test analysis as presented in Table 4.3.2.

Table 4.3.2 Summary of z-test Analysis of Post-test scores of Male and Female Biology students in the Experimental Group

Variable	N	Mean	SD	Df	Z-value	P-value	Decision
Male	92	62.39	10.62	118	1.06	0.299	H_0 Retained
Female	28	62.28	13.35				

Table 4.3.2 presents the results of z-test analysis of male and female students in the experimental group. The male students obtained the mean score of 62.39 and female students obtained the mean score of 62.28. The Z-test value calculated is 1.06 which is less than P-value 0.299 and hence the null hypothesis which stated as: there is no gender difference in academic achievements of Biology students in the Experimental group exposed to Computer aided instruction was retained. The result shows no significant difference between male and female students when exposed to computer aided instruction.

HO_3: There is no significant effect of Computer aided instruction on the retention of Biology students in secondary schools in Ringim Education zone Jigawa State.

To test this hypothesis, the mean of post-posttest scores of students in experimental and control groups were compared using z-test analysis as shown in Table 4.3.3

Table 4.3.3 Summary of z-test Analysis of Post-posttest Scores of Experimental And Control Groups

Variable	N	Mean	SD	Df	Z-value	P-value	Decision
Experimental	120	61.22	10.60	198	5.83	0.000	H_0 Rejected
Control	80	52.70	9.42				

Table 4.3.3 shows significant difference in the retention abilities of experimental and control groups. The experimental group has higher retention abilities with mean score of 61.22 compared to that of control group with mean score of 52.70. The calculated Z-value 5.83 is greater than 0.05 alpha level. Therefore the null hypothesis which stated no significant effect of Computer aided instruction on the retention of Biology students in secondary schools in

Ringim Education zone Jigawa State was rejected. The result obtained revealed that computer aided instruction positively effects Biology students' retention abilities in senior secondary schools in Ringim education zone Jigawa state.

HO_4. There is no gender difference in the retention of Biology students in secondary schools in Ringim Education zone Jigawa State.

To test this hypothesis, the mean of post-posttest scores of male and female students in experimental group were compared using z-test analysis as presented in Table 4.3.4.

Table 4.3.4 Summary of z-test Analysis of Post-posttest Scores of Male and Female Biology Students in the Experimental Group

Variable	N	Mean	SD	Df	Z-value	P-value	Decision
Male	92	61.43	11.58	118	0.53	0.603	H_0 Retained
Female	28	60.17	11.16				

Table 4.3.4 shows that at degree of freedom 118, the z-value calculated is 0.53 and P-value obtained is 0.603 which is greater than 0.05 alpha level. The null hypothesis stated as: there is no gender difference in the retention of Biology students in secondary schools in Ringim Education zone Jigawa State was retained hence Z-critical is greater than Z- value calculated. The result obtained indicate that computer aided instruction is gender friendly hence no significant gender difference was obtained.

4.4 Major Findings

The following findings emerged from the study based on the collected and analyzed data:

1. There was a significant difference in the post-test scores of students taught ecology concepts with the use of computer aided instruction when compared with those taught using the traditional lecture method of instruction Z-value calculated = 4.23, P-value = 0.00 at 0.05 level.
2. There was no significant difference in the performance between male and female students taught ecology concepts using computer aided instruction Z-value calculated = 1.06, P-value = 0.299.
3. There was a significant effect of Computer aided instruction on the retention of Biology students in senior secondary schools as obtained from the Post-posttest scores of students taught ecology concepts using computer aided instruction Z-value calculated = 5.83, P-value = 0.00.
4. No significant difference on the retention abilities between male and female Biology students when taught ecology concepts using computer aided instruction Z-value calculated = 0.53, P-value = 0.603.

4.5 Discussion of Findings

The data presented in Table 4.2.1 provided answer to research question one whose finding revealed that students taught ecology concepts using computer aided instruction achieved higher mean score than those students taught using the lecture method in the achievement test. In the same vein, z-test analysis was used in testing the first hypothesis, Table 4.3.1 with the calculated z-value of 4.23, and P-value 0.00 at 0.05 alpha level. The result shows a

statistically significant difference between the mean score of the group taught with computer aided instruction and those taught using the lecture method in their achievement. The implication of this finding is that computer aided instruction is more effective than traditional method of teaching in enhancing Students' achievement in ecology concepts. This result is similar to that of Kareem (2015) who found that there was a significant difference in the biology achievement of experimental group taught with CAI and control group taught with traditional teaching method in favour of the experimental group. Koseoglu and Efendioglu (2015) in their study on "Effects of multimedia-based biology teaching and teacher-centered biology instruction approaches on learners' achievements" also found out that the use of multimedia-based in teaching biology improved the students' achievement better than the students taught through teacher-centred biology instruction. The finding is also similar with the studies carried out in other fields of learning on students' academic achievement by Muchiri and Nephat (2015), Atadoga, Mari and Danjuma (2016), Cyril (2014) who in their separate studies found that computer based teaching produces achievement effects superior to other conventional teaching methods.

Table 4.3.2 summarizes how hypothesis two was tested. The Z-value calculated is 1.06, and P-value is 0.299 at confidence level of 0.05. The result indicates no significant difference in the academic achievement of male and female students taught Ecology concepts with the use of computer aided instruction. This result indicated that the effectiveness of treatments on students' achievement in ecology concepts does not depend on the students' gender. Hence, there were no differential effects of treatments on male and female, which implies that computer aided instruction is more effective than conventional teaching methods in

improving students' achievement in ecology concepts irrespective of their gender. Therefore Computer Aided Instruction is gender friendly hence both male and female students performed equally well.

The result of this study is similar to that of Olalekan and Oludipe (2016), Sasikala and Tanyong (2016) whose their studies revealed no significant difference in the mean scores of the students with respect to their gender when exposed to CAI in the treatment group. The opportunity given to students to interact with course materials provided by the use of computer aided instruction tended to transform their interest and enhance a better learning outcome regardless of their gender (Brewer 2003).

The data presented in Table 4.3.3 provided answer to research question three. Findings revealed that computer aided instruction has a significant effect on the retention of biology students in the experimental group whose taught ecology concepts using CAI. Z-test analysis was used to test the third hypothesis, table 4.3.3 shows the calculated Z-value 5.83, P-value 0.00 at confidence level of 0.05, the Z-value calculated is greater than P-value hence there was a statistically significant difference in the mean scores of the experimental and control groups. The result of this study confirms the finding of Cotton (2001) and Vinita & Shikha (2015) whose their findings reveals that students exposed to Computer Aided Instruction retained the learning materials better than those students taught through traditional method. This support the view of Jarvis (1998) that students learn better and retain more of what is taught in the class when they are exposed to computer based learning.

In Table 4.3.4, Z-value calculated = 0.53, P-value = 0.603. The result indicated that the Z-value calculated 0.53is less than P-value hence there is no significant difference between

the retention level of male and female biology students in the experimental group exposed to computer aided instruction. Therefore, based on the finding of this research study, it is agreed that Computer Aided Instruction enhance the retention abilities of both male and female students without gender differences. The result is similar to that of Vinita and Shikha (2015). While it is contrary to the finding of Ighwe (2012) whose finding revealed a significant difference in the retention abilities of boys and girls in favor of boys.

Therefore, the findings of this research study further suggest that Computer Aided Instruction enhance the achievements and retention of Biology students in Secondary School in Ringim, Jigawa State. It suggests that CAI is gender friendly hence both male and female Biology students performed significantly well.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter discusses the summary of the study, conclusions drawn, contribution to knowledge, limitations of the study, as well as suggested recommendations and suggestions for further studies.

5.2 Summary

This study investigated the effects of Computer Aided Instruction (CAI) on Biology students' academic achievement and retention in ecology concepts in senior secondary schools in Ringim education zone Jigawa state. Four objectives, four research questions and four hypotheses were raised to guide the study.

Quasi-experimental research design was employed for the conduct of this study. The population of the study is made up of all Biology students in the co-educational secondary schools in Ringim education zone Jigawa state which consists of seven thousand five hundred and sixty seven (7567) students. Two hundred senior secondary two (SS II) Biology students was sampled for the study of which Experimental group comprised of (120) students and control group constituted of (80) students.

Biology Achievement Test on Ecology Concepts (BATEC) was used as the instrument for data collection, it contained twenty five items of multiple-choice questions developed around the learning areas under the topics: (Basic ecological concepts, Population and community, Ecosystem and Symbiosis). The test items were selected from the WAEC and

NECO past questions. The instrument was given to six (6) experts for validation; a pilot study was then conducted to establish the reliability of the instrument.

