EFFECTS OF COOPERATIVE LEARNING STRATEGY ON BIOLOGY STUDENTS' ACADEMIC ACHIEVEMENT AND RETENTION IN SENIOR SECONDARY SCHOOLS, JIGAWA STATE, NIGERIA

BY

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MAY, 2018

DECLARATION

I hereby declare that this work (dissertation entitled 'Effects of Cooperative Learning Strategy on Biology Students' Academic Achievement and retention in Senior Secondary Schools, Jigawa State, Nigeria.' is the product of my research efforts undertaken under the supervision of Prof. Muhammad Abdullahi and has not been presented anywhere for the award of degree or certificate. All sources have been duly acknowledged.

……..…… …….

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CERTIFICATION

This is to certify that the research work for this dissertation and the subsequent write-up 'FFECTS OF COOPERATIVE LEARNING STRATEGY ON BIOLOGY STUDENTS' ACADEMIC ACHIEVEMENT AND RETENTION IN SENIOR SECONDARY SCHOOLS IN JIGAWA STATE NIGERIA' by Ahmad Gambo Ishaq SPS/14/MST/00004', were carried out under my supervision and they meets the regulations governing the award of Masters degree of Science Education/Biology of Bayero University, Kano, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

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TABLE OF CONTENTS

CHAPTER THREE

METHODOLOGY

CHAPTER FOUR

DATA ANALYSIS

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

LIST OF TABLES

Table Page

LIST OF FIGURES

LIST OF APPENDIXES

ABBREVIATIONS

BAT - Biology Achievement Test

CLS - Cooperative Learning Strategy

CTM - Conventional Teaching Method

SSS - Senior Secondary School

SS II - Senior Secondary II

STAD - Student Team Achievement Division

TGT - Team Game Tournament

TAI - Team Assisted Individualised

CIRC - Cooperative Integrated Reading and Composition

GI - Group Investigation

STAN - Science Teacher Association of Nigeria

NECO- National Examination Council

SSSCE - Senior Secondary School Certificate Examination

OPERATIONAL DEFINITION OF TERMS

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

Cooperative Learning Strategy: A learning technique in which the learners and members of varying abilities in an interdependent group collaborate, share and delegate responsibilities, practice and communicate with each others.

Retention: The ability to store information which can be easily recalled from the short term and long term memory.

Study Teams: Groups with stable membership whose primary responsibility is to provide members with support, encouragement and assistance in a learning session.

Models: Models are aspects of media for educational teaching and include concreted objects through which realities can be represented.

Charts: These are large papers containing drawings, pictures or demonstration of educational materials.

ABSTRACT

The purpose of this study was to determine the effects of Cooperative Learning Strategy on Biology students' Academic Achievement and Retention in Senior Secondary School in Jigawa State Nigeria. A total of 217 students were selected from four senior secondary schools using purposive sampling technique to make up the subjects for the study. These subjects were divided into two groups; one experimental and one control groups. A pre-test administered to the subjects established their nearly equivalent ability. Quasi experimental design was adopted. The instrument used for data collection, the Biology Achievement Test (BAT) was adapted by the researcher and validated by Science and Technology Education specialists. The BAT has reliability coefficient (r) .89. The subjects in the experimental groups were exposed to treatment, while the subjects in control groups were taught using the conventional lecture method, for a period of five weeks in each case. Three research questions were raised and three null hypotheses were formulated and tested using z-test statistics at $P \leq 0.05$ level of significance. The major findings from this study included a significant difference in biology achievement between the experimental groups and the control group in favour of the experimental groups. There was no significant difference in biology achievement between male and female in the experimental groups. There was a significant difference in the retention of biology between the experimental groups and the control group in favour of the experimental groups. The experimental groups retained biology concepts better than the control group. Based on these findings, it was recommended, among others, that teachers should be encouraged to use models cooperative learning strategy in the teaching of biology concepts in senior secondary schools.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Science Education is a vital instrument for Scientific and Technological development of any nation. This is contained in the National Policy on Education (FRN, 2004), which states that; Science education should among other things prepare learners to live effectively in a modern era of Science and Technology (Chinwe & Gloria, 2014). Science has been and would continue to be of great importance due its ability to explain many natural occurrences and the major role it plays in the world's current technology development. In this century, it is the soul of the prosperity of nations and also an economic and technological development as well as improving the quality of life of the individuals and the society at large. Science, as a school subject, has over the years gained prominence in the school curriculum world wide. In the last five decades, the world has witnessed science curriculum innovations and several changes in the teaching of the content in different levels of education (Osuolale, 2014).

Biology is one of the science subjects which students must pass so as to qualify them to offer some science courses at the tertiary level of education. The knowledge of Biology provides students with opportunities to develop an understanding of the world we live (Ekinfe, Olofin & Fashiku, 2012). It is a basic science which deals with the study of living things and their diversity as well as their interaction with one another and with their environment (Dan-Ogel &Shitu, 2012).

The purpose of teaching Biology is primarily to assist the learner to obtain a kind of knowledge and skill that will provide desirable changes in him and his society. This can only be actualised when the teaching and learning processes provide an enabling environment for the learner to think critically and analytically, and consequently become an agent of change

to himself, his community and the society at large. Nigerian education system consists of three major divisions.

Generally, in Nigeria the Educational system is subdivided in to three broad categories of primary, secondary and tertiary levels. The National Policy on Education (FRN 2004) states that, secondary education is the education children receives after primary education and before the tertiary education. The major goal for secondary education is to prepare individual for useful living within the society and for higher education. In order to meet this goals, secondary education last for six years, planned in two stages of Junior Secondary School stage and Senior Secondary School stage each of which last for three years duration.

The achievement of the above stated goals is dependent on the extent at which the secondary school teachers are capable of applying the appropriate teaching process during their delivery. For the teacher to function effectively in the present dynamic society, she/he must raise to the challenges of adopting different teaching strategies in his/her classroom management. Teaching science in Nigerian secondary schools is dominated by conventional lecture (teacher centred) method. This method has failed to produce students that are committed to science and who can reason critically and analytically (Salihu, 2015). Conventional teaching is simply chalk-talk approach in which students remain passive learners. Instruction is ill organized and rote learning is heavily emphasized. Mostly the results of students are not satisfactory due to the use of this approach. Ever since the beginning of 20th Century, research on teaching has generated useful knowledge about teaching skills, methods and models that can be usefully employed by teachers to promote students learning (Ihedioha, 2012).

Olanipekun, & Aina, (2014), see achievement as an observable or measurable behaviour of a person or an animal in a particular situation usually experimental situation.

This therefore means that achievement measures the behaviour or an aspect of a feat that can be observed at a specific time. Students' achievement is very important because, it is major criterion by which the effectiveness and success of any educational institution could be assessed. Seeking for effective delivery of instruction to students happen to be the major concern for science educators. This is as a result of repeated mass failure recorded in West African Secondary School Certificate examination [WASSCE] and National Examination Council (NECO) (Awolaji, 2016). Rano, Ishaq, Baffa & Otutu (2012), states that effective students' achievement in biology may be as a result of certain factors. These factors include among others; teaching methodology, types of teachers, students attitude, laboratory equipments, family background, the learning environment and peer group.

Poor teaching method adopted by Nigerian senior secondary school teachers have been identified as one of the major factors leading to low achievement of students. Conventional teaching method consists of lecture and direct instructions delivered by teachers. It is teacher centred method which emphasized learning through teacher guidance at all times. Students only listen to teachers and learn from them. The teacher often talks to the students instead of encouraging them to interact with one another (Gambari, Yaki, Gana & Ughovwa, 2014). In conventional teaching method most classes involved rote learning where learners memorise the content without having a complete understanding of the content (Ogundiwin, Asaaju & Adejoke, 2015). The persistent use of this method makes students passive learners. It does not promote insightful learning and long term retention (Halliru, 2011). Therefore there is the need to use more teaching methods which will encourage students' interaction and provide long term retention.

Interaction is one of the major factors that enhance learning. Within the school system, students learn more and promote their knowledge and skills via interaction. Cooperative learning is working together to achieve a sheared goals. In the cooperative activities,

individuals seek outcomes that are beneficial to themselves and to all other members of the group. Cooperative learning refers to the instructional use of small groups of students that work together to maximise their own and each other member's learning. In each group students work together and help each other to solve given problems rather than seeking answer from the teacher (Balal, 2013). Bot and Eze (2016) also defined cooperative learning strategy as the process in which students are made to work together in order to achieve certain goal under the supervision of their teacher. This strategy has many features which involve having students to work in small teams or groups on problems or activity under conditions that assures both positive interdependence and individual accountability, the success of one member helps others to be successful too, and it promotes the principles of shared leadership and responsibility. There are the student-student interaction, student-teacher interaction and teacher-head teacher interaction patterns, in the school. All these interaction patterns involve sharing of ideas among one another in order to solve a common problem (Ugwuadu & Abdullahi, 2012). One of the interaction patterns in the school is the co-operative learning which is student-student/learner-learner interaction pattern or peer discourse/peer-led learning.

Cooperative learning play vital roles for students learning of which include; help teacher manage large class of students with diverse needs, improve academic achievement and social development, prepare students for increasingly interactive work place and also make school a supportive learning environment for students. Cooperative learning has emerged as the leading learning approach to classroom instruction over the past decade. Students who complete group task cooperatively tend to show higher academic achievement, high self esteem, greater number of social skills, fewer stereotype of individual to other races or ethnic groups and greater acquisition of the content and skills they are learning (Mbacho, 2013). It is thought that lesson prepared using cooperative learning instruction provides

students with more efficient thinking and problem-solving skills and cooperative working habit, develops students cooperation skills, enables them to present more extensive studies when using their shared experiences and provide retention of learning by supporting peer learning (Altun, 2015).

Gender is an issue of concern to researches in Education. So many researches on gender and academic achievement led to a number of conciliating conclusions. Some researchers found that gender has no effect on academic achievement examples are Opara (2011) and Nnorom (2015) while some conclude that there is significant difference between male and female on academic achievement example is Adeoye (2010). Ogunneye and Lasisi (2008), point out that science and technology is a male dominated subject and that female usually shy away from scientific and technological fields. Mostly, boys appear to have more positive attitude to science and technology subject while girls show negative attitude. This is due to the acceptance of the fallacy that boys are better in science subjects than girls. Opara (2011) observed that gender has no significant effect on Biology achievement. Meanwhile, Awolaju (2016) found that gender has no significant influence on students' academic achievement in Biology. The influence of gender on achievement in Biology is therefore still controversial among science researchers. It is therefore important to conduct a study on the effect of gender on academic achievement in Biology.

Based on the above, this research attempted to investigate the effect of cooperative learning strategy as one of the teaching method on the academic achievement and retention of secondary school students in biology.

1.2 Statement of the Problem

The study examined the effectiveness of cooperative learning strategy on biology students' academic achievement in senior secondary schools in Jigawa state Nigeria.

In recent times, observation on students' academic achievement in science and particularly in biology in the result of Senior Secondary School Certificate Examination (SSCE), conducted by West African Examination Council (WAEC) and National Examination Council (NECO) indicate that very few students perform better in biology examination. Both Government and community believed that their huge investment in education is not yielding the desired dividend and that despite the huge investment in education, the achievement of students continue to remain poor (Sunday and Joke 2013).

Halliru (2015) noticed that the general public outcry against poor academic achievement of Senior Secondary School students in Senior Secondary Certificate Examination (SSCE) conducted by West African Examination Council (WAEC), National Examination Council (NECO) and similar bodies indicate low quality education and associated teachers' ineffectiveness. Teachers at secondary school level were held responsible for growing decline in students' academic achievement since the quality of education depends on the teachers as reflected in the performance of their duties. The results of learning are always influenced by the nature and quality of the methods and techniques employed for the teaching and learning of a particular content, subject mater or learning experience. The ineffectiveness of teachers in classroom interaction could be responsible for the present poor achievement of students and widely acclaimed fallen standard of education in Nigeria (Halliru, 2015).

Reference to the WAEC Chief Examiner's Report on WASSCE Biology May/June 2011-2015, the weaknesses of students in WAEC examinations include: inability to interpret questions; poor command of English language; poor drawing; inability to link structural features with their functions; poor knowledge application of some biological concepts; shallow knowledge of subject matter; inability to report experiment at sequential manner; construction of 'food chain' without showing direction with arrow and poor response to ecology questions. The WAEC Chief Examiner's Report provided suggestions for remedy

among which are; teachers should endeavour to complete the syllabus before onset of examination; teachers should engage candidates to practical classes; they should also teach students how to make good diagram; students cultivate good habit to enhance preparation for examination; they should read widely and go through past question papers to familiarise themselves with the format of the examination.

From the general comment provided by the WAEC Chief Examiner's Report on the mean and standard deviation scores 2011-2015 is presented in Table 1.1

Table 1 Mean and standard deviation of WASSCE 2011-2015 from WAEC Nigeria

Year	Mean	SD	Total No. of Students
2011	19	9.54	Not provided
2012	16	9.06	1,645,047
2013	25	10.30	1645,045
2014	18	10.49	Not provided
2015	21	10.34	1,182,038

Table 1 shows that the mean score of students' achievement in WAEC 2011-2015 was fluctuating where the mean score of 2011 with mean 19 (SD=9.54) is higher than that of 2012 with mean 16 (SD=9.06). The mean score of students in the year 2013 rises to 25 (SD=10.30) which means improvement compared to 2011 and 2012. The mean score of students falls down in 2014 to 18 (SD=10.49) and rises slightly to 21 (SD=10.34).

The problem of this poor achievement in biology may not be unconnected to the frequent use of conventional lecture method being used by Secondary School teachers of biology, in the literature 70% of scientific knowledge is passed to learners via lecture method (Gambari & Yusif, 2015).

From research evidence, educators see the pressing need to reconsider the techniques and methods of instruction at senior secondary school level. To address these challenges, there is need for an instructional system that will provide students an opportunity to interact and learn from their learning partner so as to improve their learning achievement and retention of learned material. The weaknesses presented by the WAEC Chief Examiner's Report and the fluctuation of student's achievement can be taken cared of when Cooperative Learning Strategy is used in teaching and learning Biology. This is because working in small groups gives students access to a wide range of thinking strategies, contribute to better understanding of problem and provide alternative solutions (Gambari & Yusif, 2015).

Using conventional teaching method may cause wasting of facilities and energy and every effort lead to failure (Nejat & Omidian, 2015). The consistent poor achievement of students in biology at senior secondary certificate examination leaves one in doubt about the effectiveness of the teaching method being popularly used by the teachers of biology. The use of conventional method of teaching leads to only memorisation of facts and concept without full understanding of the content. As such there is the need to find out the effect of other teaching methods and strategies. This study is therefore geared toward finding out if the use of cooperative learning strategy could bring a solution to the problem of poor achievement of students in biology.

1.3 Objectives of the Study

The objectives of this study include the following, to:

1. Find out the difference in biology achievement between students taught using cooperative learning strategy and those taught using conventional lecture method in senior secondary schools, Jigawa State, Nigeria.
2. Investigate if gender affects achievement when cooperative learning strategy is used in senior secondary school biology, Jigawa State, Nigeria.

3. Establish if there is any difference in the mean retention score between students taught biology using cooperative learning strategy and those taught using conventional lecture method, Jigawa State, Nigeria.

1.4 Research Questions

The study intends to answer the following questions:

1] What is the difference between the mean achievement scores of biology students exposed to cooperative learning strategy and those exposed to conventional method in secondary schools, Jigawa State, Nigeria?

2) Is there any difference between male and female secondary school students' achievement in biology when taught using cooperative learning strategy, Jigawa State, Nigeria?

3) What is the difference between the mean retention scores of students taught biology using cooperative learning strategy and those taught using conventional method?

1.5 Research Hypothesis

The following hypothesis were tested

Ho_1. There is no significant difference in the mean academic achievement of students taught biology using cooperative learning strategy and those taught using conventional teaching method.

Ho_2. There is no significant difference in the mean achievement scores of male and female students taught using cooperative learning strategy.

Ho_3. There is no significant difference between the mean retention scores of students taught biology using cooperative learning strategy and those taught using conventional teaching method.

1.6 Significance of the Study

It is hoped that the result of the study would be beneficial to Jigawa State Ministry of Education (MOE) and Federal Government of Nigeria (FME) through creating awareness on the effect of using cooperative learning strategy in teaching and learning biology and even other subjects.

It is also hoped that the result of this study would be of beneficial to curriculum developers and school authorities by providing them with great insight into the effect of cooperative learning strategy in achieving maximum result and therefore consolidate it in their feature policy efforts.

It is also hoped that the result of this study would be beneficial to teachers through being better informed on how to help and guide their students using small groups of students working interactively to achieve a common goal. This would also make teachers use less energy while delivering lessons as they only serve as a guide to students during instruction.

The result of study would also help problem solving skill in students to become resourceful persons during lesson. Through active interaction within the group and reporting findings to the whole class, this prepare student toward becoming a socialise member of the society he find himself. The use of cooperative learning strategy for teaching biology would enhance the academic achievement of students and retention of learned material and also encourage positive interaction among them.

The finding of this study, when discussed in workshops and seminars would guide the choice of using cooperative learning strategy in teaching and learning process in biology and other subject areas. The result of the finding would also help to alleviate the problem of the scarcity of instructional materials for biology teaching and learning, through the use of a set of instructional material per group instead of a set per student.

It is also hoped that the study would serve as a reference material for other researchers who may like to undergo a similar research in the future and those who may wish to carry out the similar study in other subject area or at different area within and outside the country. This may provide them with more information on the efficiency of cooperative learning strategy in teaching and learning.

1.7 Scope of the Study

The study covers all Senior Secondary Schools in Jigawa central senatorial zone only. It has been planned to cover only public senior secondary schools in the seven local governments which constitute the Jigawa central senatorial zone. However a purposive sampling technique was employed to select some senior secondary schools within the zone. The schools selected provide a clear representation of the population.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter focuses on literature related to this study. The chapter was sub divided into sections as follows:

I. Theoretical Framework of Cooperative Learning Strategy,
II. Concept, Definition, Features Applications of Cooperative Learning Strategy
III. Importance of Cooperative Learning Strategy
IV. Limitations of Cooperative Learning Strategy
V. The Concept of Biology
VI. Academic Achievement in Biology
VII. Gender and Academic Achievement in Science
VIII. Retention of Learned Concepts in Science
IX. Review of Related Empirical Studies
X. Implications of Literature Reviewed for the Present Study.

2.2 Theoretical Framework of Cooperative Learning Strategy

The success of cooperative learning strategy is largely based on its possession of clear theoretical foundation. Cooperative learning strategy is supported by two major learning theories: the motivational and social cognitive theories. These include information processing theory, social interdependence theory and social cognitive theories (Vygotsky's and Pieget's theory in Nwosu, 2013).

a) Social Interdependence Theory

Social psychology is a discipline which uses scientific method to understand and explain how the thought, feeling and behaviour of individuals are influenced by the actual imagined or implied presence of other individual. Social Interdependence psychology is being used in a range of social settings, where interaction exists with other persons such as family, immediate society, work place and also educational institutions (Pappas, Caponecchia and Wertheim, 2012). Social and strategic interdependence is the basic element in explaining how society works. Students imitate habit fashion, customs and norms. They also learn from other people. Opinions spread throughout the society by characteristics patterns and the 'law of imitations' such as norms, attitudes and adopting of new ideas (Zurich, 2016).

Social interdependence started in early 1900s when one of the founders of the Gestalt school of psychology, Kurt Koffka proposed that groups were not 'dynamic whole' where interdependence among members could vary. A friend to Kuffka, Kurt Lewin refined his notion in 1920s and 1930s where he stated the following: (a) the essence of groups is to promote interdependence among members. This result to a dynamic group so that changes in any member of a group, lead to changes in all members of the group. (b) An intrinsic state of tension within the group motivates members to achieve a common goal. For interdependence to exist there must be more than one person involved and they must have influence to one another. In late 1940s a graduate student of Lewins, Morto Dutch extended Lewins view about social interdependence. He formulated a theory known as the theory of cooperation and computation (Johnson, Johnson & Smith 2014). Dutch develop Lewin's social interdependence theory which discusses the relationship that exists between goals of two or more individuals. According to Dutch (1949) social interdependence may be positive or negative. It is positive when individuals cooperate to attain a shared goal. It is negative when they competes one another to claim who attain the goal. In cooperative situation the

psychological process associate with the level at which an action of one person substitute the action of another (Tran, 2013).