Literature related to this study was reviewed as well as theoretical framework that supported the use of CAI in teaching and learning Biology in senior secondary schools was also discussed. The literature was reviewed on this basis: Theoretical framework, Learning Theories and implication of computer, Nature of Biology Education at Secondary School Level, Teaching Ecology at Senior Secondary School Level, Computer in education, Computer and Interactive Learning, Computer in teaching-learning Biology, Computer Aided Instruction, Categories of Computer Aided Instruction, Teaching Ecology with CAI Method selected (Computer Multimedia). Students' Academic Achievement in Biology, Retention Abilities in Biological Sciences as well as Gender and Computer utilization in science.

Empirical studies of relevance to the present study were reviewed and the researcher realized the major gap in the previous literatures was that, there are limited studies that examined the effects of CAI on students' gender and academic achievement in ecology concepts and some other courses of which the present study intended to bridge such existing gap by examining the effects of CAI on students' gender, academic achievement and retention abilities in senior secondary schools.

The results obtained based on the collected data of this study were summarized in Tables using descriptive statistics (mean and standard deviation) and inferential statistics (z-test analysis) using Statistical Package for Social Sciences. The four null hypotheses

formulated for this study were tested at 0.05 level of significance.

5.2 Conclusions

The following conclusions were drawn from the findings of this research study. Thus;

1. The experimental group means academic achievement is higher than control group indicating computer aided instruction is more effective in learning ecological concepts than traditional lecture method.
2. Both male and female students performed equally well when ecology concepts were taught to them using CAI. This indicated that CAI is gender friendly.
3. Computer Aided Instruction happened to be superior to lecture method in the teaching of ecology concepts as students in the experimental group retain the learnt materials higher than their counterparts in the control group.
4. Both male and female students retain the learnt materials better without significant difference in gender when taught ecology concepts using CAI.

5.3 Contributions to Knowledge

Several authors published several studies on the effects of computer aided/assisted instruction which focused mostly on academic achievement, motivation and attitude of the students. The present study determines the effects of computer aided instruction on biology students' academic achievements and retention and hence contributed as follows:

1. The finding of this study provided an additional knowledge on the impact of computer aided instruction on secondary school biology students as the students in the experimental group exposed to Computer Aided Instruction achieved higher mean

(63.00) than (55.50) of those students in the control group exposed to lecture method. Therefore, this study could serve as a source of literature review for conducting further research.

2. The study find out that Computer Aided Instruction improved the performance of both sexes (62.39 and 62.28) and therefore, it is gender friendly and could be used to address gender inequality in Science Education.
3. The study give further suggestion that CAI teaching strategy makes teaching and learning more effective and more retentive as the students in the experimental group exposed to Computer Aided Instruction retained more learned Biology concepts (61.22) than their counterparts (52.70) in the control group exposed to lecture method of teaching.

5.4 Limitation of the Study

The study has the following limitations:

1. The restriction of the study to only 2 secondary schools under Ringim Education Zone of Jigawa State, made the scope of this study fairly narrow.
2. Students' lateness on coming to school also affected the successful completion of the treatment.

5.5 Recommendations

Based on the findings of this research study, the following recommendations were made:

1. Since the students performed better and retain the learning more when they are taught ecology concepts with Computer Aided Instruction, the use of CAI in teaching ecology and other Biology topics should be encouraged and imbibed by the teachers

in senior secondary schools in Jigawa state.

2. Effective implementation of teaching defended largely on the availability of material resources. The Federal, State and Local governments and other stakeholders in education should therefore provide computers and other CAI accessories to all schools in Jigawa state so as teachers and students would get access to and effectively use them in educational processes.
3. According to the finding of this study, gender does not play a significant role in the learning of Ecology concepts using CAI. Curriculum planners should therefore consider the review of Biology curriculum in senior secondary schools to incorporate Computer Aided Instruction.
4. Teachers should be fully trained on how to handle computer programs and software in teaching ecology and other Biology concepts in senior secondary schools in Jigawa state.

5.6 Suggestions For Further Study

This study requires further suggestions and clarification hence it can be extended in the following ways:

1. Similar study can be replicated in other educational zones in the state to obtain similar or different results.
2. There is need to conduct similar studies focusing students' academic achievement, retention and satisfaction in senior secondary schools.
3. Other studies can be conducted on the effect of teacher factor on the successful application of CAI in teaching and learning ecology at senior secondary school level.

REFERENCES

Achor, E, Ogbeba, J. and Samuel A.O. (2014). Effects of School Outdoor Activities on Senior Secondary Two (SS II) Students' Retention in Ecology in Jalingo Metropolis, Taraba, Nigeria. *Nigeria Educational Forum*, Vol 22, Pp 83-95.

Achuonye, K. A., & Olele, C. N. (2009). Internet Using Patterns of Nigerian Teacher-Trainees: Implications for Teacher Education in Nigeria. J. Sci. Teach. Assoc. Nig., 44(1&2): 103-108.

Achuonye, K.A., (2011). Using computer in science class: The interactive effect of gender, Journal of African Studies and Development Vol. 3(7), pp. 131-134, Available at http://www.academicjournlas.org/JASD.

Adedeji, T. (2011). Availability and Use of ICT in South-Western Nigeria Colleges of Education. *International Multidisciplinary Journal, Ethiopia* Vol. 5 (5), Pp. 315-331

Adeniyi, E.O. (2004). Science as a way of knowing the NSSSP Experience. Annual Conference Proceedings, 26th of the Science Teachers Association of Nigeria, Pp 101-111.

Ahmad, Y. (2010). Effects of Field Trip on retention and Academic Achievement in Ecology Among Secondary School Students in Zaria, Nigeria. Unpublished research thesis submitted to the department of Science Education, Ahmad Bello University, Zaria. Pp 1-116

Ahmed, M. A. & Abimbola, I. O. (2011). Influence of teaching experience and school location on biology teachers' rating of the difficult levels of nutrition concepts in Ilorin, Nigeria. JOSTMED, Vol. 7(2), Pp 52-61.

Ajagun, G.A. (2001). A Study of The Performance of Science Students in The Senior School Certificate Examination In Selected Schools in Kaduna State. Tambari Kano *Journal of Education* 6(2) Pp 11-126.

Ajaja, O.P, (2010), Effects of Field trip studies on learning outcome in Biology. Journal of Human Ecology, Department of Science Education, Delta State University, Abraka, Nigeria. 31(3):171 – 177.

Al-Rawi, I. (2013). Teaching methodolgy and its effects on quality learning. Journal of Education and Practice, 4(6), 100-105. Available at: www .idpublications.org/TEACHING- METHOD.

Altun, T. Yigit, N., & Alev, N. (2007). The Effects of Computer Supported Materials on Student Achievements and Perceptions in Science Education, Conference IMCL2007, April 18 -20, Amman, Jordan.

Ambuno, S. Egunyom, A. and Osakwe, V.C. (2008). Comprehensive Certificate Biology for Senior Secondary School. New Edition. University Press, Plc. Ibadan, Nigeria.

Anderson, I.K. (2006). The Relevance of Science Education As seen by Pupils in Ghanaian Junior Secondary Schools. A thesis submitted in partial fulfilment of the requirements of the degree of Doctor of Philosophy in the Department of Mathematics and Science Education, University of the Western Cape. Pp 1-357

Anderson, W. (2010). Principles and big ideas of Science Education. Heartfield, Association of Science Educators. Pp 1-60

Arnold, D.N. (2010). Computer-Aided Instruction," Microsoft Encarta Online Encyclopedia 2010 http://encarta.msn.com Microsoft Corporation.

Associated Press (August 28,1989). "Most teachers think computers are boon to schools, poll says" . The Deseret News.

Atadoga, M.M, Mari J.S. and Danjuma, A.B. (2016). Effects Of Computer - Assisted Instruction On Academic Achievement Of Nigeria Certificate In Education Physics Students, In Niger State, Nigeria. Rep Opinion;8(1) Pp39-46. Available at: http://www.sciencepub.net/report.

Bajah, S. T. (2002). Teaching Science for Scientific Development. A Key note address to the NCE Conference at Federal College of Education, Zaria.

Basham, L. K. (2007). The effect of 3-dimensional CADD modeling software on the development of spatial ability of ninth grade technology discovery students. Retrieved February 03, 2017, http://www.etd.isu.edu/docs/available/etd-01192007-120328

Battaly, G. (2017). Nature of Statistics, Simple Random Sample. Westchester Community College, New York. Pp 1-7

Bayani, W.U. (2016). Ecological concepts. Masive Open Online Courses. Available:wapsung.info/view/video/i_m68oo6zxU/concept-of-ecology.html

Beauchamp, G. (2012). 'ICT in the Primary School', in Pedagogy to Practice, Upper Saddle River, NJ: Pearson Education Ltd

Bichi, S.S., (2003). Effect of Problem Solving Method on Secondary Schools Students' Achievement in Evolution. *Journal of Vocational and Technical Education,* Jovted4(1): 98- 105.