The origin of social psychology was often traced to normal Triplett's 1987 experiments, which indicate that due to competitive instinct, people expanded more effort on task in the presence of another person, but that individual effort decrease as group size increased. By 1960s, social psychology had emerged as a separate field from Freudian psychoanalysis and behaviourism. While psychoanalyst studied introspection using limited controlled research methods, behaviourists viewed the only scientifically valid causes of behaviours as those observable aspects of environment that reinforced or punished behaviour (Pappas et al 2012). Social understanding first takes place immediately when the learner is engaged with other peoples in social interaction, and in some times can be constituted by social interaction process. Social interdependence is a mutually co-regulated interaction which took place among two or more people where the co-regulation and interactive behaviours mutually affect one another, so that the process of interaction constitute self controlled organisation (De jaegher, Di paolo & Gallager, 2010).

In late 1940s a graduate student of Lewins, Marto Dutsch developed Lewins social interdependence theory which examine the relationship that exist between goals of two or more individuals. According to Dutch (1949) social interdependence may be either positive or negative. It is positive when individuals cooperatively attained their shared goals. When individuals compete with one another to claim who attain the gaol, then it is negative interdependence (Tran, 2013).

b) Information Processing Theory

The most common form of communication among people is through speaking. Even in the modern society where computer and other personal devices are mostly text and image

based, people talk to each other more than any other form of communication. Speech passes information from a speaker to one or more listeners (O'shaughnessy, Deng & Li, 2013). Information processing theory tries to explain the communication and exchange of ideas between two or more peoples. Information processing is not only relating to social influence and rational models of interaction but also related to culture (Olaniran, Rodiriguez & Williams, 2012).

In 1964 Atkinson and Shiffrin proposed a model of human memory which consists of two different memory stores. These are short-term memory and long-term memory. Memory refers to the ability to remember information that has been acquired (Surgenor, 2010). Information processing theory support that learning take place as information passes through short-term memory to long-term memory. This theory believed in scaffold learning where learning starts from easy to difficult (Lunerbarg, 2012).

c) Social Cognitive Theory

This section deals with the social cognitive theories that support the use of cooperative learning strategy. These include Vygotsky's and Piaget's theory**.**

I. Vygosky's Theory

Lev Vygotsky was born in1896 in USSR. He developed social development theory of learning where He proposed that ''social interaction profoundly influence cognitive development of a learner''. He noticed that biological and cultural development rarely occur in isolation (Riddle 2008). This theory was developed shortly after Russian revolution where the rule of Czar was replaced by Maxism. Maxist emphasized socialisation and collectivism as such individuals are expected to sacrifice their personal goals and achievement for the development of the society. Sharing and cooperation was encouraged and the success of any

person depends upon the success of culture. Vygotsky incorporate this into model of human development referred to as socio-cultural approach. To Vygotsky development in thought, language and reasoning process are dependent upon social interaction with others; therefore He supported shared knowledge (Fani & Ghaemi, 2011).

Vygotsky positioned that; knowledge is constructed through interaction with others and shaped by the skill and abilities valued in a given culture. To him language promotes thinking, develop reasoning and support cultural activities such as reading and writing. He noticed that; children use speech, eyes and hand to solve problem. He noticed that language help children to be strategic when solving complex problems and it help them to gain self control to thinking and behaviour (Vygotsky 1978).

Vygotsky develop 'Zone of Proximal Development (ZPD)' as centre for enhancing instruction and change. Zone of proximal development is the variation between the actual development level of individuals' problem solving and the level of potential development as determined by problem solving under the guidance of adult teacher or peers [Christmas, Kutzai & Josia (2013) see also Allahyar & Nazari, 2012].

According to Liu (2012), students, teachers and administrators benefit from instruction in line with Vygotskys' zone of proximal development. Students will be faced with challenging but reasonable task that stimulate their thinking and motivate their learning effort. It help teacher to identify the strength and weakness of the individual learner and small group so as to have better understanding through appropriate support (Liu, 2012). Child can always do more intellectual activities in cooperation with others than he can do independently (Maloshonok, 2014).

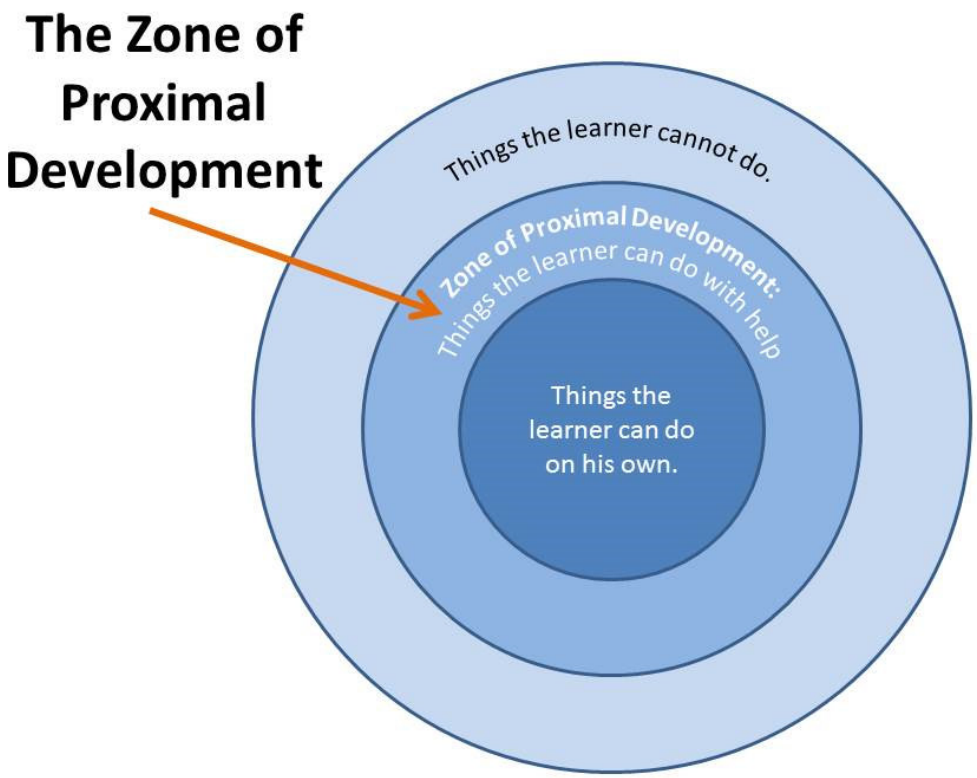


Figure 1: Vygotsky's Zone of Proximal Development (ZPD) (Vygotsky 1978)

Looking at the Vygotsky's ZPD where learners can do more things with the help of others than they can do individually, this relate to cooperative learning strategy been used in this study. This is due to the fact that Cooperative Learning Strategy allows learners to interact and discuss their understanding thereby learning more from their group member.

II. Piaget's Theory

Piaget was born in 1896 and was a creative thinker who obtains his bachelor's degree in 1915 from university of Niuchatel in New Zealand and his PhD in applied science in 1918. He developed a theory of knowledge about how the process of thinking develops gradually to a tangible deal. According to his theory there are three aspects of intelligence growth. These are: construction, content and function. Construction and content are changing as child

develops but function remains unchanged. Piaget proposed that knowledge and structure are the rules dealing with information or events, so, through them ideas are organised in a better way and cognitive growth depends on experience (Awwad, 2013).

The major concepts involved in Piaget's theory include: schemas, assimilation, accommodation and equilibration. Schema explains mental and physical actions that are involved in understanding and acquisition of knowledge. A child may have a schema about a type of animal such as dog. If the child experience is with small dogs he might conclude that all dogs are small. When ever he comes across big dog he will now develop new schema that dog can be small or big (Kendra, 2012).

Piaget's theory supported the use of cooperative learning because learners with different ability and views work together to achieve a shared goal. This provides them with the opportunity to resolve experience cognitive conflicts (Fushino, 2008). Advocates of Piaget's theory support that cooperative learning promotes learning as learners interact cooperatively to acquire knowledge. Through these cooperative activities conflicts and disequilibrium may occur, this make learner to review their understanding and tryout new ideas (Woolfolk, 2010). Therefore students should be allowed to freely identify the relationships and differences of the variables to be learned and should be allowed to present their understanding to the whole class. The teacher has the role of regulating class participation so that discussion should be based on the variable to be learned. This involve given opportunity for learners to participate and ensure that others listen when they are presenting their findings. The teacher should make sure that learners respect others views even when it is irrelevant. He should also be patient and understanding even when erratic behaviour occurs. He should also be sympathetic and open minded and not to ridicule or categorically condemn errors from students (Simatwa, 2010).

Piaget's theory is in line with the Cooperative Learning Strategy because learners with different ability and views work together to achieve a shared goal. This therefore motivated the researcher to find out the effect of cooperative learning strategy on biology students' academic achievement in senior secondary schools, Jigawa State, Nigeria.

2.3 Concept, Definition, Features, Application of Cooperative Learning Strategy

Cooperative learning is referred to as the oldest form of group learning. This can be traced to the study partners used by Hebrews thousand of years ago, as boy studied the Talmud. In common sense, the word 'cooperate' refers to work together, act jointly, collaborate, join forces, pitch in, work side by side and stand shoulder to shoulder. In the classroom situation cooperative learning was first employed in 1970s by Britton in 1973, Barnes in 1976 and Barnes and Todd in1977 (Davidson, 2014).

In 1960 Johnsons first integrated social psychology and constructivism. Constructivist philosophy declares that students learn by themselves. Johnson, Johnson and Holubec connected between their work and the Piaget's and Vygotsky's theories of cognitive development. Cooperative learning evolves where learners work together in a small group to carryout task.

Cooperative learning is an old idea. Talmud stated that for a person to learn, he need learning partner. During the first centaury Quintilion ague that students learn from one another. Seneca, (a Roman philosopher), states that in the process of teaching one is also learning twice than that of the learners. Johnson Amos Comenius (1592-1679) posited that a student benefits by teaching others and through being taught by others. In the late 1700 Joseph Lancaster and Andrew Bell use group cooperative learning in England and later in 1806 in US when Lancastrian School was opened.

Cooperative learning encourages students' engagement and involvement in their own learning. It provides the opportunity for all students to express their thought to others. It enhances higher order thinking skills that lead to higher achievement (Alhusseiny 2014).

Application of cooperative learning strategy in classroom improves students' achievement and knowledge of the subject matter. When applied appropriately in classroom setting it improve the overall success of the group (Adams 2013). According to Mcleish (2009) cooperative learning makes learning easier. He pointed out that when students are given class activity to complete, they seem to be more engaged in a lively discussion. He supported that cooperative learning indeed result in higher academic achievement. He noted that students learn better in cooperative work than working individually and students learn better from their peers. High achieving students may help low achieving ones. This benefits both of them resulting in intensive learning. Students who teach other students deepen their knowledge and those taught by their fellow students may be less threatened by their weak performance. They therefore feel more comfortable to ask questions to their fellow than to the teacher (Castle Jr 2014).

Guido and Amelie (2010) defined cooperative learning strategy as a method whereby learners work in small groups to accomplish a common goal under the guidance of their teacher. The three major purposes of using cooperative learning strategy include to develop learners' communication skills, increase tolerance and accept individual differences and to improve academic achievement. On the other hand conventional method of instruction emphasized learning through listening, teacher is the source of knowledge and learners are passive, this is less helpful to learners (Mahira and Azamat, 2013). According to Slavin (2011) cooperative learning strategy involves instructional method in which teachers organise learners into small groups, who work together to assist one another to learn academic content.

This is contrary to the conventional learning method where most of the instructions are teacher centred (Van & Raymon, 2012).

Cooperative learning is the instructional use of small groups that work together to maximise their own and each other members learning. This is contrary to competitive method where student individually achieve academic goal, and individualistic where students work by themselves to achieve goals unrelated to those of other students (Johnson, Johnson & Smith, 2013). Cooperative learning strategy is learner centred and it focuses on coordinating, supporting, stimulating and encourages interaction among learners and are expected to learn from their interaction. Cooperative learning strategy is perceived as an alternative teaching method to conventional teaching which create competitive learning environment (Haman & Nguyen, 2010).

Johnson and Johnson (2009) forwarded five essential elements for effective cooperative learning strategy as individual accountability, face to face interaction, inter personal small group social skills and group processing. Teacher supervision and heterogeneous grouping are also essential features of cooperative learning strategy.

a) Heterogeneous Grouping

Graf and Bekele (2012) defined Heterogeneous grouping in cooperative learning as the process of grouping students whose performance include low, medium and high performances. These comprise of small group of mixed ability learners that include low achievement, average achievement and high achievement learners working together to perform task. According to Zamani (2016), heterogeneous grouping involve grouping students with variety of ability levels, talents, and interest to complete an activity together. He performed a test on writing skill to find out whether there is significant difference between homogeneous (groups of students with same ability level) and heterogeneous

groups. He found out that students assigned to heterogeneous grouping achieved higher than those assigned to homogeneous groups.

Jargensen (2009) proposed that when drawing heterogeneous grouping there is need for strong recognition that groups should be of mixed ability. This approach gives clear representation of usual practices outside the school community. Outside the school setting, there is usually a broad range of skills, strength, and disposition in most community which collectively enable successful completion of activity. Likewise in the classroom setting, heterogeneous grouping should be encouraged so that students will be able to complete the task given to them. Heterogeneous grouping benefits all learners because mixing offer greater potential for learning. Positive effect of heterogeneous grouping on students' performance becomes higher when group membership is small (Miller, Witherow & Carson 2012).

b) Positive Interdependence

In positive interdependence teachers structure learning in a way that students feel that they are swimming together. This mean the reward obtained is shared among member of the group. Tasks are structured in a way that personal, team mates and group success occurs when their group complete and master the task assigned to them (Johnson & Johnson, ND). Positive interdependence is important component of cooperative learning where students working together in group do not only give recognition and reward to other members but also obtain individual reward and recognition (Haroon, 2014). Positive interdependence should be established among learners for the success of the group. This can be provided by an award, resource, roles and task commitment. Award interdependence can be provided through extra points to the groups in which each member obtain over 90%. Resource interdependence is provided by sharing a task to be completed to each group member. Role interdependence can be provided by nominating tasks like reporter, controller, and secretary to the group

members. Task commitment is provided by differentiating task to each member for researching, creating report and presentation (Isik &Saygili, 2015).

c) Teacher Supervision

Without careful planning and supervision by teachers, interaction among group members will rather reduce social interaction than improving it and this hinders students learning (Woolfolk 2010). As groups are working together, teachers need to move round in the classroom in order to observe the activities and support students where needed. When monitoring the learning process teacher has the opportunity to clarify instructions, review important strategies and procedures. Teachers need to prepare activities carefully and provide considerable support to their students when they are struggling to work together with their group members. Teachers need to provide direct instruction to their students on basic competence (Battistich & Watson 2011).

d) Face to Face Promotive Interaction

In this element of cooperative learning strategy teachers need to ensure that group members meet face to face to work together in order to complete tasks and promote the success of all their group members. Group members need to do certain work individually and collectively. There is an academic assistance for members of the group and support mechanism for others in face to face interaction. When individuals share materials and support one another's' effort to complete a task so as to attain a collective goals then promotive interaction exist (Siwach, 2014). Though some of the group activities may be done individually, majority of the works are performed through an interactive process where each group member provide feedback, challenges each other and teach and encourage his/her group members (Tsay & Brady 2010).

e) Individual Accountability

Individual accountability refers to students taking responsibility to complete their share of the work for their group and learning takes place in the process of completing the task (Ben, 2014). Individual accountability involves an individual being responsible of completing his/her share of the task or master the task assigned to their group. Individual accountability exists if the general performance of the group is assessed and rewards are supplied to all team members to compare against the criterion measure. Individual accountability happen when performance of every individual member of the group is evaluated and the result is supplied to each individual for the group to compare with a criterion measure and individual member is accountable by the group members for contributing his or her share to the group (Siwatch 2014). Individual accountability ensures equal distribution of responsibilities among group members so as to achieve a common goal.

Without individual accountability some common problems may arise. These problems include either certain members may contribute less or may not contribute at all or one of the group members may dominate the project and possibly complete the task on his/her own. In any of the above scenarios, the grades obtain by all members may be affected. Therefore assigning roles to each group member will increase individual accountability (Amentla, 2009).

f) Interpersonal and Small Group Skills

In order to achieve group's goal, group members should develop trust among them, communicate clearly, accept and support each other and also solve any conflict that may arise among group members (Johnson & Johnson, 2009). Group skills include listening to the opinion of every group member, allowing all members of the group express their understanding in the discussion, supporting alternative views critically, maintaining views

until convinced with contrary evidence, effective communication, accommodating others, resolving conflicts and compromise among others (Kimamo & Muraya 2011). Woofolk (2010) noticed that, since conversational teaching methods dominated our schools, learner may not possess the needed group skills for effective cooperative learning. It is therefore necessary that teachers use group skills to support cooperative learning.

g) Group Processing

In group processing groups analyse individual's and groups' ability to work together. Team set goals, periodically assess their successes and identify the challenges they are facing so as to make improvement in the next time (Safandi 2013). When learners are engaged in group processing they improve the skill of working together. They learn to address misunderstanding within the group thereby experiencing the process of conflict resolution which may be reflected in their feature endeavour (Kimamo & Muraya, 2011).

Apart from the essential features, there are certain models of Cooperative Learning Strategies. Learning model is a conceptual framework that describes a systematic procedure in organising learning experiences to achieve specific learning goals and serve as a guide to instructional designers and teachers in planning and implementation of learning activities. Thus the activity of teaching and learning is a systematically arranged activity (Pitayo, Waluyo, Suwandi & Andayani 2014). These models include:

a) Students' Team Achievement Division (STAD)

Students' Team Achievement Division (STAD), it was first developed by Robert Slavin and his associates at Johns Hopkins University. Students are grouped into four or five member teams that are of mixed performance level, gender and ethnic background (Tiantong & Teemuangasai 2013). Teachers nowadays are facing large class size of heterogeneous

learners. STAD cooperative learning approach help teachers to manage large heterogeneous classes they have by encouraging students to learn from their team members and other knowledgeable peers (Nikou, Bonyadi & Ebrahimi 2014). STAD might overcome these problems. It is the way to stimulate students to learn so as make them active learners. This technique is learner centred (Fitriyaningisih 2009). STAD is a cooperative learning strategy where students work together in groups of different composition to achieve a common goal. Students share ideas, work together and assist one another to maximise mutual benefits. This differs from traditional method where students work individually or competitively (Njoroje & Githua 2013). STAD is one of the basic approaches that are thought to be an efficient and effective method to teach well defined educational subjects (Kordaki, Daradoumis, Fragidakis & Grigoriadou 2012).

Class representation is given by the teacher and is similar to direct instruction. It take place inform of lecture method but the lecture must focus on the task to be learned. Later teams are organised to work together and ensure that every member learned the task to the best of their ability. Each member seat for examination or quiz on the area covered. Then individuals' results are calculated into one group (Arnadottir 2014).

STAD consist of five components as follows

1) Class representation: here teachers introduce the lesson to students after which cooperation begins.
2) Teams: students start to work cooperatively in groups on the task to achieve a common goal.
3) Quizzes: students undertake individual quizzes and they are not allowed to help each other during the test.

4) Individual improvement: learners gain score to see whether they improve in relation to their previous performance and to see how per they improve.
5) Group may win certificate or any reward when their average score improve to certain level (Slavin 1995 in Boudehane 2015).

Low, average and high achievers are equally challenged to do the best and participate in the group activities by improving their own past achievement (Habi 2010 and also Aljanian 2012). STAD is easy for teachers to apply and can be used in different subjects from primary to university level (Majoka, Dad and Mahmood 2010).

STAD poster good interaction among students, enhance positive attitude toward the course, promote self confidence, improve academic achievement and improve interpersonal skills (Norzoles 2015).

b) Jigsaw Learning

Jigsaw technique was introduced by Elliot Aranson in 1978 to improve peer cooperation and create team solidarity. Jigsaw based cooperative learning activities distribute tasks to all group members, it does not only increase participation but also make all students to be involved in the learning activities (Huang, Lio, Huang and Chen 2014). In jigsaw method students are assigned to groups to work together on academic materials which have been divided into sections. Each individual group member studies a given section and understands it thoroughly (Adams 2013). Each student in a group has a given responsibility. Students are set to work in two different groups of main group and jigsaw groups. Learners were first assigned to a main group to work together. Then the main groups are subdivided into smaller groups (jigsaw groups). Jigsaw group consist of members from different main groups who come together to perform the same task. After performing the task in jigsaw

group they return to their main group to share the information they learned (Sengul & Katranci 2014).

Jigsaw motivates students to learn their task deeply and it gives the opportunity to develop the communication skill of students (BCIT 2010).

c) Learning Together

Learning together cooperative learning strategy was first developed at the University of Minnesota by David Johnson and Roger Johnson. In learning together method, students work in four or five heterogeneous groups. When student ask question during discussion, the teacher refer the question to the group to find out the answer. After discussion group members choose group leader to present their finding to the whole class and obtain reward together. The scores are based on individual performance and success of the group but there is no competition between individuals (Bukunola & Idowu 2012). The most important features of leaning together method include existence of group goals and sharing of materials and opinion, division of labour and asking each other questions and group reward (Gokkurt Dundar, Soylu & Akgun 2012).

d) Group Investigation

Group investigation was first established by Herbert Helen when trying to reach an experience based learning situation which can be transferred easily to feature characterised by rigorous enquiries. According to Helen individuals must establish a social order and interdependently work together to meet their needs (Siddiqui, 2013). Group investigation is organised to emphasise deep thinking skills like analysis and evaluation. It aimed at allowing students to brainstorm and discusses their opinion, define, access, evaluate, manage, integrate, create and communicate their understanding (Jogngsermtrakoon & Nasongkhla

2015). In this method all students practice by topic and that the group have a topic which the group leader try to understand thoroughly and then explain it to members of group (Chuang, Chiang, Yang & Tsai 2012).

There are four components of group processing according to Tan (2013). These are: investigation, interaction, interpretation and intrinsic motivation.

e) Team-Game-Tournaments (TGT)

Team-game-Tournaments are abbreviated as TGT and were developed by Devries and Edward. In this method, Students are assigned into groups to compete in an academic game with members of other group. (Adams 2013). It was used for evaluating students after a lesson that involves heterogeneous groups of students. Each group prepare fore tournament using materials related to the topic to be discussed. The two groups of the same level go to tournament table where the tournament begins. Group score point if they answer the question correctly. Successful group in the tournament compete with another who has a high level of competency the next day (Isik & Saygili 2015).TGT resemble STAD but the only difference is that quizzes are replaced by weekly tournaments (Slavin, 2011).

f) Cooperative Integrated Reading and Composition (CIRC)

CIRC is used to teach reading and writing (US Department of Education, 2012). Students are assigned to different groups and teacher work with one team while the other teams are engaged in cognitive activities like reading, predicting what will happen at the end of the story, summarising story, writing responses, decoding understanding the vocabulary. But all the teams should work in accordance with the teachers' instructions. Reward is usually given (Glanz 2009).

CIRC develop reading, writing and other language skills. It developed a structure that gives opportunity for direct teaching of reading and writing. CIRC technique is developed to support traditional 'skilled based reading groups' approach. Reading groups are first established in the classroom and students are then paired within the group. After the teacher work with a reading group, pairs try to teach each other meaningful reading and writing skills using reciprocal learning method. They help each other to perform basic skills like asking questions, oral reading, summary and writing composition. Team books are then published and finally teams are rewarded for the effort they made (Drukan 2011). CIRC help students to get better explanation of the topic from other students. They obtain important skills such as critical thinking, creative problem solving techniques and obtain knowledge cooperatively (Gupta & Ahuja 2014).

g) Team Assisted Individualisation (TAI)

TAI cooperative learning approach, combine cooperative learning with individualised programmed teaching. Cooperative learning refers to learning in small group to affect individual accountability and achieve a common goal. On the other hand individualise programme learning, materials to be learned are arranged and presented by small group called 'frames' that lead the learning from known to unknown and from simple to difficult. TAI method uses four to six member heterogeneous teams; and high performing teams receive certificate. It involves an individualised sequence of learning lead by placement test which allow students to proceed at their own face (Awofala, Arigbabu & Awofala 2013).

TAI is a cooperative learning method which makes students to solve problems given by their teacher in small groups. Students participate actively in the classroom. Students are also taught to accept misunderstanding which might happen in the group. Cooperative learning model type TAI is one of the efforts to Overcome these problems.

In this study the researcher decided to use Student Team Achievement Division (STAD) model of Cooperative Learning Strategy to teach the experimental group, while Conventional teaching method will be used for control group. This because, STAD can be used in different subjects (Biology included) and at different level of education including secondary school level.

2.6 Importance of Cooperative Learning

Cooperative learning plays some vital roles to the life of students. These include:

a) Promote Students' Achievement

Cooperative Learning resulted in higher academic achievement than conventional learning method. This is because cooperative learning encourages students' engagement and involvement in their own learning. It provides the opportunity for all students to express their thought to others. It enhances higher order thinking skills that lead to higher performance (Alhusseiny 2014). This can be proved from a research study by Gupta & Ahuja (2014) where students were introduced to a cooperative learning strategy. A peer and self assessment was adapted to count for the individual performance in cooperative learning group assignment. The result suggested that cooperative learning was well received by students and they show willingness to join cooperative learning groups.

Application of cooperative learning strategy in classroom improves students' achievement and knowledge of the subject matter. When applied appropriately in classroom setting it improve the overall success of the group (Adams 2013). According to Mcleish (2009) cooperative learning makes learning easier. He pointed out that when students are given class activity to complete, they seem to be more engaged in a lively discussion. He supported that cooperative learning indeed result in higher academic performance. He noted that students learn better in cooperative work than working individually and students learn

better from their peers. High performance students may help low performing ones. This benefits both of them resulting in intensive learning. Students who teach other students deepen their knowledge and those taught by their fellow students may be less threatened by their weak performance. They therefore feel more comfortable to ask questions to their fellow than to the teacher (Castle Jr 2014).

b) Improve Inter-group Relations

By having students to explain their feelings and opinion, cooperative leaning develop oral communication skill of students. Due to the social interaction among students cooperative learning do not only help students to associate with student in their group but also acquire appropriate social behaviours for successful living in the wider community. Students also develop practice skills like communication, leadership, decision making, building trust and managing conflicts (Musiugafi & Rugonye 2014).

c) Better Classroom Management

Teachers gain a lot from the use of cooperative learning strategy in their teaching activities. These include helping them to manage and structure their lessons better. Teachers also maintain happier and more enjoyable classroom for their students (Gillies & Boyle 2010).

d) Psychological Health

Learners who are engaged in cooperative learning strategy in their classroom activities are usually healthier psychologically than those in the traditional classes (Li & Lam 2013).

e) Higher Self Esteem

In cooperative learning, decision making involves students and this yield greater satisfaction to the students. Researchers suggest that students who are engaged in solving problems became more committed to the solution and become better satisfied with their participation in the group more than those who work individually (Barke 2011).

2.7 Limitations of Cooperative Learning Strategies

The most common responses of people is that cooperative learning create problem of discipline and renders teacher helpless in controlling the level of noises and conversations in the class. Another problem include that students might have problem in working with others in a situation where the teacher organise the groups. If students are allowed to formulate the groups, there might be race or ethnic differentiation among students or high level students might decide to form a group leaving the weaker ones helpless. Selection of students could also lead to feeling of hostility or hurt to those who are the last to be selected. It is therefore very difficult for the teacher to organise cooperative learning class if it is the first encounter to the students because it is a strange transition from competitive to cooperative experience (Eneogu & Ejimonye 2014).

Wei & Tang (2015) point out that some limitations of cooperative learning strategy are as follows: Some students may not do the task assigned to them, rather they depend on others. Sometime few students may dominate the class while many of the students remain passive acting like audience with fewer things to do. Sometimes students with weak academic performance are neglected. Cooperative learning occasionally has vague objectives and poor expectation of accountability especially if the teacher and students do not have experience of cooperative learning activities. These make students lost behind because they do not know the actual goal to be achieved. These lead to waste of time in trying to find out the exact goal

to be achieved. Teacher need to take a long time explaining how the activity should be carried out and students need another time to think individually after which they share the experience with their group members which also need more time. Also presentation to the wider group consume another time, thus it is seen as time consuming. Teachers may be confused and lack full understanding of the cooperative learning method because of these limitations. These may cause the teacher to avoid using the strategy (Sharan 2010).

2.8 Concept of Biology

Biology can be defined as the scientific study of living organisms. Cushwa (2015) defined biology as the study of living organisms and their interactions with one another and with their environments. Araoye (2011) see biology as a natural science which comprises of contents from ‘’microscopic organisms to the biosphere in general’’ consisting the surface of the earth and all living matter. Due to its importance and fundamental characteristics, biology is now a standard subject of instruction to almost all level of our educational system. It is the only science subject whose study is highly related to successful living to human.

Biology as one of the science subjects taught in senior secondary schools, it is one of the basic subjects offered by almost all students in senior secondary schools in Nigeria. Teaching biology involve two major components which are theory and practical. Practical in biology give opportunity for students to do actual science while theory explains concepts (Thomas 2013). Biology is a very vast subject with several divisions which includes: botany, zoology, ecology, evolution, morphology, anatomy, physiology, histology, micro biology, biochemistry, genetics, cell biology, molecular biology among others. Apart from the internal relationship between these branches, biology is also closely related to other science subjects like Agriculture, chemistry, physics, geography and mathematics. It also has an application to some specialised subjects like medicine, pharmacy, food production and processing,

biotechnology, agriculture and horticulture, genetic engineering, environmental protection, tourism industries and etc (Osuafor & Okonkwo 2013). Considering its many branches and vast application to every human endeavour, it is very important for every nation to find out a lasting solution to poor achievement in the subject.

a) Academic Achievement in Biology

There is still a very low achievement in biology as revealed by SSCE result of 2007-2011. Educators are seeking alternative ways of teaching biology so as to bring changes to the situation (Opara 2011). The students' achievement has not been impressive from the West African Examination Council (WAEC) and National Examination Council (NECO) in science especially biology. An example is the performance of students in WAEC biology examination from 2007-2011 where in 2007 34.00% passed, in 2008, 33.90% passed, in 2009, 28.50% passed, in 2010, 49.60% passed, in 2011, 38.40% of the students passed at credit level (Gambari et al 2014). In a study carried out by Ali, Torimon and Gasim (2011), the SSCE result of some selected secondary schools in Kano state for the year 2007-2011, show that only 26.9% of the students performed nicely while the remaining 73.1% achieved below credit level which means failure. From above, the result show that only in the year 2010 49.60% of students pass at credit level which indicate that more than 50% of the students will not have an opportunity for further education as per as biology is concerned.

The implication of this persistent poor achievement of students in biology is that a very large percentage of students may not obtain grades that will allow them to be admitted into higher institution for further education. This has been a source of concern to meaningful Nigerians, parents, science educators as well as researchers. As such, Nigerian researchers continue to find out ways of improving the situation and maximising students learning of

biology (Osuafor & Okonko, 2013). These are some of the reasons that motivated the researcher's intention to carry out this study.

b) Conventional Teaching Method and Student Academic Achievement.

Conventional teaching strategy is otherwise known as the traditional teaching method or chalk-talk method. It is the oldest method used by most Nigerian teachers. The teacher assumes the position of one who knows all he passed out the knowledge while students remain at the receiving end. The teacher does most of the activities and materials are presented topic by topic (Salihu 2015). Conventional method is sometimes referred to as lecture method which involves a unidirectional communication pattern. Students only listen, ask questions and jot down notes and the teacher dominates the lesson (Ikitde 2013). Based on the literature reviewed, conventional teaching strategy presents low academic achievement.

c) Gender and Academic Achievement in Biology

Gender has been and will continue to be an issue of concern to researches in Education. This is because many researches on gender and academic achievement led to a number of conciliating conclusions. Some find that gender has no relevance on academic achievement while some conclude that there is significant difference between sexes on academic achievement. Ogunneye and Lasisi (2008), point out that science and technology is a male dominated subject and that female usually shy away from scientific and technological fields. Mostly, boys appear to have more positive attitude to technological and science subject while girls show negative attitude. This is due to the acceptance of the myth that boys are better in science subjects than girls. They reported that more females are found in Biology and Chemistry than in Physics Departments of higher institutions. This led to low population of females in the areas of engineering, medicine and technology. Opara (2011) observed that

gender has no significant effect on Biology achievement. Meanwhile, Awolaju (2016) found that gender has no significant influence on students' academic achievement in Biology. The influence of gender on achievement in Biology is therefore still controversial among science researchers. It is therefore imperative for studies on the effect of gender on academic achievement in Biology.

d) Retention of Learned Concepts in Biology

Olarewaju (2012) defined retention as the ability to retain and consequently remember things experienced or learned by an individual. Retention of concepts is an essential factor in determining students' achievement in a given task or activities carried out. Students must retain information from classes in order to benefit from the learning. The instructors' jobs are not finished until they have assisted the learner in retaining the information. In order for participants to retain the information taught, they must see a meaning or purpose for that information. They must also understand and be able to interpret and apply the information. This understanding includes their ability to assign the correct degree of importance to the materials. Retention is also defined as the ability to actively hold information in the mind needed to complete certain task such as active thinking, comprehension and learning. Agbeyekun (2011) explained that retention of learned concept would help student to reflect and use the retained concept for creative thinking to solve certain problem. We can therefore conceived retention as a process in which information is encoded, saved and retrieved. Encoding involves receiving, processing and containing of received information.

Olarewaju (2012) see retention as a tool employed by learners to assist them performs efficiently and effectively in all aspects of life particularly in the school. This essential tool is needed by learners to maintain and manipulate information in the mind for short and even long period of time. Agbeyenku (2011) noticed that the level of retention is determined by the

nature of material coded. He outlined certain factors affecting students' retention in relation to academic achievement in science. These factors include:

I. Individuals thinking style of the learners
II. The age of learners
III. Nature of materials to be learned
IV. Teaching method employed by the teacher

Therefore lessons need to be presented to learners using a strategy that touches their sub-consciousness which can trigger quick recalling of concepts being taught or learnt. This study therefore, intends to employ the use of cooperative learning strategy to determine its' effect on biology students' academic achievement and retention.

2.9 Review of Empirical Studies

This section will deal with review of research findings on the use of cooperative learning strategies with regards to students' academic achievement. The section will start with research findings that support the effect of cooperative learning strategy in improving students' achievement. Then the research findings that do not support the effect of cooperative learning strategy in promoting academic achievement will follow.

There are several evidences that support the effectiveness of cooperative learning strategy in promoting students' academic achievement. Halliru (2015) investigated the effect of cooperative learning method on the Academic achievement of geography students in senior secondary schools in Sokoto state. The researcher uses quasi experimental research using pre-test post-test control design. The experiment consisted of 234 samples of senior secondary school students in geography. He statistically analysed the data using t-test which revealed that students taught geography with cooperative learning strategy achieved better

than those taught using traditional teaching method. In another research carried out by Yusif (2014), on the effects of collaborative learning on Chemistry students' academic achievement and anxiety in balancing equation in secondary schools in Katsina Metropolis, Nigeria. The researcher used quasi experimental pre-test post-test research design. The experimental group were allowed to learn using collaborative learning while the control group were taught using traditional method for six weeks each. The result of the data obtained through chemistry achievement test was analysed. It revealed that the students taught using collaborative learning strategy show higher achievement and lower anxiety than their counterpart. The researcher therefore recommended that chemistry teachers should be using collaborative learning strategy in teaching and learning.

Ajaja (2010) study the influence of cooperative learning in teaching and learning integrated science on students' academic achievement. The researcher used a sample of 120 students using pre-test post-test control group design for the experimental and control groups. The result of the study significantly shows higher achievement in favour of cooperative learning class to the traditional teaching approach. Also in a descriptive study which attempted to find out the perception and practice of primary school teachers toward the effect of cooperative learning strategy, Haroon (2014), used a sample of 65 teachers who answer questionnaires. The data obtained was analysed, which indicates that teachers use lecture method more frequently than any other method including cooperative learning strategy but their perception was that the use of cooperative learning approach leads to grater understanding of the content and interpersonal skill improvement. Haroon (2014) recommended that schools need to implement cooperative learning strategy through provision of academic support and conducive learning environment.

Duyilemi & Bolajoko (2014), studied the effect of cooperative learning strategy on senior secondary school students' achievement and retention in biology. The study adopted a

pre-test, post-test, delayed test control group quasi experimental design. A total of160 students from two co-educational schools participated in the study. 80 students served as experimental group while 80 served as the control group. The data were analysed using Analysis of Covariance (ANCOVA). The result obtained showed that there were significant main effects of treatment on students' achievement and retention in experimental group.

Alabekee, Samuel & Osaat (2015), investigated the effect of traditional instruction, Jigsaw 2 and STAD models of cooperative learning on student' learning experience and achievement in mathematics. The population consists of 120 SS 2 students from senior secondary schools in Etchi and Umuma local Government area of Rivers state. ANNOVA statistical design was used to analyse the data obtained after six months intensive class lesson. The result presents a significant difference between students' achievement scores in favour of cooperative learning strategy and likewise that of learning experience. The recommendations made by the researchers include the need to encourage teachers to implement cooperative learning in their classroom activities.

In another research, which investigated the effect of cooperative instructional strategy on senior secondary school students' academic achievement in biology in Anambra state Nigeria, Nnorom (2015), used quasi experimental research with pre-test post-test non equivalent control group design. The sample consisted of 111 SS II students drawn from 2 co-educational secondary schools. Cooperative learning method was used to teach the test group while the control group were taught using traditional method. The result revealed that cooperative strategy increases student achievement and retention more than traditional method and also there is no significant difference in the achievement and retention between male and female students.

In a study conducted by Balal (2013), 32 students were randomly selected from two classes of second year secondary schools in Riyadh in Saudi Arabia. The experimental class

were taught using STAD cooperative learning strategy for a complete semester while the control group were taught using traditional method on grammar translation. The researcher used pre-test post-test experimental research design. He found out that students taught using cooperative learning strategy performed better than those taught using traditional method. The research discovered that using cooperative learning method show positive effect than the other none cooperative learning approach. In another study conducted by Gambari and Yusif (2015) which investigated the effectiveness of computer assisted students team achievement division (STAD) on physics problem solving, a type of cooperative learning strategy. The study involved 84 SS II students each to both sides of experimental and control groups. Analysis of Covariance and Scheffe test were used for data analysis and the result indicate that students taught physics with computer supported STAD achieved significantly better than those taught using individualised computer instruction. They recommended that teachers should be encouraged to teach physics using computer assisted cooperative learning to enhance students' achievement.

In another study which investigates the effect of Jigsaw teaching method (one of the types of Cooperative Learning Strategy) on male student's academic achievement at sixth grade of elementary school in Shoosh city located in the south of Iran, Nejat & Omidian (2015) conducted a semi-experimental research using pre-test and post–test design. A total number of 120 students of sixth grade from two elementary schools were categorized into two groups of experimental and control through simple random sampling technique. Data collecting tool was an academic achievement standard test including some lessons such as mathematics, empirical science, and sociological science. The data was analysed using descriptive and inferential statistics methods including ANCOVA. The findings showed that students who are trained using Jigsaw method had a better educational progress than students trained using traditional teaching methods. Also Tunga (2015) investigates the effects of

cooperative learning as an instructional strategy for teaching Quantitative Chemistry .The study investigates how other variables like sex affect students' performance in quantitative chemistry when cooperative learning was used as an instructional strategy. Three hypotheses were formulated and tested at 0.05 level of significance. The study employed a pre-test- post-test quasi-experimental design. The population of the study was made up of 980 SS II chemistry students in Kebbi state, from where a sample of 200 students was purposively selected. The instruments used for data collection were Cooperative learning guide (CLG) and Achievement test in quantitative chemistry (ATQC). The data collected were analyzed using t- test statistics. The study fund out that the students in cooperative learning group performed higher than those in traditional learning group; there is also an insignificant difference in performance between the male and female students in the cooperative learning group. Based on the findings, the study recommended that cooperative learning strategy should be adopted by all secondary school chemistry teachers as an effective learning strategy in order to improve students' performance.