Bordy, S. (2010). Drill and Practice. Retrieved March 11, 2017, from https://edel518.wikispaces.com/Drill+and+Practice..

Brewer, C. (2003). Computer in the Classroom: How Information Technology can improve conservation education. Retrieved from Gtt://www.ibecre.dbs.ur.nt:edu/ publication/Brewer – conBisarticle.pdf.

Burman, M.S. & Trust N. (2016). prospects for Computer Assisted Teaching and Learning in Secondary Schools Accounting Classrooms. *Asian Journal of Management Sciences & Education* Vol. 5(3) Pp 1-11

Burns, C., & Myhill, D. (2004). 'Interactive or Inactive? A consideration of the nature of interaction in whole class teaching', Cambridge Journal of Education, vol. 34, no. 1, pp. 35-49

Campbell, N.A. (2008). 'Biology'. Pearson International Edition. Benjamin Cummings. New York. Pp 1148-1167.

Castaño-Muñoz, J. (2010). Digital inequality among university students in developed countries and its relation to academic performance. Universities and Knowledge Society Journal (RUSC), 7 (1).

Castaño-Muñoz, J., Duart, M., & Sancho Vinuesa, T. (2013). The Internet in face-to-face higher education: Can interactive learning improve academic achievement? British *Journal of Educational Technology* . doi: 10.1111/bjet.12007. Retrieved from http:// onlinelibrary.wiley.com/doi/10.1111/ bjet.12007/abstract

Chinna, N.C., & Dada, M.G. (2013). Effects of Developed Electronic Instructional Medium on students' achievement in Biology. *Journal of Education and Learning,* 2(2), 1

Cotton, K. (2001). Computer Assisted Instruction Retrieved http./www.nwrel.org/scpd/sirs/computer Assisted Instruction.htm

Cyril, M.U. (2014). Effects of Computer-Assisted Instruction and Demonstration Method of Teaching Automobile Technology in Federal Colleges of Education (Technical) in North-Eastern Nigeria. *International Journal of Science and Research* Vol. 6(14) Pp 1325-1329. Available at: https://www.ijsr.net/SUB159096

Danmole, B.T and Femi, A. (2004). Effects of Concept Mapping Technique on Senior Secondary School Students Achievement and Retention of Ecology. *Journal of the Science Teachers Association of Nigeria* 39, (1&2) Pp 32-38.

De Jong, T. and Joolingen, W. (2007). What do we know about computer simulations? Kaleidoscope Network of Excellence for Technology Enhanced Learning. Dutch brochure.

Deslauriers, L. Schelew, E., & Wieman. (2011). Improved learning in a large-enrollment physics class. Science, 332, 862–864. http://doi.org/10.1126/science.1201783.

Digregorio, P., & Sobel-Lojeski, K. (2010). The effects of interactive whiteboards (IWBs) on student performance and learning: A literature review. *Journal of Educational Technology Systems,* 38, 255–312.

Ehondor, S.E., & Omuruyi, F.E. (2013). Assessment of the Problems Associated with the teaching/learning of Computer Science education in Nigerian institution. *Education Research Journal* 3(8); pp 192-196, Available at http://www.resjournals.com/ERJ ISSN:2026-6332

Epunam, A.D. (1999). Influence of school environmental variables on academic performance as perceived by students. Unpublished M.Ed thesis. University of Nigeria, Nsukka.

Erin B. (2012). ICT Projects in government – challenges for procurement and contract management *The Victorian Ombudsman's investigation into ICT-enabled projects VGSO Seminar Program* 26 April 2012 Pp 1-7 eurasia_v6n1_s orgo.

Federal Republic of Nigeria, (Revised 2004) National Policy on Education, Abuja.

Frank, E., Ritter, Gordon, B., Jong W. Kim, and Sowmyalatha Srinivasmurthy (2010). Learning and Retention. A Handbook of Cognitive Engineering.College of Information Sciences and Technology. The Pennsylvania State University, University park, Pp 1-23.

Fred, M. (2007). The field trip in Biology. New York, *Journal of School Science and Mathematics.* 28(22) 31

Glasersfeld E. V. (1995) A constructivist approach to teaching. In: Steffe L. P. & Gale J. (eds.) Constructivism in education. Erlbaum, Hillsdale: 3–15. Available at: http://www.vonglasersfeld.com/172

Great Soviet Encyclopedia, 3rd Edition (2010). Biological sciences. The Gale Group, inc. Available online at: http://encyclopedia2.thefreedictionary.com/biological+science

Griffiths, T. (2016). Why do students find Biology so difficult to learn? University of British Columbia. Vancouver, Canada. Available at: ...

Hargreaves, L., Moyles, J., Merry, R., Paterson, F., Pell, A. & Esarte-Sarries, V. (2010) 'How do primary school teachers define and implement 'interactive teaching' in the National Literacy Strategy in England', Research Papers in Education, vol. 18, no. 1, pp. 217-236.

Harlen, W. (2010). Principles and big ideas of science education. Association for Science Education, College Lane, Great Britain. Pp 1-63

Harrison, C. (2006). 'Children's Self and Peer-assessment In Harlen W. (Ed) ASE Guide to primary science Education. Hatfield: Association for Science Education

Haynie, W.J. (2003). Effects of take-home tests and study questions on retention of learning in technology education. Journal of Technology Education Vol.14(2). Retrieved March 07, 2017 from: http//www.scholar/ib.vt.edu/ejournals/jte/v14n2/haynie.html.

Heemskerk, I., Kuiper, E., & Meijer, J. (2014). Interactive whiteboard and virtual learning environment combined: Effects on mathematics education. *Journal of Computer Assisted Learning*, 30(5), 465–478.

Hennessy, S., & London, L. (2013). Learning from international experiences with interactive whiteboards: The role of professional development in integrating the technology (OECD Education Working Papers, No. 89). Paris, France: OECD Publishing. Retrieved from http://dx.doi.org/10.1787/5k49chbsnmls-en

Hubbard, R., & Scott A. (2011). "Why We Don't Really Know What "Statistical Significance" Means: A Major Educational Failure". Marketing Papers. University of Pennsylvania ScholarlyCommons. Retrieved March 11, 2016.

Huynh, M.Q., Lee, J. & Schuldt, B.A. (2005). The Insiders' Perspectives: A Focus Group Study on Gender Issues, in a Computer Supported Collaborative Learning Environment. J. Inf. Technol. Educ., Retrieved on 15/5/16 255Huynh14.ptd

Ibrahim, B.K. (2017). Effectiveness of Computer Assisted Instruction on Students' Achievement in Teaching and Learning Chemical Bonding. Unpublished thesis Pp 35

Igwhe, A.U. (2012). combined effect of computer tutorial and drill on senior secondary school students' achievement, interest, and retention in basic electronics in Lagos state. A thesis submitted in partial fulfilment of the requirements of the degree of Doctor of Philosophy in the Department of Vocational Teacher Education, University of Nigeria Nsukka. Pp 1-11

International Telecommunication Union (ITU) Geneva, The role of ICT in advancing growth in least developed countries Trends Challenges and Opportunities, 2011. Retrieved 15 march 2016 from http://www/itu.int/ITU/Idc/Turkey/docs/The role of ICT in advancing growth in LDCsTrends Challenges and Opportunities. pdf

Isaacs, S. (2007). Survey of ICT and education in Africa: South Africa Country Report South Africa . Pp 32-34 available at www.infodev.org

Jarvis, P. (1998). Theory and Practice of Learning. London. Kogan press. Retrieved from http://www.it theory.Com/Jonassen).htp.

Jean, B. (2001). Teaching Biology. London Macmillan and Co. Ltd. J 271

John, E. (2013). How High School and College Are Failing Our Economy (and Students) in the wall street journal and breaking news Oct. 14, 2013 Available at:www.wsj.com/articles/SB10001424052702304561004579135253438812772.

Johnstone, B. (2003). Never Mind the Laptops: Kids, Computers, and the Transformation of Learning . Lincoln, NE: iUniverse, Inc. pp. 1–8. ISBN 0-595-28842-1 . Retrieved May 19, 2010.

Josiah, A., & Nancy, K. (2012). The relationship between electronic banking and Banking performance among commercial banks in Kenya. *Journal of finance and investment analysis.* Vol.1, No 3 Pp 99-103.