In a research which study the effects of corporative learning and how teachers are familiar to it during teaching Mathematics at secondary level, Javed (2013), used the population of students of 10th Class in the Government Girls High School Qasaban No.5 Dera Ismail Khan city. Fifty student from class 10 were selected randomly and divided into two groups namely Group A and B (experimental and control groups). The Data obtained from pre-test and post-test scores were analyzed using Mean and standard deviation and a paired T-test was used to test the hypothesis. The finding of the study indicates those students who learn through corporative learning techniques scored better than those taught using traditional approach. Adeoye, (2010) investigated the effects of problem-solving and cooperative learning strategies on senior secondary two (SS.II) students' achievement in physics. The study employed a quasi-experimental research design using pre-test, post-test

control group setting. A multi-stage sampling technique was employed to select 141 physics students comprising of 78 males and 63 females. A validated Physics Achievement Test (PAT) instrument with reliability coefficient of 0.75 was administered. Also, three validated instructional materials namely: Instructional Packages on Problem-Solving Strategy, Cooperative Learning Strategy and Convention/traditional Method with reliability values of 0.82, 0.79 and 0.76 respectively were used. The experimental groups were exposed to Problem- Solving Strategy and Cooperative Learning Strategy while the Conventional method was used for the control group. The study lasted for five weeks and the data collected were analysed using ANCOVA. The result indicated that Cooperative Learning Strategy showed a significant effect on students' achievement than the Conventional Method. The study also revealed significant gender effect in favour of male students' achievement. The investigation concludes that Cooperative Learning Strategy is an effective learning strategy; the study therefore recommended that practicing physics teachers at senior secondary schools should use CLS and should as well be implemented in all teacher education programmes in Nigeria.

Some research findings concluded that cooperative learning strategy has no effect in improving students' academic Achievement. One of these studies include the one conducted by Sengul and Ketranci (2014) which investigated the effect of jigsaw cooperative learning technique in the seventh grade Geometry subject on students' mathematics achievement. The research uses 33 primary school students in Sukarya province in Turkey. Using one group pre-test post-test experimental design, the result shows no significant difference between pre-test and post-test scores of pupils. The study therefore concluded that jigsaw technique of cooperative learning strategy has no effect on students' self efficiency perceptions in mathematics.

In a research thesis titled ‘’Cooperative Learning in foreign language teaching’’ carried out by Arnadottir (2014) which investigate how teachers in Iceland use group work in their classes and whether teachers are familiar with formal cooperative learning methods. The result of this survey research indicate that the group work, though used to some extent and teachers believed that it is beneficial, but cooperative learning strategy still seems to play minor role in language teaching. One of the reasons pointed out by the researcher include that most teachers are not familiar with the cooperative learning strategies of instruction.

2.10 Implications of Literature Reviewed for the Present Study

In this chapter studies that are supporting and those that are not in support of cooperative learning strategy, historical development, features and various models of cooperative learning strategy were discussed. Most of the literature reviewed, claimed that cooperative learning strategy enhances learning, improve academic achievement and retention as well as promote the skill of social interaction, such literature include Nnorom (2015), and Alabkee et al (2015). Some limitations of cooperative learning strategy were highlighted by some researchers. Majority support that cooperative learning strategy results in higher academic achievement and retention than conventional method. Such literature includes Duyilemi et al (2014) and Ajaja (2010). Some like Sengul et al (2014) and Arnadottir (2014) concluded that cooperative learning strategy has no effect on students’ achievement. Also studies reviewed on the students’ academic achievement in biology showed low achievement from students.

The main theme from the reviewed literature is that cooperative learning strategy improves students’ academic achievement and retention. We therefore need to prepare our students to work actively in a social situation. As earlier mentioned researches suggests strongly that cooperative learning strategy can increase academic achievement, retention and

develop students' social skills. The next step is for educators find out ways to implement the valuable classroom strategy of cooperative learning.

The researches that supporting cooperative learning are practically self-evident. However, it does not address some things that concern Biology teaching. I am deeply interested in knowing more about the effects of team work on students' achievement and willingness to become actively involved in learning concepts in Biology. Additionally, while the researchers discussed various support structures for successful cooperative grouping, they had little to say about which strategies were most effective in teaching Biology to senior secondary students.

Finally, as I read the researches, I kept asking myself how cooperative learning strategy fits in with learning Biology. Does it help students learn Biology content and enable them to apply it to a real-life situation? What effect does cooperative learning specifically have on the Biology classroom? This project uses much of my knowledge gained from the literature and pushes me to gain further information and answer questions not directly addressed in the researches. It therefore influences my interest to find out the effects of cooperative learning strategy on Biology students' academic achievement and retention, Jigawa state, Nigeria.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter deals with the methods and procedures used for the purpose of data collection and gathering information that are relevant to this study. Peersman (2014) points out that, a well selected and implemented method for data collection and analysis are essential for all types of research. The chapter discusses the research design, population of the study, sample size, sampling technique, instrument for data collection, data collection procedures and procedure for data analysis.

3.2 Research Design

There are many research designs used by researchers in conducting educational research. However quasi experimental research, especially pre-test post-test post-post test control group design which is one of the types of experimental design is considered to be the most appropriate for this study considering the nature of the study and the subject matter.

McMillan and Schumacher (2010) point out that an experimental research design involve manipulation of an independent variable and measuring its' effect on one or more dependent variables. Experimental research is characterised by hypothesis, random assignment of subjects, manipulation of independent variables, measuring dependent variable, use of inferential statistics and control of extraneous variables.

Quasi-experimental design is also referred to as 'field experiment' 'insitu-experiment'. The researcher has limited control over selection of study participants. This means that, the researcher has no power to randomly assign the participants in to groups like heterogeneous groups. There is also limited control over the variables and the effect of the treatment on the

study group (Levy &Ellis, 2011). In a situation where students come in an intact group, it is more appropriate to use quasi-experimental design where treatments are assigned to groups. The treatment may be assign randomly (e.g. by picking classroom out of hat) or purposive (e.g. student may decide which class they may be assigned). Quasi-experimental design may be improved by the use of control group (Anne 2010). As such the researcher used quasi-experimental research due to intact classes in the schools selected and the limited power to select the classes.

A pre-test was administered to both the experimental and control groups to see their equivalence in ability and these score was used to place student in the same prior knowledge level. Then a post-test was administered to all groups after the treatment so as to determine the effectiveness of the treatment and determine their achievement level on the concept taught. A retention test referred to as post-post test was delivered to each group two weeks after the treatment. This was used to determine the learning retention between the two groups. It was the same test (BAT) delivered with a slight modification.

The experimental group were taught Biology using cooperative learning strategy while the control group were taught using conventional method of teaching. This has been diagrammatically illustrated as follows:

EG $\longrightarrow$ O_1 $\longrightarrow$ X_1 $\longrightarrow$ O_2 $\longrightarrow$ O_3

CG $\longrightarrow$ O_1 $\longrightarrow$ X_2 $\longrightarrow$ O_2 $\longrightarrow$ O_3

Key:

EG = Experimental group

CG = Control group

X_1 = Treatment using cooperative learning strategy (experiment)

X_2 = Treatment using conventional teaching method (control)

O_1 = pre-test administration

O_2 = Post-test administration

O_3 = Post-post-test administration

3.3 Population and Sample Size

This section deals with the population of the study, the sample to be selected for the conduct of this research and sampling technique.

3.3.1 Population of the Study

The target population of the study comprises all public Senior Secondary Schools Students in Jigawa central senatorial zone. This zone consists of seven Local Governments which are Gwaram, Buji, Birnin Kudu, Dutse, Kiyawa, Jahun and Miga. There are 50 senior secondary schools with 25,793 students in the area.

The population distribution of students according to Local Government is represented in Table 3.1

Table: 3.1 Population of the Study.

LGA	No of Schools	Boys	Girls	Mixed	Total No of Students
Gwaram	11	3,141	2,256	1,180	6,577
Buji	3	377	0	0	377
Birnin Kudu	8	4,083	380	295	4,758
Dutse	12	5,914	747	1,744	8,405
Kiyawa	5	1,136	0	80	1,216
Jahun	7	2,371	845	679	3,895
Miga	4	565	0	0	565
Total	50	17,587	4,228	3,978	25,793

Source: - Dept. of school services, Jigawa State Min. of Education.

Table 3.1, indicates that there are 50 Senior Secondary Schools in the seven Local Governments within Jigawa Central Senatorial Zone. Gwaram Local Government Area has 11 Senior Secondary Schools which include boys' schools, girls' schools and mixed schools with total of 6,577 students. Buji has only 3 boys' schools with 377 students. Birnin Kudu Local Government has 8 Secondary schools which are boys', Girls' and mixed schools with total of 4,758 students. Dutse Local Government Area has 12 senior secondary schools that include both boys' schools, girls' schools and mixed schools having a total number of 8,405 students. Kiyawa Local Government Area has 4 boys' only and 1 mixed senior secondary schools with 1,216 students. Also Jahun Local Government Area has 7 schools with total of 3,895 students which are boys,' girls' and a mixed school. Miga Local Government Area has only boys' schools which are 4 and a total of 565 students.

There are total of 17,587 students from boys' only schools, 4,228 students from girls' only schools and 3,978 students from mixed schools. These constitute 25,793 students from the whole 50 senior secondary schools within Jigawa central senatorial zone.

The population was derived from public Senior Secondary II students of the region. They are mostly Hausa and Fulani by tribe with average age of 15-17 years.

3.3.2 Sample Size of the Study

In any research it is not always possible to use the entire population of the study. It is therefore important to select a specific number from the population to serve as sample for the study. In order to get an unbiased and reliable sample, two (2) secondary schools were selected from the fifty (50) senior secondary schools within the zone. Intact classes were used from each sample school so as to avoid destruction of classes and promote continuity. The sample was selected from each of the mixed schools as the study sample. The number of students' representation can be illustrated in the Table 3.2.

Table 3.2 Selected Samples:

Schools	**Males**	**Females**	**Total**	**Group**
GDASS Sara	67	40	107	Control
GDASS Jikas	71	39	110	Experimental
Total	138	79	217	

From Table 3.2, an intact class was selected from each of the schools to constitute the one experimental and one control groups. The intact classes were selected from SS II students of each school and comprises of 107 students in the control group while 210 students were in the experimental group. Both the groups consist of male and female participants who are mostly Hausa and Fulani by tribe with average age of 15-17years.

3.3.3 Sampling Technique

A purposive Sampling Technique was used to select the schools from the population. In sampling, the researcher select particular sample from the population that will give clear representation or provide information about the topic of interest. The researcher therefore decided to use purposive sampling technique because it is considered to be the most appropriate sampling technique for this research.

In purposive sampling, the researcher select particular sample from the population that will give clear representation or provide information about the topic of interest. Purposive sampling is appropriate where the researcher has prior knowledge of the population and has specific purpose for the study. The researcher therefore relies on personal judgement when selecting a sample that involves subjects with characteristics of interest (Mc.Millan et al 2010).

3.3.4 Selection of Topics to be Taught

The topic taught in this research is ecology. This is because it is contained in the SS II biology curriculum and it was pointed out by the WAEC Chief Examiners' Report 2011-2015 that most students show poor response to ecology questions. This topic chosen comprises of ecosystem, feeding relationship, habitat, population and the soil composition and its' characteristics. The selection of this topic is also due to the fact that many environmental issues are contemporary issues that need serious consideration. A learner needs to know his environment and realise the relationship that exist between him/her and other living organisms. This enables the learner to know who he is, and what other biotic

components are. This will make him value and conserve other living organism around him.

3.4 Data Collection Instrument

Evaluation relies on data collection instrument used to elicit and record information. There are different types of data collection instruments which include summary report form, questionnaire, interview, inventory, observation and checklist. According to Pierce (2009), data collection instrument refers to a survey, test, scale, rating, or tool designed to measure the variables, characteristics or information of interest.

In this study Biology Achievement Test (BAT) was used to measure students' academic achievement in the experimental and control group before and after the intervention. BAT was planed based on the content taught during the study and consists of thirty multiple choice tests. The total marks allocated for the test was 30 and the duration for the test was an hour.

3.5.1 Validity of the Research Instrument

The instrument was validated by experts from the department of Science and Technology Education, Bayero University. A copy was issued to a professor and a senior lecturer in Science and Technology Education and a senior lecturer from Biological Science departments of the university. To ensure validity of the BAT, item was issued to Biology teacher at secondary schools in the zone with more than fifteen years teaching experience so as to ensure the validity of the test.

Table 3.3: Table of specification for BAT

Content	Knowledge	Comprehension	Application	Total
Soil	2,20,25	3,26,29	4,30	8
Ecosystem	11,12	10,23	22	5
Food chain & food web	13,14,16	19,17,21	9	7
Habitat	6,7,8	22	15	5
Population	1,5	28,27	24	5
Total	13	11	6	30

Table 3.3 shows that the test items tests students' knowledge, comprehension and application of what they learned during the teaching and learning activities. The content tested comprises Soil, Ecosystem, Feeding relationship (food chain and food web), Habitat and Population. There are 13 questions which test knowledge of the subject matter, 11 questions tests comprehension while 6 questions tests application of what was learned.

3.5.2 Reliability of the Instrument

To test the reliability of the research instrument, a test-retest method was employed. This involved administering the BAT instrument to students from a school in the population which is not part of the schools selected as sample of the study. After two weeks interval, the same instrument was re-administered to the same students for the second time. This is inline with Sambo (2008) who recommend two weeks as an appropriate interval. The data obtained from the two tests (first test and the second test) was used to determine the reliability of the instrument using Pearson Product Moment Coefficient (PPMC) statistical technique.

3.5.3 Items Characteristics of the Instruments (BAT)

An item analysis involves many statistics that can provide useful information for improving the quality and accuracy of multiple-choice or true/false items. Some of these statistics are:

Item difficulty: the percentage of students that answered the item correctly.

Item discrimination: the relationship between how well students did on the item and their total exam score.

Reliability coefficient: a measure of the amount of measurement error associated with an exam score.

Items was analysed based on the scores obtained from the pilot study to determine the facility and difficulty indices of the items in the BAT. The facility index (FI) is the percentage of students that gets an item right (Haladyna, 1999). It is determined by using formula

$$\text{F.I} = \frac{R}{T} \times 100$$

Where R= Number of correct responses.

T = Total Number of students.

Agbeyenku (2011) recommended values which ranges between 0.3 to 0.7 as good test item usually used to assess the performance of the students.

Discrimination index: indicates the discriminating power of each of the test items or is the ability to sort between high and low ranking students in the whole test. The score was done using the scores of the top 27% and the bottom 27% scores of the total respondents. This was calculated using formula given by (Kelly, 1939).

$$\text{D.I} = \frac{Ru - Ri}{1/2N}$$

Where D.I = Discriminating index

Ru= Number of candidates that got item correct among upper 27% of respondent

Ri = Number of candidates that got item correct among lower 27% of respondent

N = total Number of respondents

The D.I, which ranges from 0.3 to 0.7 is regarded as moderately positive and is good for selecting the items of the BAT

3.6 Data Collection Procedure

A pre-test was administered to the students during the first stage of the study to obtain data which shows students' achievement based on the content prior to the intervention. Then, a five weeks lesson was delivered at the second stage. The experimental group were taught Biology by the researcher using cooperative learning strategy. The control group were taught Biology using conventional teaching by a trained research assistant from the sampled school. The lesson plans were adapted by the researcher from Salihu (2015) and copies were issued to the research assistant. This happens because the researcher can not cover all the selected schools due to time factor. At the end of the teaching and learning activities, BAT was administered to both the experimental and control group and collected the post-test data which shows students' achievement after the intervention. Another test was conducted two weeks after post-test to test the retention of the learners. This test is referred to as post post-test. The teachers and students of Biology were informed about the aim of the research which is to improve teaching and learning Biology at senior secondary school level.

3.7 Procedure for Data Analysis

The data collected for the purpose of this study were presented and analysed using mean, standard deviation and z-test to test the hypotheses. The researcher decided to use z-test because it is more versatile technique for data analysis usually used to find out whether a significant difference exists between variables at 0.05 levels of significance. The data were summarised and presented in the following chapter (chapter four). Z-test is an inferential

statistical procedure for determining the probability level of rejecting hypothesis that two means are the same. A paired z-test is used to compare the means of two populations where you have two samples in which observations in one group can be compared with observation in another group. This includes giving a diagnostic test before studying a particular thing and then another test after completing the study (Shier 2014). This was practiced through the use of pre-test post-test pos-post-test control group design in this study. The research questions will be answered using descriptive statistics (mean & standard deviation)

The following hypotheses were rested along with the appropriate statistical tool for data analysis at the significant difference of 0.05 as follows:

Ho_1. There is no significant difference in the mean academic achievement of students taught biology using cooperative learning strategy and those taught using conventional teaching method.

Hypothesis one would be tested using z-test statistics.

Ho_2. There is no significant difference between male and female students taught using cooperative learning strategy in their mean academic achievement in biology.

Hypothesis two would be tested using z-test statistics.

Ho_3. There is no significant difference between the mean retention scores of students taught biology using cooperative learning strategy and those taught using conventional teaching method.

Hypothesis three would be tested using z-test statistics at 0.05 level of significance (this is due to the possession of two groups and it is an interval scale).

CHAPTER FOUR

DATA ANALYSIS

4.1 Introduction

This study investigates the effect of cooperative learning strategy on students' academic achievement in senior secondary schools, Jigawa State, Nigeria.

For the purpose of data collection, Biology Achievement Test (BAT) was used as an instrument for data collection. The data collected were analyzed using z-test and the level of significance adopted for rejecting or retaining the stated null Hypotheses was $p \leq 0.05$. In order to collect data for this study, three research questions were formulated.

To answer the research questions the data collected were analyzed, interpreted and discussed as presented in the following subheadings: Data Analysis and Result Presentation, Summary of the Findings and Discussion of the Results.

4.2 Data Analysis and Result Presentation

The results of the analysis are presented in the form of inferential analysis as provided in the preceding chapter (3). The results are presented and described based on research questions and hypothesis.

4.2.1 Demographic Information of the Subjects

The participants in this research are the SS II secondary schools students in Jigawa Central Senatorial Zone and demographic information of the participants is presented on Table 4.1.

Table 4:1. Demographic Characteristics of the Participants

	Frequencies	%
Pre-test		
Control Group	107	49.3%
Experimental Group	110	50.7%
Post-test		
Control Group	107	49.3%
Experimental Group	110	50.7%
Gender		
Male	138	63.6%
Female	79	36.4%

The distribution of the samples as presented in Table 4.1 shows that, 107 (49.3%) were from the control group while 110 (50.7%) of the respondents were from the experimental group in both pre-test and post-test period. The distribution of the respondents with respect to gender shows that, 138 (63.6%) of the sample are male while 79 (36.4%) are female.

The entire sample used in this study was 217 comprising male and female selected using simple a purposive procedure. The distribution of the respondents shows that, all the groups were fairly represented in this study.

Table 4:2 Summary of Z-test Analysis of Pre-test Score of the Experimental and Control Group

Group	N	Mean	Std Dev.	df	z-cal	Sign
Experimental Group	110	7.78	2.61	215	1.55	0.123
Control Group	107	7.23	2.60			

Table 4.2 shows that the mean academic achievement scores for the experimental and control groups during pre-test were 7.78 (SD =2.61) and 7.23 (SD =2.60) respectively. Therefore the difference in the mean academic achievement scores of the experimental group and that control group are not significantly different. This means that both the two groups show nearly an equal achievement at the base line.

4.2.2 Answering the Research Questions

Research Question 1: What is the difference between the mean achievement scores of biology students exposed to cooperative learning strategy and those exposed to conventional method in senior secondary schools, Jigawa State, Nigeria?

To answer this research question, the post-test scores of experimental and control group were subjected to descriptive statistics. Mean and standard deviation were computed and used to draw Table 4.3.

Table 4.3: Mean and Standard Deviation of Post-test Scores for the Experimental and Control Groups.

Variable	N	Mean	Std Deviation	Std Error of the mean
Experimental	110	15.01	3.487	0.332
Control	107	11.23	3.578	0.346

Table 4.3 shows that the mean academic achievement scores for the experimental and control groups were 15.01 (SD=3.487) and 11.23 (SD=3.578) respectively. Therefore mean academic achievement scores of the experimental group is higher than that of control group this means that the experimental group performed better than control group. This shows that cooperative learning strategy has more positive effects on biology students' academic

achievement than those taught using conventional method. To determine whether the difference is significant or not, hypothesis one was formulated and tested.

Research Question 2: What is the difference between male and female secondary school students' achievement in Biology taught using cooperative learning strategy?

To answer this research question, the post-test scores of experimental and control group were subjected to descriptive statistics. Mean and standard deviation were computed and used to draw Table 4.4.

Table 4.4: Mean and Standard Deviation of Post-test Scores for Male and Female in the Experimental Groups.

Variable	N	Mean	Std Deviation	Std Error of the mean
Male	71	15.23	3.265	0.388
Female	39	14.62	3.870	0.620

Table 4.4 shows that the mean academic achievement scores of male and female in the experimental group. The means academic achievement scores for the male and female of the experimental groups were 15.23 (SD=3.265) and 14.62 (3.870) respectively. As such the mean scores of both male and female are not very different. This shows that there is no considerable gender difference on academic achievement of students when Cooperative Learning Strategy is used to teach biology. To verify whether there is significant difference or not, hypothesis two was formulated and tested.

Research Question 3: What is the difference in the mean retention scores between students taught biology using Cooperative Learning Strategy and that of those taught using conventional method in senior secondary schools, Jigawa State, Nigeria?

Table 4.5: Mean and Standard Deviation of post-post-test Score for the Experimental and Control Groups.

Variable	N	Mean	Std Deviation	Std Error of the mean
Experimental	110	14.46	3.242	0.309
Control	107	8.89	2.703	0.261

Table 4.5 shows that the mean retention scores for the experimental and control groups were 14.46 (SD=3.242) and 8.89 (SD=2.703) respectively. The mean retention scores of the experimental group are therefore higher than those of control group. This indicates that the experimental group were able to retain knowledge better than the control group. This shows that Cooperative Learning Strategy has more positive effects on students' retention in biology than the conventional method. To determine whether the difference is significant or not, hypothesis three was formulated and tested.

4.2.3 Hypotheses Testing

Ho_1: There is no significant difference in the mean academic achievement of students taught Biology using Cooperative Learning Strategy and those taught using Conventional Teaching Method

To test this hypothesis, the mean academic achievement of students taught Biology using Cooperative Learning Strategy and those taught using Conventional Teaching Method were used to conduct the test of differences. The coefficient of the difference was determined by comparing the mean academic achievement of the two groups using independent sample z-test at 0.05 level of significance. The result of the analysis is presented in Table 4.6;

Table 4.6 Summary of Z-test Analysis of Post-test Score of Experimental and Control Groups

Group	N	Mean	Std Dev.	df	z-cal	Sign
Experimental Group	110	15.01	3.49	215	7.87	0.00
Control Group	107	11.23	3.58			

The result of the analysis shows that, the mean academic achievement of students taught using Cooperative Learning Strategy (Mean=15.01; SD=3.49) is significantly higher than that of students taught using Conventional Teaching Method (Mean=11.23; SD 3.58) and the P= 0.000 < 0.05. The result of the test for differences using the independent sample z-test obtained, as shown in Table 4.6 revealed the z-value = 7.87 and p *value*= 0.00, $\alpha = 0.05$. The null hypothesis which says there is no significant difference in the mean academic achievement of students taught Biology using Cooperative Learning Strategy and those taught using Conventional Teaching Method is therefore rejected since p=0.00< 0.05. This means that the academic achievement of students taught Biology using Cooperative Learning Strategy and those taught using Conventional Teaching Method are significantly different. The difference is in favour of students taught using Cooperative Learning Strategy (Experimental).

H_{O2}: There is no significant difference in the mean achievement scores of male and female students taught Biology using Cooperative Learning Strategy

To test this hypothesis, the mean academic achievement of male and female students taught Biology using Cooperative Learning Strategy were used to conduct the test of difference. The coefficient of the difference was determined by comparing the mean academic achievement of male and female students using independent sample z-test at 0.05 level of significance. The result of the analysis is presented in Table 4.7;

Table 4.7: Summary of Z-test Analysis of Post-test Scores of Male and Female Students in the Experimental Group

Gender	N	Mean	Std Dev.	df	z-cal	Sign
Male	71	15.23	3.265	108	.877	0.383
Female	39	14.62	3.870			

The result of the descriptive analysis shows that, the mean academic achievement of male students taught using Cooperative Learning Strategy (Mean=15.21; SD=3.265) is not significantly higher than that of female students taught using Cooperative Learning Strategy (Mean=14.625; SD 3.870) and the P= 0.383 > 0.05. The result of the test for differences using the independent sample z-test obtained, as shown above revealed that z value = 0.877 and p *value*= 0.383, $\alpha = 0.05$. The null hypothesis which says There is no significant difference between male and female students taught Biology using Cooperative Learning Strategy in their mean academic achievement is therefore retained since p= 0.383 > 0.05. This means that the academic achievement of male students taught Biology using Cooperative Learning Strategy and that of female taught using the same method are not significantly different. This indicates that cooperative learning strategy is gender friendly.

H_{O3}: There is no significant difference in the mean retention scores of students taught Biology using Cooperative Learning Strategy and those taught using Conventional Teaching Method.

To test this hypothesis the mean retention scores of students taught Biology using Cooperative Learning Strategy and those taught using Conventional Teaching Method was used to conduct the test of differences. The coefficience of the difference was determined by comparing the mean retention scores of the two groups using independent sample z-test at 0.05 level of significance. The result of the analysis is presented in Table 4.8;

Table 4.8: Summary of Z-test Analysis of Post-Post-test Scores of Students in the Experimental Groups

Group	N	Mean	Std Dev.	df	z-cal	Sign
Experimental Group	110	14.46	3.242	215	13.74	0.00
Control Group	107	8.89	2.703			

The result of the descriptive analysis shows that, the mean retention score of students taught using Cooperative Learning Strategy (Mean=14.46; SD=3.242) is significantly higher than that of students taught using Conventional Teaching Method (Mean=8.89; SD 2.703) and the P= 0.000 < 0.05. The result of the test for differences using the independent sample z-test obtained, as shown above revealed the z value = 13.74 and p *value*= 0.00, α = 0.05. The null hypothesis which says there is no significant difference in the mean retention scores of students taught Biology using Cooperative Learning Strategy and those taught using Conventional Teaching Method is therefore rejected since p=0.00< 0.05. This means that the mean retention scores of students taught Biology using Cooperative Learning Strategy and those taught using Conventional Teaching Method are significantly different. The difference is in favour of students taught using Cooperative Learning Strategy (Experimental).

4.4 Summary of Findings

Based on the outcome of the analysis, the major significant findings of this study are;

I. There is significant difference in the mean academic achievement of students taught Biology using Cooperative Learning Strategy and those taught using Conventional Teaching Method.

II. There is no significant difference between male and female students taught Biology using Cooperative Learning Strategy in their mean academic achievement.

III. There is significant difference in the mean retention scores of students taught Biology using Cooperative Learning Strategy and those taught using Conventional Teaching Method.

4.5 Discussions of Findings

The objective of this study is to determine the effects of Cooperative Learning Strategy on Biology Students' Academic Achievement in Senior Secondary Schools, Jigawa State, Nigeria.

To achieve this objective, students in experimental group were taught Biology using Cooperative Learning Strategy while students in control group were taught using Conventional Teaching Method. Three research questions were formulated and three null hypotheses were tested. Before the commencement of the treatment, it was established that the subjects had equivalent knowledge of Biology (Ecology) through the pre-test. Therefore, the observed differences in the result were due to treatment. The result of the analysis of the data on the research questions and null hypotheses are hereby discussed.

The research question one was answered by testing the corresponding hypothesis which states that there is no significant difference in the mean academic achievement of students taught Biology using Cooperative Learning Strategy and those taught using Conventional Teaching Method. Analysis of the data showed that the students taught Biology using Cooperative Learning Strategy had a higher mean achievement score than the students taught using conventional method. This significant difference of the students taught with the use of Cooperative Learning Strategy could be due to the fact that Cooperative Learning Strategy is engaged in learning involving students to perform activities themselves and finding out facts in groups thereby making the students actively working together and achieving their own intellectual goals. Also, charts and flashcards could be an anchoring device for enhancing

learning so that student can have easy comprehension of the concepts through instant feedback. This finding concurred with that of Alabekee et al (2015) whose work opined that Cooperative Learning Strategy has positive impact on students' achievement. Javed, (2013) suggested that the use of Cooperative Learning Strategy promote better academic achievement than the conventional approach. The result has also agreed with the finding of Yusif (2014) who found that Cooperative Learning Strategy promotes understanding and achievement of students better than those in the control class which received Conventional Teaching Method. The students in the experimental classes expressed positive responses towards Cooperative Learning Strategy due to the activities conducted in collaboration with their group members in the learning process.

Research question two was answered by testing the corresponding hypothesis which states that there is no significant difference between male and female students taught Biology using Cooperative Learning Strategy in their mean academic achievement. The analysis of the mean achievement score between male and female students were not statistically significant. The finding from this study indicates that gender has no effect on learning biology when Cooperative Learning Strategy is used. This means that Cooperative Learning Strategy is gender friendly. The result of this finding coincide with that of Ajala (2013) who observed that gender has no significant effect on students' Achievement when taught using Cooperative Learning Strategy. The result also agree with that of Mobark (2014) who established that gender has no significant effect on student academic achievement.

The research question three was answered by testing the corresponding hypothesis which states that there is no significant difference in the mean retention scores of students taught biology using Cooperative Learning Strategy and those taught using conventional teaching method. Analysis of result revealed that the students taught biology using Cooperative Learning Strategy show a higher mean retention score than the students taught

using conventional method. This significant achievement related to the use of Cooperative Learning Strategy could be due to the fact that Cooperative Learning Strategy involves the use of student cooperation system which enhances better learning and retention. This is in line with the findings of Olaruwaju (2012) who observed that teaching students using cooperative learning strategy models have higher retention score in biology concept than those taught using conventional method. This finding also agrees with that of Nnorom (2015) who revealed that retention takes place when Cooperative Learning Strategy learning is used more than when conventional method is used.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This study investigated the effects of Cooperative Learning Strategy on biology students' academic achievement in Senior Secondary Schools, Jigawa State, Nigeria.

This chapter presents the summary of the work, the conclusion drawn and recommendations based on the findings of the study.

5.2 Summary

The study was conducted to investigate the effect of Cooperative Learning Strategy on biology students' academic achievement in Senior Secondary Schools in Jigawa State, Nigeria. The study focused on SSII students of two (2) selected Secondary Schools. Three research objectives were raised which were translated to three research questions and three null hypotheses.

Relevant literatures were reviewed on theoretical framework of Cooperative Learning Strategy, concept of Cooperative Learning Strategy, features of Cooperative Learning Strategy, models of Cooperative Learning Strategy, concept of Biology, academic achievement in biology, conventional teaching method and review of empirical studies.

Quasi experimental design was employed for this study. A purposive sampling technique was adapted to obtain four secondary Schools out of the 50 Secondary Schools within the central senatorial zone and the same sampling technique was employed to select intact classes from each sampled schools. One (1) secondary school was experimental while another one (1) was assigned to control group. The selection was done using purposive sampling technique. An intact class was selected from each sampled school. One intact class was used as experimental group and one as control group and a total of two hundred and seventeen (217) SS II students were involved in the study. The instruments used for data

collection were Biology Achievement Test (BAT), lesson plans and teaching modules. Pearson Product Moment Correlation Coefficient was used to calculate the reliability of Biology Achievement Test and an index 0.89 was obtained.

The research questions were answered using mean and standard deviation while the null hypotheses were tested using z-test technique. The results indicated that two of the null hypotheses were rejected while one hypothesis was retained. These are:

1) There is significant difference in the mean academic achievement of students taught Biology using Cooperative Learning Strategy and those taught using Conventional Teaching Method.
2) There is no significant difference between male and female students taught Biology using Cooperative Learning Strategy in their mean academic achievement.
3) There is significant difference in the mean retention scores of students taught Biology using Cooperative Learning Strategy and those taught using Conventional Teaching Method.

5.3 Conclusion

I. The findings of the study have shown that there is significant difference between the academic achievements of students taught biology using Cooperative Learning Strategy and those taught using Conventional Teaching Method.

II. It was also discovered that the male students in experimental group achieved not better than the female students in the same group.

III. There is significant difference in the mean retention score of students taught biology using Cooperative Learning Strategy and those taught using Conventional Teaching Method. Therefore, contrary to Conventional Method, Cooperative Learning Strategy helps students be more responsible in learning and it is an appropriate method for teaching biology since students are actively involved in teaching-learning process.

5.4 Contributions to Knowledge

The findings from this study suggested that Cooperative Learning Strategy improved students' academic achievement and retention in biology. The implications of the study could be stated as follows:

1. According to the results obtained from Biology Achievement Test, students obtained a high level of achievement when Cooperative Learning Strategy was used to teach them. This indicates the use of Cooperative Learning Strategy in biology instruction enhance understanding of Biology (P. value of 0.00).

2. The result obtained indicate that both male and female students show higher academic achievement in Biology when taught using Cooperative Learning Strategy (P. value of 0.38)

3. The use of Cooperative Learning Strategy not only improves academic achievement but promote retention of learned concepts in Biology (P. value of 0.00).

5.5 Recommendations

The following recommendations were made based on the findings of this study.

1. Since Cooperative Learning Strategy has been found to improve students' academic achievement and retention, there is need for pre-service and in service training of biology teachers on the use of Cooperative Learning Strategy in teaching biological concepts.

2. Teachers in public Senior Secondary Schools should be encouraged by the government to learn how to use Cooperative Learning Strategy in teaching biology. They should also be provided with conducive learning environment for effective teaching and learning to take place.

3. Biology teachers should encourage both male and female students to actively participate in the classroom activities since cooperative learning strategy shows no gender effect on teaching and learning.

5.6 Limitations of the Study

1. The Biology Achievement Test has only 30 multiple choice items. A more detailed instrument may yield a better finding.

2. Inability of the researcher to incorporate private secondary school in the zone to the experimental and control groups is another limitation of the study.

5.7 Suggestions for Further Research

The following suggestions were made for further research:

1. Studies of this nature should be conducted using larger samples and a different geographical area.

2. Studies of this nature should be conducted on other content areas of secondary school Biology especially difficult concepts like genetics and evolution.

3. Studies of this nature should be conducted using other variables like ability level.

References

Adeoye, F.E., (2010) Effects of problem-solving and cooperative learning strategies on senior secondary school students' achievement in physics. *Journal of Theory and Practice in Education.* Vol. 6 (1) 235-266.

Adams, A.R. (2013). *Cooperative learning, effects on the classroom*. Northern Michigan University pp 11-17.

Agbeyenkun, p. (2011). *Influence of advance organisers of advance organisers on students performance and retention of ecology concept in senior secondary schools in Giwa educational zone. Unpublished thesis of science education*. Ahmadu Bello University Zaria.

Agboghoroma, T.E., & Oyovwi, E.O., (2015). Evaluating effects of students' academic achievement on identified difficult concepts in senior secondary school biology in Delta state. *Journal of Education and Practice. Vol. 6 (30).*

Ajaja, P.O. (2010).Effects of cooperative learning strategy on junior secondary school students in integrated science. *Electronic Journal of Science Education* Vol. 14(1) 1-17.

Akinfe, E., Olanifinniyi, O.E. & Fashikun, C.O. (2012). Teachers quality as correlates of Students Academic Performance in Biology in Senior Secondary Schools of Ondo State, Nigeria. *Online Journal of Education and Research.* Vol. 1, 108-114. Available at http://www.onlineresearchjournals.org/IJER

Alabekee, E.C., Samuel, A. & Osat, S.D. (2015). Effect of cooperative learning strategy on students learning experience and achievement in mathematics. *International Journal of Education Learning and Development.* Vol. 3 (4) 67-75.

Alhusseiny, F.I. (2014). Enhancing critical thinking through cooperative learning in biology (A Thesis for Master of Teaching Life Science) Lebanese University.

Alijanian, E. (2012). The effect of Student Team Achievement Division technique on english achievement of Iranian EFL learners. *Theory and practice in Language Studies. 2 (9) 1971-1975.*

Ali, A.R, Torimon, M.E & Gasim, M. (2014). Academic achievement in biology with suggested solutions in selected secondary schools in Kano state Nigeria. *International Journal of Education and Research*. 2 (11), 215-224.

Allahyar, N. & Nazari, A. (2012). Potentiality of Vygotsky's socio cultural theory in exploring the role of teacher perceptions, expectations and interaction strategies. *Wopalp* Vol. 6, 82.

Altun, S. (2015). The effect of cooperative learning on students' achievement and views on the science and technology course. *International Electronic Journal of Elementary Education.* Vol.3, 451-468.

Amentla, F. (2009). *How to make Small Group Learning Work*. Teaching for Succes® present, 4.

Anne, Z. (2010). Experimental and Quasi-experimental research designs. Retrieved from nnezelenka.com/2010/08/15/experimentalandquasiexperimentalresearchdesign/

Araoye, M.I. (2014). A practical approach to effective teaching of the nervous system using cue cards. A paper presented at STAN biology panel workshop at Model Girls' Secondary Schools Rumeme, Port Harcourt, Rivers State.

Arnadottir, K.H. (2014). *Cooperative learning in foreign language teaching: A study of the use of group work language studies in Icelandic secondary schools.* HASOLI ISLANDS.

Awofala, A.O., Arigbabu, A.A., Awofala, A.A., (2013). Effects of framing and Team Assisted Individualised instructional strategies on senior secondary school students' attitude toward Mathematics. *Acta didactica napocensia. Vol. 6(1), 1-22*.

Awolaju, B.A. (2016). Instructional material as correlates of students' academic performance in biology in senior secondary schools in Osun state. *International Journal of Information and Educational Technology.* Vol. 6 (9) 705-707.

Awward, A.A.A. (2013). The Piaget's theory of learning. *Interdisciplinary Journal of Contemporary Research in Business* Vol. 4 (9), 106-107.

Balal, B. (2013). The Effects of using cooperative learning on EFL learners' performances. The European conference on language learning. *The International Academic Forum* www.iafor.org

Barke, A., (2011). Group work. How to use groups effectively. *Journal of effective teaching.* Vol. 11(2), 87-95.

Battistich, V. & Watson, M. (2010). *Fostering social development in preschool and early elementary grades through cooperative classroom activities*. Routledge falmer: Taylor and Frances Group. London and New York.

BCIT, (2010). *Effective use of group work*. British Colombia Institute of Technology

Ben, D. (2014). Cooperative learning. Cooperative learning as a transformative pedagogy in physical education. *Caltura, Cienciay Deporte*. Vol. 26, 93-94.

Bot, T.D. & Eze, J.E. (2016). Cooperative effects of concept mapping and cooperative learning strategies on senior secondary schools' students' achievement in mathematics-trigonometry in Kano state, Nigeria. *European Journal of Mathematics Education*. 4 (1), 56-66.

Boudehaane, N. (2015). *Implementing Slavin's students team achievement division (STAD) on second year at the department of letters and English*. University of Constantine 01, Algeria. 54-62.