Kalu U.U. and Ndokwo K. J. (2006). Review of the methodologies for effective practical Biology Instruction in secondary schools in Nigeria. *Journal Education Research and Development*, 11, 52-70

Kanuka, H. & Anderson, T. (2007). Ethical Issues in qualitative e- learning Research. *International Journal of Qualitative Research*, 6 (2) . [online]. Available: http:// www.ualberta.ca/~iiqm/ backissues/6_2/kanuka.pdf

Kareem, A.A. (2015). Effects of Computer Assisted Instruction on Students' Academic Achievement and Attitude in Biology In Osun State, Nigeria: *Journal of Emerging Trends in Educational Research and Policy Studies* (JETERAPS) 6(1):Pp69-73.

Kearsley, G, and Shneiderman, B. (1999). Engagement Theory: A Framework for Technology based Teaching and Learning 1-6. Retrieved on 02/03/2017

Koseoglu, P. & Eefendioglu, A. (2015). Can a Multimedia Tool Help Students' Learning Performance in Complex Biology Subjects? *South African Journal of Education* - Vol 35, No 4

Kosoko-Oyedeko, G.A. & Tella, A. (2010). Teachers' Perception of the Contribution of ICT to Pupils Performance in Christian Religious Education. Journal of Social Science, 22(1): 7-14.

Kubiatko, M. & Halakova, Z. (2009). Slovak high school students' attitudes to ICT using in biology lesson. Computers in Human Behaviour, 25(3), 743-748.

Lakpini, L. (2012). Effect of a conceptual change instructional strategy on Biology performance of low and average secondary school students in Giwa Educational zone. *Journal of studies in science and mathematics Education,* Department of science Education ABU, Zaria.2(1),47-56.

Lashley, G.Y. (2014). Integrating computer technology in the teaching of Biology. *International Journal of Biology Education* Vol. 3, Issue 2, Pp 14-30

Lawal, F.K. (2010). Relationship between Qualifying Examination (Q.E) and National Examination Council (NECO) result in Biology in selected schools of Kano metropolis. *Journal of Studies in Science and Mathematic Education.* Department of Education, ABU, Zaria. 1(1):42-46.

Learning Theories Knowledgebase - Constructivism Learning-Theories.com, Available:"http://www.learning-theories.com/constructivism.html" http://www.learning-theories.com/constructivism.html [2009]..In: L.P.Steffe & P.W.Thompson (eds.)

Maikano, S. (2010). Comparism between Outdoor and Indoor Laboratory Teaching Strategies on Secondary School Students Academic Achievement and retention in Ecology. Paper Presented in the Seminar at Department of Science Education A.B.U Zaria

Mikre, F. (2011). The Roles of ICT in Education. Review Article with Emphasis to the computer and Internet. Ethiopian Journal of Education and Science, vol. 6, No. 2

Miles, R. (2015). Tutorial instruction in science education. *Cypriot Journal of Educational Science,* 10(2), 168-179.

Mishra, G. & Kiran U.V. (2015). Role of ICT in achieving complete gender equality in India, *International Journal of Technical Research and Applications* Volume 3, Issue 3 Pp. 184-189 available at: www.ijtra.com

Mitra, A., Lenzmeier, S., Avon, R., Qu, N. & Hazen, M. (2000). Gender and Computer Use in an Academic Institution: Report from a Longitudinal Study. J. Educ. Comput. Res., 23(1): 67-84. NCCE (1996). Minimum Standards for Nigerian Certificate in Education. Kaduna: Government Press.

Mitra N K, Nagaraja H S, Ponnudurai G, Judson J P (2009). The Levels Of Difficulty And Discrimination Indices In Type A Multiple Choice Questions Of Pre-clinical Semester 1 Multidisciplinary Summative Tests. *IeJSME* 3 (1): 2-7

Momoh, O.J. (1997). Effects of cognitive preference and advance verbal organizers on the retention of O' Level physics textual materials. The Nigerian Teacher Today. 5 (1&2), Pp 26-28.

Muchiri, J.M. & Nephat, J.K. (2015). Effect of computer assisted teaching strategy on student's motivation to learn agriculture in secondary schools in Kenya. Merit Research Journal of Education and Review Vol. 3(8) pp. 269-274, Available at: http://www.meritresearchjournals.org/er/index.htm

Mudasiru, O.Y. & Adedeji, O.A. (2010). Effects of Computer Assisted Instruction (CAI) on Secondary School Students' Performance in Biology. *The Turkish online journal of Educational Technology* Vol. 9 (1) Pp 62 – 69

Muijs, D. & Reynold, D. (2010). Effective Teaching: Evidence and Practice, 3rd edition, London, UK: Sage Publications Ltd.

Murdock, E. (2007). "History, the History of Computers, and the History of Computers in Education" Retrieved May 19, 2016.

Murugesan, K. & Muthu, R. (2011). Modeling and Simulation of DSTATCOM using Space Vector Pulse Width Modulation for Load Variation. *International Review on Modelling and Simulations* 4 (6), 2926-2937.

National ICT Policy by Ministerial Committee on ICT Policy Harmonization 2012. Available at www.research ict africa.net/.../nigerian.....

Nichols, K., Hanan, J. & Ranasinghe, M. (2013). Transforming the social practices of learning with representations: A study of disciplinary discourse. Research in Science Education, 43, 179–208.

Nigerian National Computer Policy (1988). Federal Ministry of Education, Lagos, Nigeria.

Nigerian Tribune Newspaper Published April 11, 1988. Lagos, Nigeria, Page 14-15.

Noyer, C. (2007). "Hedge funds: what are the main issues?", Financial Stability Review, Special issue on hedge funds, Banque de France, 10, pp 105-111.

Nussbaum, M. (2000). Women and Human Development: The Capabilities Approach

Cambridge University press 158.

Nwachukwu, M. (2008). Growth of IT, Historical perspective. Development of ICT in Nigeria. Retrieved from URL:http://usdnhq.undo.PRC/it4dev/.

Nwagbo, C.R. (2009) Enriching Senior Secondary School Biology through Integrating Enterpreneurship Activities. 50th Annual Proceedings of Science Teachers' Association of Nigeria (STAN). 128 – 133.

Nwagu, E.K. & Nzewi, U.M. (2008), Strategies for teaching Biodegradable wastes to Primary, Secondary and Higher Education Students. In Peter Okebukola & Ben Akpan (Eds) Strategies for Environmental Education: Focus on Land and Water Pollution. Ibadan: Science Teachers' Association of Nigeria, (STAN) Series No. 12: Pp114-121.

Nwangwu, C.E, Obi A.C. and Ogwu N.O. (2014). Integration of Information Communication Technology (ICT) in the Curriculum of Federal Unity Schools (FUS) in Nigeria: Implications for Learning. *Greener Journal of Educational Research* Vol.4(4) 91-98

Nwankwoala, H. N. (2015). An Investigation of Lecturers' and students' use of ICTs in Nigerian university education as a panacea for national development. *Research on Humanities and Social Sciences* Vol.5, No.20. Pp 167-176.

Nworgu, B. F. (2007). The Indispensability of ICT in Educational Research in Information Communication Technology in the Service of Education. (Ed.)by D. N. Ezeh and NkadiOnyegbu. Enugu: Timen.

Nzelum, V.N. (2010). Mechanism of transmission of information along a Neurone: A practical approach to a reflex Action. A paper presented at STAN Biology panel workshop, model Girls Secondary School. Rumeme, Port- Harcourt, River State, Nigeria.

Obeka, S.S (2009).EPODEWALAD and Power Simulation Games of Geographical and Environmental Education. Ahmadu Bello University press Limited Zaria. Kaduna State, Nigeria

Oguneye, A.O. (1999). Science Education in Nigeria Historical Development Curriculum Reforms and Research. Sunshine International Publication (Nig) Ltd. 503

Okeke, E.A. (2007). Remedies for Students Poor in Science 27th STAN Annual Conference Proceeding, 118 - 136.

Okoli, J.N. (2006). Effect of Investigative Laboratory Approach and Expository Method on Acquisition, Different Levels of Scientific Literacy. *Journal of the Science Teachers Association* of Nigeria 41 (1 &2), 79-88

Okundaye, B.O. (2005). Educator Courseware for Statistics and Basic. An unpublished PGDCS Thesis. University of Benin.

Olalekan, A.A. & Oludipe, O. (2016). Effect of Computer Simulation instructional Strategy on Biology students' academic Achievement in DNA replication and transcription, *Asian Journal of Educational Research* Vol. 4, No. 2, Pp 16-24.

Onasanya, S. A., Daramola F. O. & Asuquo E. N. (2006). Effect of computer- assisted instructional package on secondary school students' performance in introductory technology in Ilorin, Nigeria. *The Nigeria Journal of Educational Media and Technology,* 12(1)

Oluwagbemi, O. & Oluwaranti, A. (2010). An Evaluation of the Impact of ICT Diffusion in Nigeria's Higher Educational Institutions. *Journal of Information Technology Impact*, 10(1), 25-34.