Bukunola, B.J. & Idowu, D.I. (2012). Effectiveness of cooperative learning strategy on junior secondary students' academic achievement in basic science. *British Journal of Education, Society and Behavioural Science.* Vol. 2 (3), 307-325

Castle, J. (2014). The impact of cooperative learning on the development of need for cognition among first year college students. PhD (Doctorate of Philosophy) Thesis, University of Iowa. http://tr.Uiowa.ed/etd/1437. 6.

Chinwe N. & Gloria C. (2014). Biology laboratory material resource utilization in Colleges of Education: Implication for Biology curriculum delivery in Nigerian Secondary Schools. Department of science Education, University of Nigeria Nsukka.

Christmas, D., Kudzai, C. & Josia, M. (2013). Vygotsky's zone of proximal development theory. What are its implications for mathematical teaching? *Greener journal of Social Sciences.* Vol. 3(7), 371

.

Chuang, P., Chiang, M.C., Yang, C. & Tsai, C. (2012). Social networks-based adaptive pairing strategy for cooperative learning. *Education Technology and Society.* Vol. 15 (3), 226-239.

Chukwuyemum, A.N. & Nwankwo, A.E. & Toochi, U. (2014). Impact of cooperative learning on English language achievement among senior secondary school students in Delta state, Nigeria: Implication for counselling. *Journal of Engineering Trends in Education Research and Policy Studies.* Vol.5 (7), 70-76.

Cushwa, W. (2015). *Human biology.* Chapter 1.4: Classification of organisms. Open Stax-CNX Module: M5761. http://Cnx.org/content/M45419/1.81/

Dan-Olege, I.A. & Shitu A.O. (2012). Improving the standard of teaching and learning of practical in our secondary schools: Emphasis on biology and chemistry practicals. *Journal of Qualitative Education* . Vol. 8. (1), 1-5.

Davidson, N. (2014). Boundary crossing; Cooperative learning and problem based learning. *Journal of Excellence in College Teaching.* Vol.25 (3&4), 20.

De jaegha, H., Dipolo, E.A., & Gallager, S. (2010). Can social interaction constitute social cognition? *Trend in cognitive sciences.* Vol. 14 No.10, 141-447.

Drukan, E., (2011). Effects of cooperative integrated reading and composition (CIRC) technique on reading-writing skilld. *Education research and reviews.* Vol. 6 (1), 102-109. Available at www://academicjournals.org/Err

Dutch, M., (1949). A theory of cooperative and competition. *Human Reactions* Vol. 2 (2) 129-152. Available at http://dx.doi.org/10.1177/00182674900200204

Duyilemi A.N., &Bolajoko A.A., (2014). Effects of cooperative learning strategy on senior secondary school students achievement and retention in biology. *Mediterranean journal of social science.* Vol. 5 (27), 627-633.

Ekinfe, E., Olofinniyi O.E., Fashikun, E.O., (2012). Teachers quality as correlates of students academic performance in biology in senior secondary schools in Ondo state, Nigeria. *Journal of Education and research.* Vol. 1 pp108-114.

Eneogu, N.D., & Ejimonye, J.C. (2014). Teachers' competence in using cooperative learning strategy in teaching economics in secondary schools in Anambra state Nigeria. *Journal of Education and Practice* Vol. 5 (2) 87-95.

Fani, T., & Ghaemi, F. (2011). Implication of Vygotsky's zone of proximal development (ZPD) in teaching education: ZPD and self scaffolding. *Science Direct. Procedia, Social and behavioural sciences.* 29, 1550.

Fitriyanningisih, (2009). *Improving reading competence using students team achievement division (STAD) for the First year students of SMP N 2 PENAWANGAN*. Muhammadiya University Surakarta. Chapter one (Background of the study).

FRN, (2004). *Revised national policy on education*. Lagos press.

Fushino, (2008), Measuring Japanese university students' readiness for second language group work. 20-23.

Gambari, A.I., Yaki, A.A., Gana, E.S., & Ughovwa, Q.E. (2014), Improving secondary school achievement and retention in biology through video-based multimedia instruction. *A Journal of Scholarly Teaching.* Vol. 9, 78-91.

Gambari, A.I., & Yusif, M.O. (2015). Effectiveness of cumputer-assisted STAD cooperative learning strategy on physic problem solving, achievement and retention. *MOJET Malaysian Online Journal of Education Technology.* Vol. 3 Introduction. www.mojet.net

Glanz, J., (2009). *Teaching 101: Classroom strategies for the beginning teacher*. Thousands Oaks, C.A. Corwin.

Gillies, R.M., & Boyle, M. (2014). Teachers' reflections on cooperative learning: Issues of implementation. *Teacher and Teaching Education*. 26, 933-940.

Gokkurt, B., Dundar, S., Soylu, Y., and Akgun, L. (2012). The effect of learning together technique which is based on cooperative learning on students achievement in mathematics class. *Procedia- Social and Behavioural Science*. Vol. 46. 1.2 Learning Together.

Graf, S., & Bekele, R. (2012). *Forming heterogeneous group for intelligent collaborative Learning system with ant colony optimization.* Federal ministry of education science and culture &European social fund (ESF) grant 31.963/46-VII/9/2002. Introduction section.

Guido M.E & Amelie W. (2010). *Is traditional education really all that bad? A within-students between-subject approach. Programme on Education policy and Governance* Working papers series. Available at www.hks.havard.education.edu/pepg/

Gupta, M., & Ahuja, J., (2014). Cooperative integrated reading and composition (CIRC): impact of reading comprehension achievement in English among seventh graders. *International journal of research in Humanities, Arts and Literature.* Vol. 2, 37-46.

Habi, L. (2010). *Cooperative learners' opportunity to participate in English foreign language class: The case of second year pupils at Soumani Mehmoud secondary school- Kherrata.* Universite Setfz. Introduction.

Haladyna. T. M. (1999). *Developing and validating multiple-choice exam items,2nd ed*. Mahwah, NJ: Lawrence Erlbaum Associates.

Halliru, U. (2011). Effects of cooperative learning strategy on geography students' academic performance in senior secondary schools in Sokoto state, Nigeria. Department of Education Foundation and curriculum, Ahmadu Bello University, Zaria. 1-79.

Haman, G., & Nguyen, T.N. (2010). Reforming Teaching in Vietnam's higher Education System. IN Haland M, Hyden & Nghi T (Eds) *Reforming Higher Education in Vietnam: Challenges and Priorities* pp 65-68.

Haroon, M.Z. (2014). Perspectives of primary school teachers regarding effectiveness of cooperative learning: A descriptive study. *Journal of Education and Social Sciences.* Vol. 2 (1), 95.

Huang, Y., Liao, Y., Huang, S. & Chen, H. (2014). A jigsaw-based cooperative learning approach to improve learning outcome for mobile situated learning. *Educational Technology and Society.* Vol. 17 (1), 128-140.

Ihedioha, S.A., (2012). Effectiveness of transmitter of knowledge and conventional teaching models on secondary school students' achievement on circle geometry and trigonometry. *General Math Note*. Vol. 12, 36-46.

Ikitde, G.A., (2013). Influence of learning styles and teaching strategies on students' achievement in biology. *Voice of Research.* Vol.1 (4), 5-13.

Isik, A.D., & Saygili, G. (2015). Supporting cooperative learning with technological tools. *International Journal of Learning, Teaching and Educational Research.* Vol. 11 (1) 95-108.

Javed A. (2013). The study of cooperative learning approach in teaching of Mathematics at Secondary in Pakistan. *Mathematical theory and modelling.* Vol 3 (10)

Jergensen R. (2009). Cooperative learning environment 32n annual conference of the mathematics education research group Australia. Vol. 1 Palmeston, 701.

Johnson, D.W., & Johnson, R.T. (2009). An educational psychology success theory; Social interdependence theory and cooperative learning. *Educational Researcher* Vol. 38 (5), 365-379.

Johnson, D.W., Johnson, R.T., &Smith, K. (2013), Cooperative learning: Improving university instruction by basing practice on validated theory. University of Minnesota. *Journal of Excellence in University Teaching*. 1-26

Johnson, D.W., Johnson, R.T., &Smith. (2014), Cooperative learning: Improving university instruction by basing practice on validated theory. *Journal of Excellence in College Teaching.*

Johnson, D.W., & Johnson, R.T. (ND). Cooperative learning, values and culturally plural classrooms. http://www.cooperation.org/pages/ClandD.html

Jogsermtrakoon, S., & Nosanggkhala, J. (2015). Group investigation learning system for open education resources to enhance student teachers' digital literacy and awareness in information ethics. *International Journal of Information and Education Technology;* Vol.5 No. 1 pp 783-788.

Kelley, T. L. (1939). The selection of upper and lower groups for the validation of test items. *Journal of Educational Psychology.* Vol. 30 pp 17-24.

Kendra, C. (2012). Background and Key Concepts of Piaget's Theory: Stages of Cognitive Development. Pp 1.

Kimamo, G., & Muraya, N.D. (2011), Effects of Cooperative Learning Approach on Biology Mean Achievement Scores of Secondary School Students in Machako's District Kenya.*Educational Research and Review*.Vol.6 No.2 pp726-745. Available at http://www.academicjournal.org/ERR

Kordaki, M., Daradoumis, T. Fragidakis, D., & Grigoriadou, M. (2012). *Adapting collaborative strategy team achievement divisions in an Information technology work place. Intelligence adaptation and personalisation techniques.* Sc 48 Sringer-Verlag Berlin Heidelberg. 131-152.

Levy, Y., & Ellis, T.J. (2011). A guide for novice researchers on experimental and quasi-experimental studies in information systems research. *Interdisciplinary journal of information, knowledge, and management.* Vol. 6, 151-161.

Liu, A. (2012). *Teaching in the Zone. An Introduction to Working with the Zone of Proximal Development (ZPD) to Drive Effective Early Childhood Instruction*. Children Progress pp 5.

Li, M.P., & Lam, B.H. (2013). *Cooperative Learning. The Active Classroom*. The Hong Kong Institute of Education.

Lunerbarg, F.C. (2012). The teachers' use of the theoretical frames for instructional planning; Information processing theories. *Schooling* Vol. 3 (1), 1-12.

Mahira, H., & Azamat, A. (2013). Traditional vs modern teaching methods. Advantages and disadvantages 3rd international conference on foreign language teaching and applied linguistics. http://eprints.ibu.ba/1901/

Majoka, M.I., Dad, M.H. & Mahmood, T. (2010). Student team achievement division (STAD) as an active learning strategy: Imperial evidence from mathematics classroom. *Journal of Education and Sociology*. 16-21.

Mbacho, N.W. (2013). Effects of jigsaw cooperative learning strategy on students achievement in secondary school mathematics in Laikipedia East district, Kenya. Egerton University. 1-55.

Mcleish, K. (2009*). Attitudes of students toward cooperative leaning methods at Knox community college: A Descriptive study*. Faculty of education and liberal studies. University of Technology, Jamaica. 1-71

Mc Millan, J., & Schumacher, S. (2010). Research in education. Evidence base enquiring 7th edition. International Education. Boston; Pearson Education Inc. 1-278.

Miller, H.B., Witherow, D.S., & Carson S. (2012). Students' learning outcomes and attitudes when biotechnology laboratory partners are of different academic levels. *CBE-Life Science Education.* Vol 11 (3) 323-332.

Mobark, W.M. (2014). The effect of using cooperative learning strategy on graduate students' academic performance and gender differences. *Journal of Education and practice.* Vol. 5 (11), 2.

Moloshonok, N. (2014). Vygotsky's theory: Lessons for students engagement research. SERU international research conference slide 8. Higher School of Economics Mascow.

Musingafi, M.C.C., & Rugonye, S., (2014). The role of cooperative learning in the teaching of community and developmental subjects: The case study of teaching history at secondary school level. *Asian journal of social sciences and management studies.* Vol. 1 (2), 57-61.

Nejat, S.M., & Omidian, F. (2015). The effect of jigsaw teaching method on sixth grade students' academic achievement: A semi experimental study. *Research Journal of Pharmaceutical, Biological and Chemical Sciences RJPBCS*. Vol. 6(3) 166.

Nikou, F.R., Boyandi, A., &Ebrahimi, K. (2014). The effects of student team achievement division (STAD) on languge achievement of Iranian EFL students across gender. *European Online Journal of Natural and Social Science.* VOL.3 (4) 936-949.

Njoroje, J.N., & Githua, B.N. (2013). Effects of cooperative learning/ teaching strategy on learners mathematics achievement by gender. *Asian Journal of Science and Humanity.* Vol.2 (2) 567-576.

Nnorom N.R., (2015). Effects of cooperative learning strategy on senior secondary school students' achievement and retention in Anambra state Nigeria. *International journal for cross-disciplinary subjects in education.* Vol. 5 (1), 2424-2427.

Norzoles, D.T.M. (2015). Students team achievement division (STAD): Its' effect on the academic performance of the EFL learners. *American Research Journal of English and Literature*. Vol. 1. 1-7.

Nwosu, C.M. (2013). *The impact of cooperative instructional strategy on the performance of grade 09 learners in science.* University of South Africa. 1-98.

Ogboghoroma, T.E., & Oyobwi, E.O. (2015). Evaluating effects of students' academic achievement on identified difficult concepts in senior secondary school biology in Delta state. *Journal of Education and Practice.* Vol. 6 (30), 117-125.

Ogundiwin, O.A., Asaaju, O.A., Adegoke, A.I. Ojo, A.T. (2015). Effects of iroup investigative laboratory strategies on students' achievement in biology. *Pyrex Journal of Research in Environmental studies.* Vol. 2 (4).

Ogunneye, W. & Lasisi I. (2008). Increasing women enrolment in physics education: The way forward. *Journal of science teachers association of Nigeria*. 43(1&2), 35-43.

Olanipekun, S., &Aina, J.K. (2014). Improving students performance in Nigerian schools: The role of teachers. *International journal of Research in Humanities and Social Studies.* Vol. 1, 1-6.

Olaniran, B.A., Rodriquez, N., & Williams, I.M. (2012). Social information processing theory (SIPT); A cultural perspectives for international online communication environment. *IGI Global.* 45-46.

Olarewaju R.R., (2012). Effects of cooperative learning strategy with models on academic achievement and retention among pre-natal diploma students in Kaduna state. A Phd dissertation submitted to the school of postgraduate studies, Ahmadu Bello University Zaria. 20-114.

Opera, J.A. (2011). Inquiry method and students' achievement in biology: Lesson and policy implications. *American-Eurasian Journal of Scientific Research.* Vol. 6 (1), 28-30.

Osuafor, A. & Okonkwo, I. (2013). Influence of family background on academic achievement of secondary school biology students in Anambra state. African research review. *International Multidisciplinary Journal Ethiopia.* Vol. 7 (3), 156-167.

Osualale, O.J. (2014). Problems of teaching and learning science in junior secondary schools in Nassarawa state, Nigeria. *Journal of Education and Practice.* Vol. 5 (34), 109.

O'shuaghnessy, D., Deng, L. & Li, H. (2013).The speech information processing: Theory and applications. *Preceding of the IEEE* Vol. 101 (5) 1034.

Papas, B., Caponechia, C. & Wertheim, E.H. (2012). *The human; Basic principles of social interaction.* OHS Body of Knowledge.

Peersman, G. (2014). Overview: Data collection and analysis methods in impact evaluation. UNICEF Office of Research. Florence Italy. 1-16.

Pierce, L.L. (2009). Twelve steps for success in the nursing research journey. *Journal of Continuing Education in Nursing.* Vol. 40 (4)154-162.

Pitayo, A., Waluyo, H.J., Swandi, S. &Andayani (2014). The effect of group investigative learning model accelerated learning team and role playing on elementary school students' writing skills viewed from cognitive style. *Journal of Education and Practice*. Vol. 5 No. (1).

Pons, R.M., Prieto, M.D., Lomeli, C., Bermejo, M.R. & Bulut, S. (2014). Cooperative learning in mathematics: A study on the effects of the parameter of quality on the academic performance. *Anneles de Psicologia* Vol 3 (3) 832.

Rano, A.R.A., Is'haq, A.G., Baffa, A., & Otutu A.O., (2012). *Students academic achievement in biology. A case study of some selected secondary schools in Kano state*. Unpublished BSc Ed. Project. Department of science and technology education, Bayero University Kano.

Rasuli, R. (2012). Comparison of effects of collaborative learning methods and lecture on creative thinking and educational progress in career and techniques lesson for girls students of Yazd education. *New Thought Journal.* Vol. 8 (4), 25-36.

Riddle, E.M. (2008). Lev Vygotsky's social development theory. Retrieved from: file//users/tonymac/decument/Notre%20Dane/ED%204236%20P

Sambo, A.A (2008). *Research method in education*. Stirling-Horeden publishers (Nig) Limited. Ibadan, Oyo state Nigeria.

Salihu, Z. (2015). Effects of guided discovery approach on students academic Performance in ecology in senior secondary schools in Sokoto state Nigeria. Usman Danfodio University Sokoto. 1-61.

Sathyprankasha, C.V., Nandini, N., & Kolyani, K. (2014). Research on cooperative learning-a meta-analysis. *International journal of informative and futuristic research*. Vol. 1, 139-150.

Sengul, S. & Ketranci, Y. (2014). Effects of igsaw technique on mathematics self efficiency perceptions of seventh grade primary school students. *Pocedia-socail and Beheviour al Sciences.* 116, 333-338.

Sharan, Y. (2010).Cooperative learning for academic and social gains: Valued pedagogy, problematic practice. *European Journal of Education*. Vol. 45 (2), 300-313

Shier, R. (2014), *Statistics: Paired t-tests.* Mathematics learning support centre. 1-3.

Siddiqui, M.H. (2013). Group investigation model of teaching. Enhancing learning level. *Peripex-Indian Journal of Research.* Vol. 3(4).

Simatwa, E.M.W. (2010). Piaget's theory of intellectual development and its implication for instructional management at pre-secondary school Level. *Educational Research Reviews.* Vol.5 (7), 366-371. Retrieved from: http://www.academicjournals.org/ERR2 ISSN1990-3839

Siwatch, S. (2014). Cooperative learning: A technique to excel learning. *International Journal of Interdisciplinary and Multidisciplinary Studies (IJMS).* Vol. 1(10), 66-71.

Slavin, R.E. (2009a). *Cooperative learning: What make group to work?* Retrieved from: http://www.successful.org/successFor All/media/PDFs/CL pp19.

Slavin, R.E. (2009b). *Instruction based cooperative learning.* Allyn and Becon,MA 1-27.

Slavin, R.E. (*2011). Instructional based cooperative learning*. John Hopkins University and University of York. 344.

Sofandi, A.F. (2013). *Cooperative group learning strategy*. Palembang. 13.

Sunday, A.O., & Joke, D.O. (2013). Student variables as correlates of secondary school students' academic performance in biology. *International Journal of Science and Research (IJSR), India*. vol. 2, 368-389.

Sunday, O.S. & Kola, A.J. (2014). Improving academic performance in Nigerian schools: the role of teachers. *International Journal of Research in Humanities and Social Studies.* Vol. 1, 1-7.

Surgenor, P., (2010). *Teaching toolkit. How students learn 3*. UDC teaching and learning resources.

Tan, I., (2013). *Cooperative learning with group investigation and structured academic controversy in social studies education in Singapore*. National institute of education Nyang, Technological University Singapore.

Tinungki, G.M., (2015). The role of cooperative learning type team assisted individualisation to improve the students' mathematics communication ability in subjects of probability theory. *Journal of education and practice.* Vol. 6 (32), 27-31.

Tunga, S. A. (2015). Effects of Cooperative learning on senior secondary school students' performance in quantitative chemistry in Kebbi state, Nigeria*. Journal of Education and Social Sciences.* Vol. 1(june)

Tran, U.D. (2013). Theoretical perspectives underlying the application of cooperative learning in classrooms. *International Journal of Higher Education. Vol. 2 (4), 105.*

Tsay, M. & Brady, M. (2010). A case study of cooperative learning and communication pedagogy: Does working in teams make a difference? *Journal of Scholarship Teaching and Learning*. Vol. 10 (26), 93-94.

Thomas, N. (2013). Effects of teacher preparation on students academic achievement in SS 2 biology practicals. *Journal of Education and Practice*.. Vol.4 (8), 145-150.