Osakwe, R.N. (2012). Chanllanges of Information and Communication Technology (ICT) Education in Nigerian public secondary schools, *Education Research Journal* 2(12) Pp 388-391

Osunwusi, A.O. & Abifarin, M. S. (2013). A comparative assessment of computer literacy of private and public secondary school students in Lagos State, Nigeria. Educationa Research and Reviews. 8(12), 881 -889.

Ozano, P.B. (2013). Enhancing the Teaching Profession in Nigeria: A Historical Perspective. *Academic Journal of Interdisciplinary Studies* Vol 2 No 5 Pp 51-56. Retrieved from www.mcser.org/journal/index.php/.../616.

Rahim, M.R. and Jaleel, F. (2012). Analysis of One-Best MCQs: the difficulty index, Discrimination index and Distractor Efficiency. *J Park Med Assoc* Vol. 62 No 2 Pp 142-147

Ramalingam, S.T. (2010). Modern Biology for Senior Secondary Schools. Africana first publishers. Onitsha, Nigeria.

Recommendation of the European Parliament and of the Council, of 18 December 2006, on key competences for lifelong learning [*Official Journal* L 394 of 30.12.2006].

Rutten, N. Van Joolingen, W. & Vander Veen. J. T. (2012). The learning effects of computer simulations in science education. Computers & Education 58 (1), 136-153.

Sancho-Vinuesa, T. (2013). The Internet in face-to-face higher education: Can interactive learning improve academic achievement?. *Br J EducTechnol,* 45: 149–159.

Sasikala, P. and Tanyong, S. (2016). A Study on Simulation Methods in Academic Success With Reference To Teaching Biology for Education Students. *Journal of Education and Practice.* Vol.7(11) Pp 164-168.

Senior School certificate examinations. May/June 2006 WASSCE. Chief examiner's report. Yaba Lagos; WAEC publishers, 135-143. WAEC (2004-2008).

Si-Mui, S. and Raja I.S. (2006). Relationship Between Item Difficulty and Discrimination Indices in True/FalseType Multiple Choice Questions of a Para-clinical Multidisciplinary Paper. Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia Vol. 35 No. 22.

Šorgo, A., Verčkovnik, T. & Kocijančič, S. (2010). Information and Communication Technologies (ICT) in Biology Teaching in Slovenian Secondary Schools. *Eurasia Journal of Mathematics, Science & Technology Education*, 6(1), 37-46. Available at www.ejmste.com/.../

Spotts T.H., Bowman M.A. & Mertz, C. (1997). Gender and Use of Instructional Technologies: A study of University Faculty. J. Higher Educ., 34(4): 421-436. Retrieved on 14-07-2010 from http://pdfserve.informaworld.com/662676-7512.

Ssewanyama J., & Bosler, M. (2007). Adoption and usage of ICT in developing countries: Case study of Ugandan firms. *International journal of Education and Development using Information and Communication Technology* 3(3) Pp 49-59

Sudip C. (2016). Computer Assisted Instruction: Applications in Science Education. Unpublished lecture note presentation. Gandhi Centenary College, Habra Lehman Purdue University. Pp 1-16.

Taylor, R.P. (2003). Reflection on The Computer in the School. Contemporary Issues in Technology and Teacher Education. 3(2), 253-274.

Thomas, R. (2009). Computer simulations and multimedia. JELSIM Java E-learning simulation. Available at: http//www.jelsim.organisms/simulation.

Tobias, S., & Duffy, T. M. (2009). Constructivist instruction: Success or failure? . New York: Taylor & Francis. Pp 1-16. ISBN 9780415994231.

Tsui, C.Y., & Treagust, D. (2010). Evaluating secondary students' scientific reasoning in genetics using a two-tier diagnostic instrument. *International Journal of Science*

Education, 32, 1073–1098.

Ugwuadu, O.R. and Nzewi, U.M. (2012). Effects of dialogic, peer and teacher- guided discourse patterns on students' achievement in biology in Yola educational zone of Adamawa state. *African Journal of Science Technology and Mathematics Education* 2 (1): 115-128

Umar, A.A. (2011). Effects of biology practical activities on students' process skill acquisition in Minna, Niger State, Nigeria. JOSTMED, Vol. 7(2), Pp 118–126.

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2002). ICT Competency Standards for Teachers Policy Framework. Available:http://unesdoc.unesco.org/images/0015/001562/156210E.pdf.

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2003). Gender Equality in Education Available:http://unesdoc.unesco.org/ge/023/.pdf.

United Press International (February 4, 1971). "Computers Employed as Teaching Aids" Reading Eagle .

Usman, I. (2008). The Relationship between Students' Performance in Practical Activities and their Academic Achievement in Integrated Science Using NISTEP Mode of Teaching. Unpublished Ph.D Thesis faculty of Education, ABU, Zaria.

Usman, I. A. (2010). Investigation into the Effects of Discovery Methods of instruction On the Academic Achievement in Genetics among colleges of Education in North Western Nigeria. *Journal of Science Technology and Mathematics Education,* 7(1), 120-12

Usman, L.A. (2008). Using a Selected method of Teaching in Enhancing Slow Learner's Academic performance Among Junior Secondary School Integrated Science Students. 115.

Vinita S. & Shikha B. (2015). The retention effect of computer assisted instruction (CAI) on student's achievement for teaching the chemistry topics of class VIII students. *International Journal of Scientific and Research Publications*, Volume 5, Issue 11, Pp 485-488. Available at: www.ijsrp.org/research.../ijsrp-p4774.pdf

Vygotsky, L.S. (1978). Mind in society: The development of the higher Psychological processes. Cambridge, MA: The Harvard University Press.

Wadi, D.H. (2004). Technologies for Education for All, A luxury or a necessity. Conference of Ministers of Education in Arab states Beruit, Lebanon.

WAEC Chief Examiners Reports (2005, 2006 and 20007) Publication of WAEC office,

Lagos.

WAEC Chief Examiners Reports (2008, 2009, and 2010) Publication of WAEC office, Lagos.

Weber, (2016) "Life Science, Weber State Museum of Natural Science" Community.weber.edu. Retrieved 2016-10-02. Available at: http://community.weber.edu/sciencemuseum/pages/life_main.ap

Weegar, A.M. and Dina, P. (2012). A comparison of Two Theories of Learning, Behaviorism and Constructivism as applied to Face-to-Face and Online Learning. E-Leader Manila. Pp 1-18

West African Examinations Council (WAEC) (2014). Senior School Certificate Examination. Chief Examiner's Report.

Woolfolk Hoy, A., & Hoy, W. K. (2009). Instructional leadership: A research-based guide to learning in schools (3rd ed.). Boston: Allyn & Bacon/Longman.

Yusuf, M.O. & Afolabi A.O, (2010). Effects of Computer Assisted Instruction (CAI) on Secondary School Students' Performance in Biology. The Turk. Online *Journal of Educational Technology,* 9(1): 62-69. Retrieved on 15/05/2011 from http://www.tojet.net/articles/918.pdf

APPENDIX A

BIOLOGY ACHIEVEMENT TEST ON ECOLOGY CONCEPTS [BATEC]
PRETEST

Instruction: Kindly answer the following questions by circling the appropriate option

Gender: Male [ ] Female [ ] **Time Allowed:** 45 minutes

1) Ecology is best defined as the study of
a) living things and nonliving things
b) nonliving things of the environment
c) living organisms in relation to their environment
d) microorganisms around us

2) The zone of the earth occupied by living organisms is called
a) lithosphere
b) atmosphere
c) hydrosphere
d) biosphere

3) . . . . . is the solid portion of the earth
a) lithosphere
b) atmosphere
c) hydrosphere
d) biosphere

4) The place where organism live is known as
a) community
b) population
c) pollution
d) habitat

5) Organism's behavior, feeding habits and breeding habits describe its . . . . .
a) niche
b) pollution
c) habitat
d) community

6) A group of organisms that are very similar to each other and capable of interbreeding is known as . . . . . .
a) species

b) population
c) community
d) biosphere

7) . . . . . is the number of individual of the same specie living in a specific area
a) species
b) population
c) community
d) habitat

8) . . . . . is a community of living organisms together with the nonliving components of their environment interacting as a system
a) ecosystem
b) habitat
c) competition
d) feeding

9) The following are abiotic factors affecting living organisms except:
a) disease
b) light
c) wind
d) temperature

10) . . . . . is the number of two or more populations of different species
a) species
b) population
c) community
d) habitat

11) In complex food relationships in a community the primary, secondary and tertiary consumers are referred to as:
a) omnivores
b) heterotrophs
c) autotrophs
d) symbionts

12) . . . . . is an association of two living organisms where one benefits the other one neither benefits nor harmed
a) parasitism
b) mutualism
c) commensalism
d) competition