Tiantong, M. & Teemuangasai, S. (2013). Student team achievement division (STAD) technique through the model to enhance learning achievement*. International Educaton Studies.* Vol. 6 (4), 84-92. Published by Canadian Centre of Science Education.

Ugwuadu, O.R. & Abdullahi, S. (2012). Effects of cooperative learning strategy on biology students academic achievement in Yola educational zone of Adamawa state. *Knouledge and Review*. Vol. 24 (1), 1-7.

US Department of Education, (2012). Cooperative integrated reading and composition. *ies institute of education science*. WWC intervention report. 1-19.

Van, D.T. & Ramon, L. (2012). The effect of jigsaw learning on student's attitude in a Vietnamese higher education classroom. *International Journal of Higher Education.* 1-87.

Vygotsky, L.S. (1978). *Mind in society: The development of psychological processes*. Cambridge, M.A; Harverd University press.

Wei, P. & Tang, Y. (2015). Cooperative learning in English class of Chinese junior high school. *Creative Education.* Vol. 6, 397-404.Retrivieved from: http://dx.doi.org/10.4236/ce.2015.63039

Wofolk, A. (2010). *Education psychology*. 11th edition. Pearson Education International. 324-332.

Yusuf, A., (2014). *Effects of cooperative instructional strategy on students' performance in social studies. University of Ilorin*. Ilorin. Introduction.

Zamani, M. (2016). Cooperative learning: Homogeneous and heterogeneous grouping of Iranian EFL learners in a writing context. *Student Learning, Childhood and Voices/Research Article (CongentEducation).* Vol.3, 1-11. Available at http://dx.doi.org/10/1080/233/186x.2016.1149959

Zarei, E., Zainalipour, H., Haidari, & Samavi. S.A. (2013). Study of Cooperative Learning Effect on Academic Achievement. *Journal of Life Science and Biomedicine*. Vol. 3(3), 237-240.

Zurich, E. (2014). Social interaction and society perspectives of modern sociological sciences. Retrieved from: Irene.Urbanek@soz.gess.ethz.ch

Appendix I

Biology Achievement Test (BAT)

Instructions: Answer all questions. Tick the correct option from A – D. Time: 1 hour

1. Population is defined as:

a) Number of individual organisms per unit area

b) Series of changes for a period of time in human community

c) Total number of organisms of the same species living together in a given period of time

d) Total number of different species of community living in an environment in a given period of time.

2. Which of the following soil types has the highest water holding capacity

a) Loamy soil b) Sandy soil

c) Humus soil d) Clay soil

3. The soil type with the highest degree of porosity is

a) Clay soil b) Loamy soil

c) Humus soil d) Sandy soil

4. The following are types of soil except

a) Sandy soil b) Stony soil

c) Loamy soil d) Clay soil

5. The number of particular organisms in relation to a unit area is

a) Population growth b) Population density

c) Population size d) Population cover

6. Which of the following terms refers to as a dwelling place of an organism?

a) Biosphere b) Niche

c) Habitat d) Ecosystem

7. The following are types of terrestrial habitat except

a) Arboreal b) Ground

c) Underground d) Ocean

8. The organisms that live on trees are referred to as

a) Ground organisms b) Underground organisms

c) Arboreal organisms d) Sea organisms

9. Which of the following organisms is a primary producer?

a) Dog b) Sheep

c) Fungus d). Grass

10. A self sustaining unit produced by an interaction between biotic and abiotic component is best described as

a) Community b) Habitat

c) Ecosystem d) Niche

11. Which of the following is not a biotic factor?

a) Parasite b) Predators

c) Grazers d) Pressure

12. In an ecosystem the organism which changes stored light as chemical energy is the

a) Consumer b) Producer

c) Carnivore d) Decomposer

13. The linear feeding relationship between organisms is called

a) Food chain b) Food level

c) Food web d) Production level

14. Each stage in a food chain is referred to as

a) Food level b) Trophic level

c) Pyramid of number d) Production level

15. The decreasing number of individual from one trophic level to another is called

a) Pyramid level b) Interaction

c) Food web d) Pyramid of number

16. The feeding relation that involve several chains of feeding relationships is called

a) Food chain b) Ecosystem

c) Food web d) Feeding relationship

17. Which of the following animals is not a primary consumer?

a) Snake b) Insect

c) Toad d) Field mice

18. The factors that lead to increase in population include all the following except

a) Natality b) Mortality

c) Immigration d) Food availability

19. The ultimate source of energy for all living organisms in a habitat is

a) Micro organisms b) Green plant

c) Decomposers d) Sunlight

20. Soil factor is referred to as

a) Edaphic b) Biotic

c) Climatic d) Topographic

21. Organisms which feed on dead body of both plant and animal are referred to as

a) Producers b) Consumers

c) Decomposers d) Abiotic

22. An aquatic organisms found in the marine habitat includes

a) Tadpole and Tilapia b) Shark and Wales

c) Crab and Frog d) Frog and Crocodile

23. An aquatic habitat containing salty water is referred to as

a) Marine b) Estuarine

c) Fresh water d) River

24. The species that have major controlling influence on the nature of the community is said to be

a) Population density b) Population size

c) Dominant community d) Recessive community

25. The composition of soil include the following except

a) Organic matter b) Micro organisms

c) Water d) Aborial

26. Which of the following soil types has the lowest water holding capacity?

a) Loamy soil b) Sandy soil

c) Humus soil d) Clay soil

27. The factors that lead to decrease in population is known as

a) Natality b) Mortality

c) Immigration d) Food availability

28. A living factor is referred to as

a) Edaphic b) Biotic

c) Climatic d) Topographic

29. The spaces found in the soil usually filled by air are referred to as

a) Soil porosity b) Soil texture

c) Soil constituent d) Soil composition

30. A situation which shows how fine or coarse a sample of soil is, usually is known as

a) Soil porosity b) Soil texture c) Soil constituent d) Soil composition

Biology Achievement Test (BAT) Marking Scheme

1. C 1 mark
2. D 1 mark
3. D 1 mark
4. D 1 mark
5. B 1 mark
6. C 1 mark
7. D 1 mark
8. D 1 mark
9. D 1 mark
10. C 1 mark
11. D 1 mark
12. B 1 mark
13. A 1 mark
14. B 1 mark
15. D 1 mark
16. C 1 mark
17. A 1 mark
18. B 1 mark
19. D 1 mark
20. A 1 mark
21. C 1 mark
22. B 1 mark
23. A 1 mark
24. C 1 mark
25. D 1 mark
26. B 1 mark
27. B 1 mark
28. B 1 mark
29. A 1 mark
30. B 1 mark

Appendix II

Teaching Modules on Biology (Ecology)

MODULE ONE

a. Definition of population

b. Definition of census

c. Characteristic features of a population

ACTIVITIES

- Conducting population studies using quadrat
- Conducting population studies using Capture Recapture Method

MODULE TWO

a. Definition of soil b. Types of soil

c. Soil composition d. Characteristics of soil

ACTIVITIES

- Experiment to determine the weight of water in a soil sample
- Experiment to show that soil contains different sizes of particles
- Experiment to compare the porosity and water holding capacity of soil types.

MODULE THREE

a. Ecological instruments and their uses b. Thermometer

c. Hygrometer d. Barometer

e. Sweep net f. Rain gauge

g. Wind vane h. Secchi disc

MODULE FOUR

1. Ecosystem

a. Definition of ecosystem b. Components of ecosystem

c. Relationship among living organism in an ecosystem

2. Food chain/Food web

a. Definition

b. Components of food chain/web

c. Role of producers in food chain

d. Trophic level

3. Habitat

a. Definition of habitat

b. Types of habitat

c. Characteristics of habitat

4. Population

a. Definition of population

b. Population size

c. Population density

d. Factors affecting population

5. Soil

a. Definition of soil

b. Types of soil

c. Composition of soil

d. Characteristics of soil

e. Experiment to show that soil contains different size of particles

f. Experiment to show water holding capacity and porosity of different soil samples.

Appendix III

Lesson Plan

January-February 2017

Experimental Group 1

Subject: Biology

Topic: Ecology

Subtopic: Ecosystem

Duration: 80 minutes

Age: 15 – 17 years

Methods of Teaching: Cooperative Learning Strategy

Instructional Material: An Aquarium

Behavioural Objectives: By the end of the lesson, the students should be able to

i. Define ecosystem

ii. Identify and list the component of ecosystem

iii. Explain relationship among living organism in an ecosystem.

Entry Behaviour: The students will learn the preliminary aspect of ecology concept.

Introduction: The teacher will introduce the lesson by asking the students what kind of relationship exists between them and their environment.

Presentation:

Step I: The teacher will write the meaning of ecosystem on the chalk board.

Step II: The teacher will have five stations (aquarium sandwich) setup for students to visit in small groups. Each group will decide whether or not each station is an ecosystem.

Step III: The teacher will ask groups what part of the system is biotic and abiotic. The teacher will instruct the groups to discuss whether or not the station fits the definition of an ecosystem.

Step IV: The teacher will instruct the groups to observe a working aquarium and list the elements in the aquarium.

Step V: The teacher will guide the each group to write the different types of interaction that might occur between the organisms in the ecosystem and the non living part of the environment.

Step VI: The teacher will ask groups to report their findings to the whole class.

Summary: The teacher will summarise the lesson by reviewing the definition of an ecosystem as the basic functioning unit of nature. This comprises of a group inter-relationship between living thins, non living things and their environment.

Evaluation: The teacher will evaluate the lesson asking each group to list some examples of producers and the teacher will go round to see.

EXPERIMENTAL GROUP 2

Subject: Biology

Topic: Ecology

Subtopic: Food Chain/ Food Web

Duration: 80 minutes

Age: 15 – 17 years

Methods of Teaching: Cooperative Learning Strategy

Instructional Material: Charts of food web and food chain

Behavioural Objectives: By the end of the lesson, the students should be able to:

i. Define food chain and food web

ii. Identify and list the components of food chain and food web

iii. Explain the role of producer in a food chain

Entry Behaviour: The students might learn about ecosystem in their previous lesson.

Introduction: The teacher will introduce the lesson by asking the students what is an ecosystem.

Presentation:

Step I: The teacher will provide each group with a chart containing the sun, green grass, rat and cat and ask them to give reasons why they think these four things would be placed together and what they have in common.

Step II: The teacher will provide charts of food chain to each group and ask them what it is? What is a primary producer and what animals are in each of the categories?

Step III: The teacher will draw a "connection web" on the board (The animal such as mouse) start by writing the names of the animals on the board and circling it and also the teacher will ask groups to name things that are connected to the animal (Interaction with other organism

as food shelter). Draw lines to the other factors until the web is very complex. Point out that the web has abiotic and biotic factors.

Step IV: The Teacher will ask the groups to make list of different organisms. The groups will then be supported by the teacher to form a list of different organisms. The groups' secretaries will then be guided by the rest of the members to form a list of the organisms. The teacher will later ask the group presenters to discuss their findings with the class.

Step V: The teacher will explain to the students each step in the feeding relationship which is called tropic level.

Evaluation: The teacher will evaluate the lesson by asking groups some questions based on the content of the topic.

Experiment Group 3

Subject: Biology

Topic: Ecology

Subtopic: Habitant

Duration: 40 minutes

Age: 15 – 17 years

Methods of Teaching: Cooperative Learning Strategy

Instructional Material: Charts, Diagrams of habitats

Behavioural Objectives: At the end of the lesson, the students should be able to:

i. Mention the meaning of habitat

ii. Identify their habitat

iii. Identify different organisms and their habitats

iv. Mention the types of habitats

Entry Behaviour: Students have idea about the place they live e.g. home

Introduction: The teacher will introduce the lesson by asking the students some questions on their previous lesson. E.g. where do animals find the food which they eat? From the student response, the teacher mentions the places where foods are found (e.g environment)

Presentation:

Step I: The teacher will ask each group to mention where they live as students. From the students' response, the teacher now mentions that the dwelling place of an organism is known as habitat. Therefore, where the students and other animals live is referred to as Habitats.

Step II: The teacher will assist groups to identify and write their individual habitats and then make a list of different organisms and where they live.

Step III: The teacher will go round the class to support groups' activities through asking them to list the organisms living in water and those living on land. The teacher will tell the students that land habitat is called terrestrial habitat while the water habitat is called aquatic habitat.

Step IV: The teacher will ask each group to list the characteristics of habitat after giving them an example like salinity.

Summary: the teacher will summarise the lesson by briefing the lesson taught.

Evaluation: The teacher will ask groups to present definition habitat, give types of habitat with example and mention one characteristics of each habitat.

EXPERIMENT GROUP 4

Subject: Biology

Topic: Ecology

Subtopic: Habitant

Duration: 40 minutes

Age: 15 – 17 years

Methods of Teaching: Cooperative Learning Strategy

Instructional Material: Charts, pictures and Diagrams showing different habitat.

Behavioural Objectives: At the end of the lesson, the student should be able to:

i. Classify Terrestrial and Aquatic habitat into various sub-classes or groups.

ii. List some organisms found in each sub-group of the habitats.

iii. Identify those groups of habitat using some features.

Entry Behaviour: Students have learnt the two major types of habitats.

Introduction: The teacher will ask students to mention the two (2) classes of habitat

Presentation:

Step I: The teacher ask the groups to list ten (10) organisms each of terrestrial and aquatic habitats.

Step II: The teacher will guide groups to identify from their list, the organism that live in land and tree.

Step III: The teacher will assign each group to identify the organisms that lives on trees, ground and underground.

Step IV: The teacher will explain to students that those organisms that live on trees are called arboreal organisms.

Step V: The teacher will guide groups to classify the organisms they listed from aquatic habitat into fresh water habitat, marine habitat and estuarine habitat.

Evaluation: The teacher will evaluate the lesson through asking each group to mention the classes of aquatic and terrestrial habitat with one example of animal each.

EXPERIMENT GROUP 5

Subject: Biology

Topic: Ecology

Subtopic: Population Studies

Duration: 40 minutes

Age: 15 – 17 years

Methods of Teaching: Cooperative Learning Strategy

Instructional Material: Charts, Textbooks and Diagrams.

Behavioural Objectives: At the end of the lesson, the student should be able to:

1. Define population

2. Describe the size of a given population

3. Identify the dominant organism found in a given population.

Entry Behaviour: Students are aware of changes in population of their family members.

Introduction: The teacher asks the student to mention the number of their family members.

Presentation:

Step I: The teacher will group the students and distributes the charts showing different population to each group.

Step II: The teacher will ask the groups to compare the charts from their group and discuss the difference they observed in the charts with their group members.

Step III: The teacher will guide the groups to define population and describe population size using the charts.

Step IV: The teacher will ask the each group to identify those organisms that appear most from the chart. After groups' response the teacher will explain to whole group that those organisms which appear most are known as Dominant organism.

Evaluation: The lesson will be evaluated by asking some groups to define population, describe population size and other groups to identify dominant organism in a particular population to the whole class.

EXPERIMENTAL GROUP 6

Subject: Biology

Topic: Ecology

Subtopic: Population density and factors affecting population

Duration: 40 minutes

Age: 15 – 17 years

Methods of Teaching: Cooperative Learning Strategy

Instructional Material: Charts, Maps and Diagrams.

Behavioural Objectives: At the end of the lesson, the student should be able to:

1. Define population Density

2. Mention the factors that affect population.

Entry Behaviour: Students have learnt about population and population size.

Introduction: The teacher will ask the groups to define population and population size

Presentation:

Step I: The teacher will distribute charts to the groups and ask them to observe and discuss the features on their charts.

Step II: The teacher will guide the groups to define population density using the response from their discussions.

Step III: The teacher will ask the groups to identify some factors that affect population using the charts; the teacher will then explain to the students that population density is defined as: *the total number of individual species per unit area.* Also the teacher will assist the groups to classify factors affecting population as dependant factor, independent factor and other factors like Immigration, Migration and Emigration.

Evaluation: The teacher will evaluate the lesson by asking groups to define population density and mention factors that affect population.

EXPERIMENTAL GROUP 7

Subject: Biology

Topic: Ecology

Subtopic: Soil

Duration: 40 minutes

Age: 15 – 17 years

Methods of Teaching: Cooperative Learning Strategy

Instructional Material: Soil sample, Cylinder.

Behavioural Objectives: At the end of the lesson, the student should be able to:

1. Define Soil

2. Mention the types of soil

3. Mention the soil compositions

4. State the characteristics of soil

Entry Behaviour: The students are already familiar with soils.

Introduction: The teacher and the student will go round the school premises to take soil samples. The teacher will guide the groups concerning where to take the sample from.

Presentation:

Step I: The teacher will ask the groups to explain from where they got the soil

Step II: From the groups' response, teacher will define soil as the upper most layer of the earth surface.

Step III: Groups are called in turns to identify the different soil types and mention the components of each of the soil retrieved under the guidance of the teacher.

Step IV: The teacher will ask the groups to mention soil characteristics. The teacher will supervise them against mistake and corrects them where necessary with suitable explanation.

Summary: The teacher will summarises the lesson by reviewing the definition of soil as the uppermost layer of the earth surface. It is of three (3) types i.e. Sandy, Loamy, and Clay soil.

Sandy Soil: It has low water retaining capacity. It has layer particles.

Loamy Soil: it has moderate water holding capacity. It is a good soil for cultivation.

Clay Soil: It has high water holding capacity. It has fine particle.

Evaluation: The teacher will evaluate the lesson by asking groups to define soil and mention three types with two characteristics for each.

EXPERIMENTAL GROUP 8

Subject: Biology

Topic: Ecology

Subtopic: Soil

Duration: 40 minutes

Age: 15 – 17 years

Methods of Teaching: Cooperative Learning Strategy

Instructional Material: Soil sample, Cylinder, funnel, cotton wool and water.

Behavioural Objectives: At the end of the lesson, the student should be able to conduct an experiment showing that soil contains different sizes of particles.

Entry Behaviour: The students have learned about soil types and characteristics.

Introduction: The teacher will ask the students questions from the previous lesson e.g. what is soil and what are types of soil.

Presentation:

Step I: Teacher will group the students and provide instructional materials to each group

Step II: Teacher will write the procedures of the experiment on the board as follows:

i. Put some quantity of soil sample into a graduated cylinder.

ii. Add sufficient water to it to cover the soil sample

iii. Add some hydrogen peroxide to quicken the dispersion of soil particles.

iv. Cover the open and of the cylinder with your palm and shake well for few minutes

v. Place the cylinder on the table to allow the content to settle

Step III: The groups will conduct the experiment with the support of the teacher.

Step IV: The teacher will ask each group to make their observations on the experiment and discuss with the rest of the class.

Step V: The teacher will discuss with the students that when the soil settles in water, the larger and heavier particles settled first. Light organic particle plots on top of the water. This indicates that soil is a mixture of different sizes of particles.

Evaluation: the teacher will evaluate the lesson by asking the procedure for conducting an experiment to show that the soil contains different sizes particles.

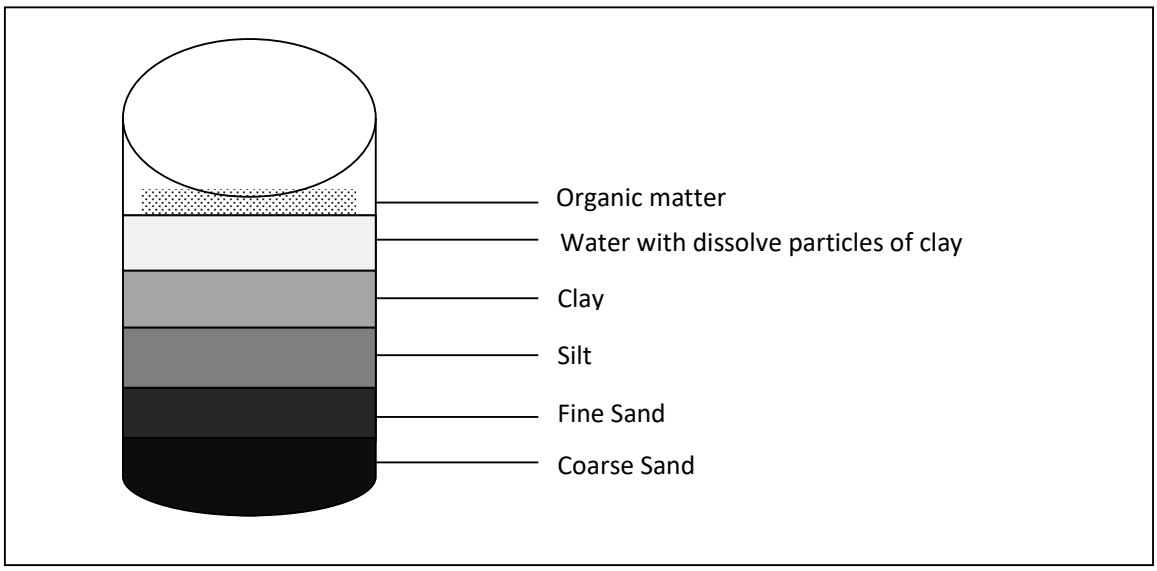


Fig 2: Experiment to show that soil contain different sizes of soil particles.

EXPERIMENTAL GROUP 9

Subject: Biology

Topic: Ecology

Subtopic: Soil

Duration: 40 minutes

Age: 15 – 17 years

Methods of Teaching: Cooperative Learning Strategy

Instructional Material: Soil sample, Measuring Cylinder, funnel, cotton wool and water.

Behavioural Objectives: At the end of the lesson students should be able to conduct an experiment to compare the porosity and water holding capacity of different soil types.

Entry Behaviour: The students have learned how to conduct an experiment to show that soil contains different sizes of particles during the last lesson.

Introduction: The teacher will ask groups some questions on the previous lesson example: what are the procedures for conducting an experiment to show that soil contains different sizes of particles.

Presentation:

Step I: The teacher will provide instructional materials to each group

Step II: Teacher will write the procedures of conducting the experiment on the board as follows:

i. Setup three graduating cylinder with funnel in each

ii. Plug the neck of the filter funnel with cotton wool and put equal weight of soil samples into each of them.

iii. Pour equal volume of water into each sample at the same time using a stop watch and record the volume of water collected by each cylinder and the time taken for the water to drain after no more water drains through each of the funnel.

Step III: Groups will conduct the experiment under the guidance of the teacher.

Step IV: The teacher will ask each group to make their observations on the experiment and discuss with the other groups.

Summary: The teacher will summarise the lesson by guiding groups of students to understand that clay soil retain more water than other soil types and therefore its porosity is very low. Sandy soil retains less water and therefore has less water retention capacity.

Evaluation: The teacher will evaluate the lesson by asking groups the following questions.

i. Which of the soil type is more porous?

Ii, Which of the soil type has the highest water retention capacity.

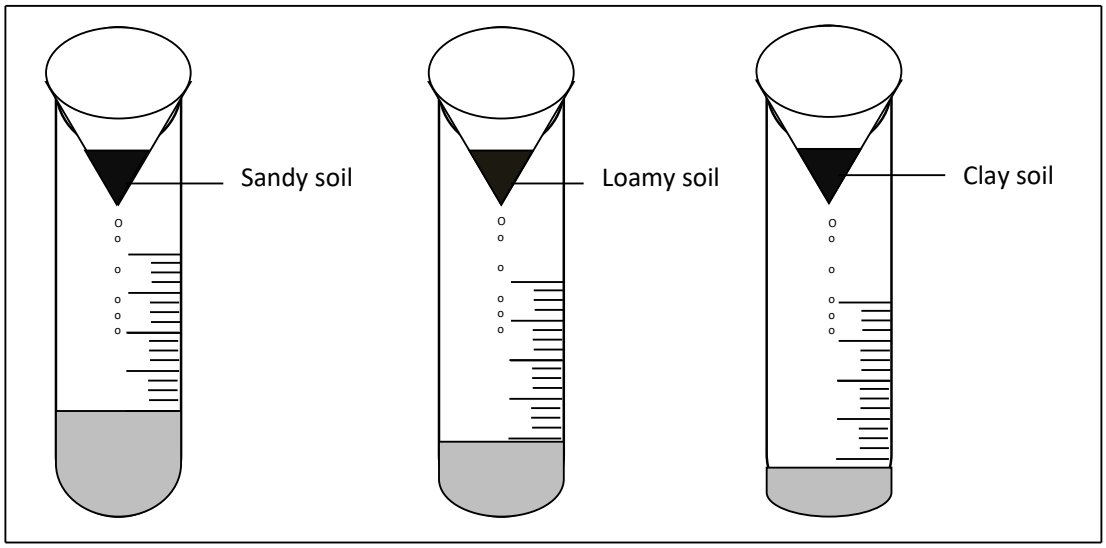


Fig. 3: Experiment to compare porosity and water retention capacity.

CONTROL GROUP 1

Subject: Biology

Topic: Ecology

Subtopic: Ecosystem

Duration: 80 minutes

Age: 15 – 17 years

Methods of Teaching: Conventional Lecture Method

Instructional Material: A chart of an ecosystem

Behavioural Objectives: By the end of the lesson, the students should be able to

iv. Define ecosystem

v. Identify and list the component of ecosystem

vi. Explain relationship among living organism in an ecosystem.

Entry Behaviour: The students might learn the preliminary aspect of ecology concept.

Introduction: The teacher will introduce the lesson by asking the students to define ecosystem as the basic functional units of nature that comprises that comprises group of interrelating living organisms, non-living organisms and their environment.

Presentation:

Step I: The teacher will give examples of interrelating living organisms and their non-living environment; that in aquatic environment the fish absorbs oxygen dissolved in water through the gills and gives back carbon dioxide into the water. In terrestrial environment animals breadth in oxygen and gives out carbon dioxide which in turn taken in by plants during photosynthesis and oxygen is released as by product for animals to take in.

Step II: Teacher will explain the components of an ecosystem which include biotic (living) and abiotic (non living). The abiotc are classified into three types known as producers, consumers and decomposers. All things in an ecosystem form the community.

Step III: The teacher will explain that producers are green plants that obtain their nutrition through the process of photosynthesis and are prepared to as autotrophs.

Step IV: The teacher will explain to students that consumers are animals which feed on plants and other animals. They are divided into primary, secondary and tertiary consumers.

Step V: The teacher will explain that decomposers are organisms which feed on dead body of both producers and consumers. They breakdown dead organic matter to release simple chemical compounds which can be used by the producers. The teacher will explain the interaction between living and non living things in the ecosystem.

Evaluation: The teacher will evaluate the lesson by asking students to explain the differences between biotic and abiotic organism and to give one example each of the producers, consumers and decomposers.

CONTROL GROUP 2

Subject: Biology

Topic: Ecology

Subtopic: Food Chain/ Food Web

Duration: 80 minutes

Age: 15 – 17 years

Methods of Teaching: Conventional Lecture Method

Instructional Material: Charts of food web and food chain

Behavioural Objectives: At the end of the lesson, the students should be able to:

i. Define food chain and food web

ii. Identify and list the components of food chain and food web

iii. Explain the role of producer in a food chain

Entry Behaviour: The students have learned about ecosystem in their previous lesson.

Introduction: The teacher will introduce the lesson by asking the students as:

In an ecosystem the organism which changes light into stored chemical energy is the (a) Consumer (b) Decomposers (c) Producer (d) Carnivore

Presentation:

Step I: The teacher will begin the lesson by defining a food chain; as a linear feeding relationship among organism in the same community. A food chain can be represented as follows:

Guinea grass → Grass hopper → Toad → Snake →hawk

Humus → Earthworm → Domestic Fowl → Man

In an aquatic habitat a food chain is represented as follows

Diatoms → Mosquito larvae → Tilapia fish → Whale

Step II: The teacher will define food web as a complex feeding relationship consisting of interrelated food chains.

Step III: The teacher will explain pyramid of number as the decreasing number of individuals from one trophic level to another in a food chain is called pyramid of numbers. The number of green plants is more than the grasshoppers the number keep decreasing up to the last trophic level.

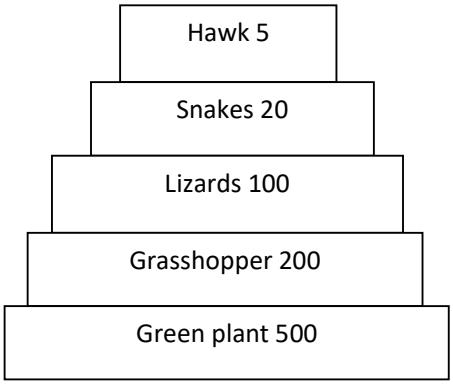
Fifth trophic level

Forth trophic level

Third trophic level

Second trophic level

First trophic level



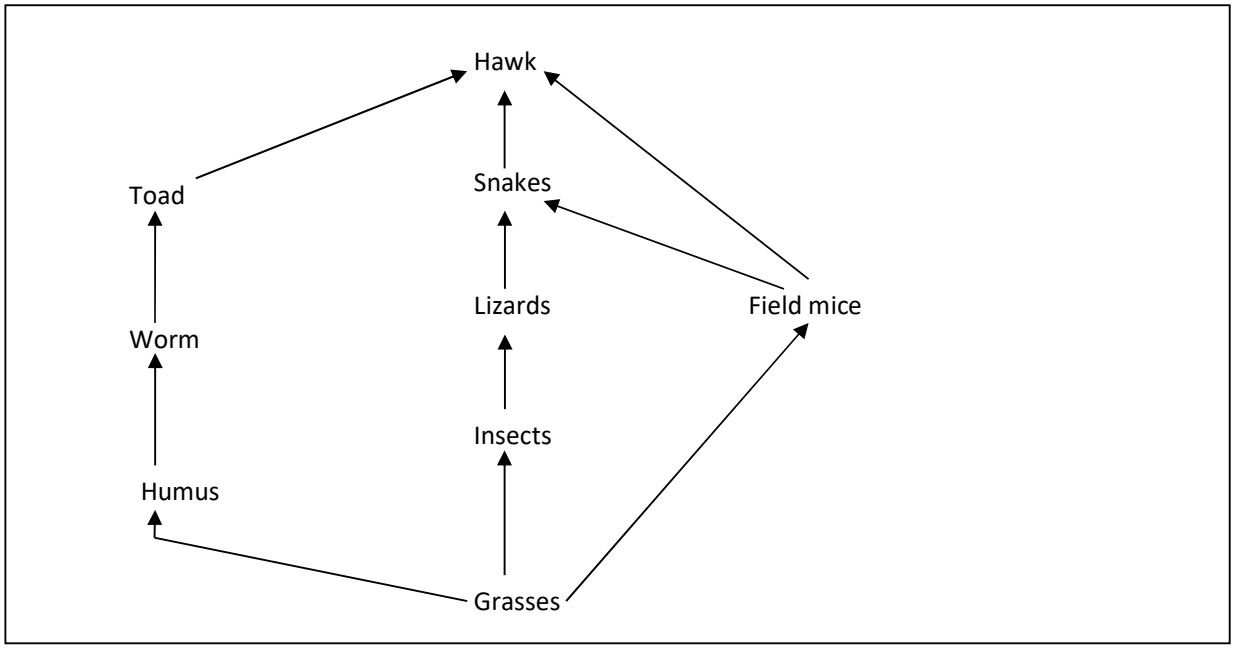
Evaluation: The teacher will evaluate the lesson by asking students the following questions:

Define the following terms:

i. Food chain

ii. Food web

iii. Tropic level.



CONTROL GROUP 3

Subject: Biology

Topic: Ecology

Subtopic: Habitant

Duration: 40 minutes

Age: 15 – 17 years

Methods of Teaching: Conventional Lecture Method

Instructional Material: Charts

Behavioural Objectives: At the end of the lesson, the student should be able to:

i. Mention the meaning of habitat

ii. Identify their habitat

iii. Identify different organisms and their habitats

iv. Mention the types of habitats

Entry Behaviour: Students have idea about the place they live e.g. home

Introduction: The teacher will introduce the lesson by asking the students questions on their previous lesson. E.g. where do animals find the food they eat?

Presentation:

Step I: The teacher will define the term habitat as the dwelling place of an organism.

Step II: The teacher will explain to the student that habitat is classified into two (2) main groups namely, aquatic (water) and terrestrial (land) habitats.

Step III: The teacher will give examples of organisms that are found in water like toads, fish crabs etc and the organisms that live on land example cat sheep lizard cattle etc.

Evaluation: The teacher will evaluate the students' learning using the following questions to define habitat, list the types of habitat and give examples of animals that are found in each habitat.

CONTROL GROUP 4

Subject: Biology

Topic: Ecology

Subtopic: Habitant

Duration: 40 minutes

Age: 15 – 17 years

Methods of Teaching: Conventional Lecture Method

Instructional Material: Charts

Behavioural Objectives: At the end of the lesson, the student should be able to:

Behavioural Objectives: At the end of the lesson, the student should be able to:

i. Classify terrestrial and Aquatic habitat into various sub-classes or groups

ii. List some organisms found in each sub group of the habitat.

iii. Identify those groups of habitat using some features.

Entry Behaviour: Students have learnt the two (2) major types of habitats.

Introduction: The teacher ask the students to mention the two (2) classes of habitats

Presentation:

Step I: The teacher will explain to the student that aquatic habitat could be classify into various groups depending on the salinity of the water. The habitat includes: fresh water, marine, and estuarine habitat.

Step II: The teacher will give examples of habitat as follows: Fresh water e.g. tadpole, Tilapia etc, marine e.g. sharks, Wales etc and estuarine e.g. crabs, fish etc.

Step III: The teacher will explain the characteristics of fresh water, marine and estuarine habitat to students.

Evaluation: The teacher will evaluate the lesson by asking students to mention the classes of aquatic and terrestrial habitats with example each.

CONTROL GROUP 5

Subject: Biology

Topic: Ecology

Subtopic: Population Studies

Duration: 40 minutes

Age: 15 – 17 years

Methods of Teaching: Conventional Lecture Method

Instructional Material: Charts, Textbooks and Diagrams.

Behavioural Objectives: At the end of the lesson, the student should be able to:

1. Define population

2. Describe the size of a given population

3. Identify the dominant organism found in a given population.

Entry Behaviour: Students are aware of changes in population of their family members.

Introduction: The teacher introduces the lesson by asking the student to mention the number of their family members.

Presentation:

Step I: The teacher will define population as the total number of organisms of the same species living together in a given area.

Step II: The teacher will define population size and population density as:

Population size: This indicates how large the total number of individuals in a population is. Thus, it can be said that Nigeria has a human population of 88 million people.

Population Density: this is the number of organisms per unit area.

Step III: The teacher will explain to the students that those species that have a major controlling influence on the nature of the community is said to be Dominant.

Evaluation: The teacher will evaluate the lesson by asking students to define population, population size, population density and dominance.

CONTROL GROUP 6

Subject: Biology

Topic: Ecology

Subtopic: Population density and factors affecting population

Duration: 40 minutes

Age: 15 – 17 years

Methods of Teaching: Conventional Lecture Method

Instructional Material: Charts, Maps and Diagrams.

Behavioural Objectives: At the end of the lesson, the student should be able to:

1. Define population Density

2. List and describe the factors affecting population.

Entry Behaviour: The Students have learnt about population and population size.

Introduction: The teacher introduces the lesson by asking the student to define population and population size

Presentation:

Step I: The teacher will define population density as the density of a species as the number of individual of that species which are found per unit area.

Step II: The teacher will list the factors that affect population as

1. Natality (Birth rate). 2. Mortality (death rate). 3. Immigration 4.Emigration 5. Availability of food. 6. Seasonal Climatic change 7.Breeding period 8. Natural Disaster e.g. fire, drought and floods etc.

Step III: The teacher will explain the factor as follows:

Natality (Birth rate): When a child is born in a family, the population of that family increases.

Mortality (death rate): When a family member dies, the population of that family decreases.

Immigration (Dispersed): When people or animals move away from a particular area so the population of that area will decrease.

Availability of Food: When food is available in a particular area, the population of that area increases but when there is shortage of food, the population decreases.

Evaluation: The teacher will evaluate the students by asking the students to define population density and to mention factors that affect population.

CONTROL GROUP 7

Subject: Biology

Topic: Ecology

Subtopic: Soil

Duration: 40 minutes

Age: 15 – 17 years

Methods of Teaching: Conventional Lecture Method

Instructional Material: Samples of soil.

Behavioural Objectives: At the end of the lesson, the student should be able to:

1. Define Soil

2. Mention the types of soil

3. Mention the soil compositions

4. State the characteristics of soil

Entry Behaviour: The students are already familiar with soil.

Introduction: The teacher will introduce the lesson by asking the students questions on the previous lesson.

Presentation:

Step I: The teacher will define soil as the uppermost layer of the earth crust which provides support and nutrients for plants and animals.

Step II: The teacher will explain to the students that there are three (3) types of soil namely Sandy, Loamy, and Clay soil.

Step III: The teacher will mention soil composition as organic matter, micro-organisms, water, mineral matter and living organisms.

Step IV: The teacher will explain to the students that the common soil characteristics include soil colour, soil texture, soil structure and soil constituents.

Evaluation: The teacher will evaluate the lesson by asking students to define soil, mention types of soil and state soil compositions.

CONTROL GROUP 8

Subject: Biology

Topic: Ecology

Subtopic: Soil

Duration: 40 minutes

Age: 15 – 17 years

Methods of Teaching: Conventional Lecture Method

Instructional Material: Sample of soil, graduated cylinder, water, sodium carbonate or hydrogen peroxide.

Behavioural Objectives: At the end of the lesson, the students should be able to mention the procedures for conducting an experiment to show that soil contains different sizes of particles.

Entry Behaviour: The students have learned about soil types and characteristics.

Introduction: The teacher will introduce the lesson by asking the students questions from the previous lesson.

Presentation: Step I: The teacher will explain the method of conducting the experiment to show that soil contains different sizes of particle as follows:

i. Some quantity of soil sample is put into a graduated cylinder.

ii. Sufficient water is added to cover the soil sample

iii. Some sodium carbonate or hydrogen peroxide is added to quicken the dispersion of soil particles.

iv. The open end of the cylinder is to be covered with the palm and shaken well for few minutes

iv. The cylinder is then placed on a table for few minutes to allow the content to settle.

Step II: The teacher will explain the expected result as follows, the content settles in layers.

1. The larger and heavier particles settle first i.e. coarse sand, fine sand, silts and clay.

2. Light organic matter float on top of water surface

Step III: The teacher will explain to the students that soil is a mixture of different sizes of particles.

Evaluation: The teacher will evaluate the lesson by asking the students to mention the procedure for conducting an experiment to show that the soil contains different sizes of particles.

CONTROL GROUP 9

Subject: Biology

Topic: Ecology

Subtopic: Soil

Duration: 40 minutes

Age: 15 – 17 years

Methods of Teaching: Conventional Lecture Method

Instructional Material: Soil sample, Measuring Cylinder, funnel, cotton wool and water.

Behavioural Objectives: At the end of the lesson the students should be able to mention the procedure conducting an experiment to compare the porosity and water holding capacity of different soil types.

Entry Behaviour: The students have learned the procedures of conducting a soil experiment.

Introduction: The teacher asks the students question on the previous lesson

Presentation:

Step I: The teacher will define porosity as the pores (spaces) of the soil. Pores are those portions of soil occupied by water and or air.

Step II: The teacher will explain the methods of conducting the experiment as follows:

i. Plug the neck of the filter funnel with cotton wool and put equal weight of soil samples into each of them.

ii. Pour equal volume of water into each soil sample and recorded the volume of water collected by each cylinder after no more water drains through each of the funnel.

Step III: The teacher will explain the expected result of the experiment as follows: it will be observed that clay retains most of its water while more volume of water is collected in the measuring cylinder carrying the sandy soil. This shows that clay retains more water than the two other types. While loamy soil retains more water than sandy soil.

Step IV: The teacher will explain that sandy soil is more porous than loamy soil and loamy soil is more porous than clay soil.

Evaluation: The teacher will evaluate the lesson by asking the following questions:

i. Which of the soil type is more porous?

ii. Which of the soil type has the highest water retention capacity?