13) Which of the following statement best describe symbiosis?
a) movement of living organisms in a habitat

b) a closed and prolong association of two or more organisms
c) a different mode of feeding among living organisms
d) total number of species of two or more organisms

14) Which of the following limiting resources is competed for by organisms in the desert?
a) light
b) temperature
c) water
d) oxygen

15) Relationship between lice and man is an example of
a) parasitism
b) mutualism
c) commensalism
d) competition

16) A group of ecosystem with similar climate is called
a) tolerance
b) ecosystem
c) forest
d) biome

17) . . . . . is a complex feeding relationship
a) food chain
b) food web
c) predation
d) competition

18) Which of the following natural resources is most readily available to all organisms?
a) Water
b) air
c) food
d) mineral resources

19) . . . . . are higher in number in the pyramid of numbers
a) producers
b) primary consumers
c) secondary consumers
d) tertiary consumers

20) . . . . . are least in number in the pyramid of numbers
a) producers
b) primary consumers
c) secondary consumers

d) tertiary consumers

21) . . . . . is a linear feeding relationship
a) food chain
b) food web
c) predation
d) competition

22) The position of a lion in an ecosystem is . . . . . .
a) producer
b) primary consumer
c) secondary consumer
d) tertiary consumer

23) All the following are biotic factors affecting ecosystem except. . . . . .
a) competition
b) parasitism
c) humidity
d) mutualism

24) Bacteria and fungi are examples of . . . . . .
a) producers
b) consumers
c) decomposers
d) predators

25) An association of two living organisms where both of them benefits is known as . . . . . .
a) parasitism
b) mutualism
c) commensalism
d) none of the above

APPENDIX B

BIOLOGY ACHIEVEMENT TEST ON ECOLOGY CONCEPTS [BATEC]
POST-TEST

Insstruction: Kindly answer the following questions by circling the appropriate option
Gender: Male [ ] Female [ ] **Time Allowed:** 45 minutes

1) . . . . . is the number of individual of the same specie living in a specific area
a) species
b) population
c) community
d) habitat

2) In complex food relationships in a community the primary, secondary and tertiary consumers are referred to as:
a) omnivores
b) heterotrophs
c) autotrophs
d) symbionts

3) The place where organism live is known as
a) community
b) population
c) pollution
d) habitat

4) . . . . . is the solid portion of the earth
a) lithosphere
b) atmosphere
c) hydrosphere
d) biosphere

5) Which of the following statement best describe symbiosis?
a) movement of living organisms in a habitat
b) a closed and prolong association of two or more organisms
c) a different mode of feeding among living organisms
d) total number of species of two or more organisms

6) A group of organisms that are very similar to each other and capable of interbreeding is known as . . . . . .

a) species
b) population
c) community
d) biosphere

7) Ecology is best defined as the study of
a) living things and nonliving things
b) nonliving things of the environment
c) living organisms in relation to their environment
d) microorganisms around us

8) . . . . . is a community of living organisms together with the nonliving components of their environment interacting as a system
a) ecosystem
b) habitat
c) competition
d) feeding

9) The following are abiotic factors affecting living organisms except:
a) disease
b) light
c) wind
d) temperature

10) . . . . . is the number of two or more populations of different species
a) species
b) population
c) community
d) habitat

11) The position of a lion in an ecosystem is . . . . . .
a) producer
b) primary consumer
c) secondary consumer
d) tertiary consumer

12) . . . . . is an association between two living organisms where one benefits the other one neither benefits nor harmed
a) parasitism
b) mutualism
c) commensalism
d) competition

13) Organism's behavior, feeding habits and breeding habits describe its . . . .

a) niche
b) pollution
c) habitat
d) community

14) An association of two living organisms where both of them benefits is known as . . . . . .
a) parasitism
b) mutualism
c) commensalism
d) none of the above

15) Relationship between lice and man is an example of
a) parasitism
b) mutualism
c) commensalism
d) competition

16) A group of ecosystem with similar climate is called
a) tolerance
b) ecosystem
c) forest
d) biome

17) . . . . . is a complex feeding relationship
a) food chain
b) food web
c) predation
d) competition

18) Which of the following natural resources is most readily available to all organisms?
a) Water
b) air
c) food
d) mineral resources

19) . . . . . are higher in number in the pyramid of numbers
a) producers
b) primary consumers
c) secondary consumers
d) tertiary consumers

20) . . . . . are least in number in the pyramid of numbers
a) producers
b) primary consumers

c) secondary consumers
d) tertiary consumers

21) . . . . . is a linear feeding relationship
a) food chain
b) food web
c) predation
d) competition

22) The zone of the earth occupied by living organisms is called
a) lithosphere
b) atmosphere
c) hydrosphere
d) biosphere

23) All the following are biotic factors affecting ecosystem except. . . . . .
a) competition
b) parasitism
c) humidity
d) mutualism

24) Bacteria and fungi are examples of . . . . . .
a) producers
b) consumers
c) decomposers
d) predators

25) Which of the following limiting resources is competed for by organisms in the desert?
a) light
b) temperature
c) water
d) oxygen

APPENDIX C

BIOLOGY ACHIEVEMENT TEST ON ECOLOGY CONCEPTS [BATEC]
POST-POSTTEST

Instruction: Kindly answer the following questions by circling the appropriate option

Gender: Male [ ] Female [ ] **Time Allowed:** 45 minutes

1) .. . . . . is a linear feeding relationship
a) food chain
b) food web
c) predation
d) competition

2) In complex food relationships in a community the primary, secondary and tertiary consumers are referred to as:
a) omnivores
b) heterotrophs
c) autotrophs
d) symbionts

3) Organism's behavior, feeding habits and breeding habits describe its . . . .
a) niche
b) pollution
c) habitat
d) community

4) An association of two living organisms where both of them benefits is known as . . . . . .
a) parasitism
b) mutualism
c) commensalism
d) none of the above

5) Relationship between lice and man is an example of
a) parasitism
b) mutualism
c) commensalism
d) competition

6) A group of ecosystem with similar climate is called
a) tolerance
b) ecosystem
c) forest
d) biome

7) Ecology is best defined as the study of
a) living things and nonliving things
b) nonliving things of the environment
c) living organisms in relation to their environment
d) microorganisms around us

8) . . . . . is a community of living organisms together with the nonliving components of their environment interacting as a system
a) ecosystem
b) habitat
c) competition
d) feeding

9) The following are abiotic factors affecting living organisms except:
a) disease
b) light
c) wind
d) temperature

10) . . . . . is the number of two or more populations of different species
a) species
b) population
c) community
d) habitat

11) The position of a lion in an ecosystem is . . . . . .
a) producer
b) primary consumer
c) secondary consumer
d) tertiary consumer

12) . . . . . are least in number in the pyramid of numbers
a) producers
b) primary consumers

c) secondary consumers
d) tertiary consumers

13) . . . . . is the number of individual of the same specie living in a specific area
a) species
b) population
c) community
d) habitat

14) The zone of the earth occupied by living organisms is called
a) lithosphere
b) atmosphere
c) hydrosphere
d) biosphere

15) All the following are biotic factors affecting ecosystem except. . . . . .
a) competition
b) parasitism
c) humidity
d) mutualism

16) . . . . . is a complex feeding relationship
a) food chain
b) food web
c) predation
d) competition

17) Which of the following limiting resources is competed for by organisms in the desert?
a) light
b) temperature
c) water
d) oxygen

18) . . . . . is an association between two living organisms where one benefits the other one neither benefits nor harmed
a) parasitism
b) mutualism
c) commensalism
d) competition

19) The place where organism live is known as
a) community
b) population

c) pollution
d) habitat

20) . . . . . is the solid portion of the earth
a) lithosphere
b) atmosphere
c) hydrosphere
d) biosphere

21) Which of the following statement best describe symbiosis?
a) movement of living organisms in a habitat
b) a closed and prolong association of two or more organisms
c) a different mode of feeding among living organisms
d) total number of species of two or more organisms

22) A group of organisms that are very similar to each other and capable of interbreeding is known as . . . . . .
a) species
b) population
c) community
d) biosphere

23) Bacteria and fungi are examples of . . . . . .
a) producers
b) consumers
c) decomposers
d) predators

24) Which of the following natural resources is most readily available to all organisms?
a) Water
b) air
c) food
d) mineral resources

25) . . . . . are higher in number in the pyramid of numbers
a) producers
b) primary consumers
c) secondary consumers
d) tertiary consumers

APPENDIX D

MARKING SCHEME

PRE-TEST	POST-TEST	POST-POSTTEST
1 C	1 B	1 A
2 D	2 B	2 B
3 A	3 D	3 A
4 D	4 A	4 B
5 A	5 B	5 A
6 A	6 A	6 D
7 B	7 C	7 C
8 A	8 A	8 A
9 A	9 A	9 A
10 C	10 C	10 C
11 B	11 D	11 D
12 C	12 C	12 D
13 B	13 A	13 B
14 C	14 B	14 D
15 A	15 A	15 C
16 D	16 D	16 B
17 B	17 C	17 C
18 B	18 B	18 C
19 A	19 A	19 D
20 D	20 D	20 A
21 A	21 A	21 B
22 D	22 D	22 A
23 C	23 C	23 C
24 C	24 B	24 B
25 B	25 C	25 A

APPENDIX E
LESSON PLAN FOR CONTROL GROUP
Lesson 1

Date- 2nd February, 2017
Topic - Basic Ecological Concepts
Duration - 40 minutes
Class - SS II
Instructional Materials - Essential Biology and Modern Biology Textbooks
Previous knowledge - Students learnt from the previous lesson, the effects of food supply on population.

BEHAVIOUR OBJECTIVES
At the end of the lesson, the students should be able to:
1. Explain on their own words the following ecological concepts:
(a) Ecology
(b) Environment
(c) Habitat
(e) Biosphere
(f) Hydrosphere
(g) Atmosphere
(i) Lithosphere
(j) Ecological niche

INTRODUCTION
The teacher introduces the leason by asking students the following questions:
Define food shortage
Explain the effects of food availability on human population

PRESENTATION
The teacher presents the lesson step by step as follows:
Step I: The teacher defines
a) Ecology as the study of living organisms in relation to their environmemt.
b) Environment is the organism's surrounding
c) Habitat is the place of living of the organisms. It is the organism's home

Step II: The teacher futher explains that environment consist of all factors found in the surroundings that affect organisms. Example place of living, physical condition like tempereture, light, humidity e t c. While Habitat is part of environment where organisms lives. Example aquatic, terrestrial, arboreal.

Step III: The teacher define ecological niche as the organism's entire way of life and its role in the community. It includes organism's behaviour, its feeding habits, breeding habits e t c.

Step IV: The teacher explains that biosphere is the part of the earth that support life. It is the zone of life.
Biosphere is the part of atmosphere (enveloping layer of air), hydrosphere (parts composed of water) and lithosphere (the solid part of the earth).

Step V: The teacher gives room for students to ask questions if any.

SUMMARY
The teacher summarises the main points of the lesson afterwhich allows the students to copy the summary notes from the board.

EVALUATION
The teacher evaluates the students by asking them the following questions:
On your own words, define the following terms
(a) Ecology
(b) Environment
(c) Habitat
(e) Biosphere
(f) Hydrosphere
(g) Atmosphere
(i) Lithosphere
(j) Ecological niche

Lesson 2

Date- 9th February, 2017
Topic - Population and Community
Duration - 40 minutes
Class - SS II
No. of Pupils in Class- 80
Average age - 17 years
Instructional Materials - Essential Biology and Modern Biology Textbooks
Previous knowledge - Students learnt basic ecological concepts from the previous lesson.

BEHAVIOUR OBJECTIVES

At the end of the lesson, the students should be able to explain and give examples the following:
(a) Specie
(b) Population
(c) Community

INTRODUCTION

The teacher introduces the leason by asking students the following questions:
Define ecology
Explain biosphere

PRESENTATION

The teacher presents the lesson step by step as follows:
Step I: The teacher defines specie is a group of organism that are very similar to each other and capable of interbreeding. Specie means an individual organism.

Step II: The teacher further explains population as the total number of all organisms of the same specie living in the specific area or habitat. Example mango trees in the school compound, insect population, human population.

Step III: The teacher explains community is made up of all the populations of living organisms that live together in the habitat. It can also be define as the number of two or more populations of different species.

Step IV: The teacher further explains the example of community in a fresh water may consists: microorganisms, worms, insect, frog, algae and other rooted plants.

Step V: The teacher gives room for students to ask questions if any.

SUMMARY

The teacher summarises the main points of the lesson afterwhich allows the students to copy the summary notes from the board.

EVALUATION

The teacher evaluates the students by asking them the following questions:

Expain and give examples the following:

(a) Specie

(b) Population

(c) Community

Lesson 3

Date- 16th February, 2017
Topic - Ecosystem
Duration - 40 minutes
Class - SS II
Instructional Materials - Essential Biology and Modern Biology Textbooks
Previous knowledge - Students learnt the concept population and community from the previous lesson.

BEHAVIOUR OBJECTIVES
At the end of the lesson, the students should be able to explain the following:
(a) Ecosystem
(b) Food chain
(c) Food web
(d) Producers
(e) Consumers
(d) Decomposers
(e) Biotic and Abiotic factors

INTRODUCTION
The teacher introduces the leason by asking students the following questions:
Define population
What is specie?

PRESENTATION
The teacher presents the lesson step by step as follows:
Step I: The teacher defines ecosystem as the group of biotic and abiotic parts of an environment which function together as a unit. The component of ecosystem are:
Biotic - Living example diseases, competition,
Abiotic - Non living example light, humudity, temperature.

Step II: The teacher futher explains food chain as a linear feeding relationship among living organism example
Grass Grasshopper Sheep Lion
Food web is a complex feeding relationship

Step III: The teacher explains the trophic levels as feeding levels categorises as follows:
Producers - plants
Consumers

- primary consumers - eats producers, grasshoppers, insects
- secondary consumers - eats primary consumers, birds, rats frogs
- tartiary consumers - eats secondary consumers, hawk man, lion

Decomposers - bacteria and fungi

Step IV: The teacher further esplains energy flow as the representation of the number of individuals of each trophic levels found in the natural community. Producers are largest in number followed by primary consumers, than secondary and than the terminal group of organisms which have no predators (tartiary consumers).

Step V: The teacher gives room for students to ask questions if any.

SUMMARY

The teacher summarises the main points of the lesson afterwhich allows the students to copy the summary notes from the board.

EVALUATION

The teacher evaluates the students by asking them the following questions:
Expain and give examples the following:
(a) Ecosystem
(b) Food chain
(c) Food web
(d) Producers
(e) Consumers
(d) Decomposers
(e) Biotic and Abiotic factors

Lesson 4

Date- 23rd February, 2017
Topic - Ecology
Topic - Symbiosis
Duration - 40 minutes
Class - SS II
Instructional Materials - Essential Biology and Modern Biology Textbooks
Previous knowledge - Students learnt ecosystem from the previous lesson.

BEHAVIOUR OBJECTIVES

At the end of the lesson, the students should be able to explain and give examples the following:
(a) Symbiosis
(b) Parasitism
(c) Mutualism
(d) Commensalism

INTRODUCTION

The teacher introduces the leason by asking students the following questions:
Define ecosystem
Differentiate between abiotic and biotic factors affecting ecosystem

PRESENTATION

The teacher presents the lesson step by step as follows:
Step I: The teacher defines symbiosis as any closed and prolonged association of two or more organisms of different species. The members of symbiosis are known as symbionts.

Step II: The teacher futher explains parasitism as type of association which one organism (parasite) benefit on the other organism (host). The parasite often causes harm to the host. Example ticks on man, plasmodium on man.

Step III: The teacher explains mutualism as the association between two organisms where both of them benefits. Example leguminous plant and rhizobium bacteria, algae and fungi.

Step IV: The teacher further esplains commensalism as another type of association between two organisms where one organism (commensal) benefit while the other organism (host) not benefit and nor harmed. The host is neirther gain nor harmed. Example: shark and remora fish, epipyte and a tree.

Step V: The teacher gives room for students to ask questions if any.

SUMMARY

The teacher summarises the main points of the lesson afterwhich allows the students to copy the summary notes from the board.

EVALUATION

The teacher evaluates the students by asking them the following questions:
Expain and give examples the following:
(a) Symbiosis
(b) Parasitism
(c) Mutualism
(d) Commensalism

APPENDIX F

LESSON PLAN FOR EXPERIMENTAL GROUP

COMPUTER AIDED INSTRUCTION

LESSON 1

Date- 2nd February, 2017

Topic: Basic Ecological Concepts

Duration: 40 Minutes

Class: SSII

Instructional Materials: Computers, projector, Textbook

Instructional Objectives: By the end of the lesson, students should be able to explain on their own words, the following ecological concepts:-

a. Ecology
b. Environment
c. Habitat
d. Biosphere
e. Hydrosphere
f. Atmosphere
g. Lithosphere
h. Ecological Niche

Content Development	**Teachers Activities**	**Students Activities**	**Strategies**
Entry Behavior:	**Step I:** The teacher allow students to settle down and sit according to group, then ask them to log in.	The students sit down into groups then log in and the topic appears on the screen.	Listening and watching.

Effect of food Supply on population	**Step II:** The teacher ask them to click to the next botton to process.	On clicking the screen displays the list of the lesson topics	Note taking and questioning
	Step III: The teacher instruct the students to click on lesson one which contain CAI presentation on basic ecological concept.	The students click on lesson one and then listen and watching to take note on their own.	Listening watching and note taking.
	Step IV: The teacher then ask the students to have group discussion on what they have leant.	The students on their respective groups, discuss on what they have seen and learnt.	Free discussion on the lesson learnt.
	Step V: The teacher evaluate by asking the following questions: On your own words, define the following: a. Ecology b. Environment c. Habitat d. Biosphere e. Hydrosphere	The students respond to the questions and take corrections.	Answering the questions and seek clarifications on what they do not understand.

	f. Atmosphere g. Lithosphere h. Ecological Niche		

LESSON II

Date- 9th February, 2017

Topic: population and Community

Duration: 40 Minutes

Class: SSII

Instructional Materials: Computers, projector, Textbook

Instructional Objectives: By the end of the lesson, students should be able to explain on their own words, the following ecological concepts:-

i. Species

ii. Population

iii. Community

Content Development	**Teachers Activities**	**Students Activities**	**Strategies**
Entry Behavior: Basic ecological concepts	**Step I:** The teacher allow students to settle down and sit according to group, then ask them to log in. **Step II:** The teacher ask them to click to the next botton to process. **Step III:** The teacher	The students sit down into groups then log in and the topic appears on the screen. On clicking the screen displays the list of the lesson topics The students click	Listening and watching. Note taking and questioning Listening watching

	instruct the students to click on lesson two which contain presentation on population and community. **Step IV:** The teacher then ask the students to have group discussion on what they have leant. **Step V:** The teacher evaluate by asking the following questions: On your own words, define the following: i. Species ii. Population iii. Community	on lesson one and then listen and watching to take note on their own. The students on their respective groups, discuss on what they have seen and learnt. The students respond to the questions and take corrections.	and note taking. Free discussion on the lesson learnt. Answering the questions and seek clarifications on what they do not understand.

LESSON III

Date- 16th February, 2017

Topic: Ecosystem

Duration: 40 Minutes

Class: SSII

Instructional Materials: Computers, projector, Textbook

Instructional Objectives: by the end of the lesson, students should be able to explain on their own words, the following ecological concepts:-

i- Ecosystem

ii- Food chain

iii- Producers

iv- Consumers

v- Decomposers

vi- Biotic and Abiotic factors

Content Development	**Teachers Activities**	**Students Activities**	**Strategies**
Entry Behavior: Population and the community	**Step I:** The teacher allow students to settle down and sit according to group, then ask them to log in. **Step II:** The teacher ask them to click to the next	The students sit down into groups then log in and the topic appears on the screen. On clicking the screen displays the	Listening and watching. Note taking and questioning

	botton to process. **Step III:** The teacher instruct the students to click on lesson three which contain CAI presentation on ecosystem. **Step IV:** The teacher then ask the students to have group discussion on what they have leant. **Step V:** The teacher evaluate by asking the following questions: On your own words, define the following: i- Ecosystem ii- Food chain iii- Producers iv- Consumers v- Decomposers vi- Biotic and Abiotic factors	list of the lesson topics The students click on lesson one and then listen and watching to take note on their own. The students on their respective groups, discuss on what they have seen and learnt. The students respond to the questions and take corrections.	 Listening watching and note taking. Free discussion on the lesson learnt. Answering the questions and seek clarifications on what they do not understand.

LESSON IV

Date- 23rd February, 2017

Topic: Symbiosis

Duration: 40 Minutes

Class: SSII

Instructional Materials: Computers, projector, Textbook

Instructional Objectives: by the end of the lesson, students should be able to explain and give examples on the following:-

i- Symbiosis

ii- Parasitism

iii- Mutualism

iv- Commensalism

Content Development	**Teachers Activities**	**Students Activities**	**Strategies**
Entry Behavior: Ecosystem	**Step I:** The teacher allow students to settle down and sit according to group, then ask them to log in. **Step II:** The teacher ask	The students sit down into groups then log in and the topic appears on the screen. On clicking the screen displays the	Listening and watching. Note taking and questioning

	them to click to the next bottom to process. **Step III:** The teacher instruct the students to click on lesson four which contain CAI presentation on symbiosis. **Step IV:** The teacher then ask the students to have group discussion on what they have leant. **Step V:** The teacher evaluate by asking the following questions: On your own words explain and give example on the following: i- Symbiosis ii- Parasitism iii- Mutualism iv- Commensalism	list of the lesson topics The students click on lesson one and then listen and watching to take note on their own. The students on their respective groups, discuss on what they have seen and learnt. The students respond to the questions and take corrections.	Listening watching and note taking. Free discussion on the lesson learnt. Answering the questions and seek clarifications on what they do not understand.

APPENDIX G
DIFFICULTY INDEX (P) OF THE BIOLOGY ACHIEVEMENT TEST ON ECOLOGY CONCEPT (BATEC)

Items	Difficulty Index (P)
1	0.60
2	0.55
3	0.60
4	0.75
5.	0.75
6.	0.70
7.	0.65
8.	0.70
9.	0.65
10	0.70
11	0.75
12	0.65
13.	0.65
14	0.70
15	0.65
16	0.70
17	0.75
18.	0.75
19	0.75
20.	0.60
21	0.50
22	0.30
23	0.75
24	0.55
25	0.45

APPENDIX H
DISCRIMINATION INDEX (D) OF THE BIOLOGY ACHIEVEMENT TEST ON ECOLOGY CONCEPT (BATEC)

Items	Ranking	Discrimination Index (P)
1	15	0.43
2	15	0.43
3.	15	0.43
4	15	0.57
5	15	0.57
6	14	0.57
7	14	0.71……. **Upper Group**
8	14	
9	14	
10	14	
11	14	
12	13	
13	13	…… **Middle Group**
14	13	
15	13	
16	13	
17	13	
18	13	
19	12	…….....**Lower Group**
20	12	
21	12	
22	11	
23	11	
24	10	
25	9	

APPENDIX I

Correlations

X is the Test Score
Y is the Re-test Score

Correlations			
		X as Dependent Variable	Y as Independent Variable
X as Dependent Variable	Pearson Correlation	1	.830**
	Sig. (2-tailed)		.001
	N	20	20
Y as Independent Variable	Pearson Correlation	.830**	1
	Sig. (2-tailed)	.001	
	N	20	20
**. Correlation is significant at the 0.01 level (2-tailed).			

Coefficients[a]				
Model		Correlations		
		Zero-order	Partial	Part
1	Y as Independent Variable	.830	.830	.800
a. Dependent Variable: X as Dependent Variable				

APPENDIX J

Answering Research Questions and Hypotheses Testing

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
POST TEST BATEC	Equal variances assumed	1.63	.030	4.23	198	.000	2.89183	.87306	2.24102	3.97421
	Equal variances not assumed			2.300	93.586	.000	2.89183	.85943	2.19332	3.86963

Group Statistics					
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
POST TEST BATEC	EXPERIMENTAL	120	63.00	10.1624	.9264
	CONTROL	80	55.50	8.42032	.9357

Independent Samples Test			
		Levene's Test for Equality of Variances	t-test for Equality of Means

								95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Std. Error Difference	Lower	Upper
EXPERIMENTAL BATEC	Equal variances assumed	12.548	.002	1.06	118	.299	.92403	3.74360	3.64730
	Equal variances not assumed			5.80		.034	.39220	4.36471	3.72914

Group Statistics					
	GENDER	N	Mean	Std. Deviation	Std. Error Mean
EXPERIMENTAL BATEC	MALE	92	62.3941	10.6234	.82143
	FEMALE	28	62.2824	13.3492	.29220

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
POST POST TEST BATEC	Equal variances assumed	1.63	.040	1.06	198	5.83	2.89183	1.103	2.34612	2.97421
	Equal variances not assumed			.300	137.586	3.02	2.89183	2.230	2.29341	2.86963

Group Statistics					
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
POST POSTTEST BATEC	EXPERIMENTAL	120	61.22	10.604	1.210
	CONTROL	80	52.70	9.4212	1.060

Independent Samples Test			
		Levene's Test for Equality of Variances	t-test for Equality of Means

		F	Sig.	t	df	Sig. (2-tailed)	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
EXPERIMENTAL BATEC	Equal variances assumed	2.548	.000	.53	118	.603	2.5023	4.38141	2.64321
	Equal variances not assumed			5.80		.040	3.1431	4.36772	2.70193

Group Statistics

	GENDER	N	Mean	Std. Deviation	Std. Error Mean
EXPERIMENTAL BATEC	MALE	92	61.431	11.5810	2.1904
	FEMALE	28	60.172	11.1612	2.0901