EFFECTS OF ADVANCE ORGANIZERS ON PERFORMANCE AND RETENTION OF ECOLOGY CONCEPTS AMONG SENIOR SECONDARY SCHOOL STUDENTS IN GIWA EDUCATIONAL ZONE

BY

PETER, AGBENYEKU

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DECLARATION

I hereby declear that this thesis titled **Effect of Advance Organizers on Performance and Retention of Ecology Concepts Among Senior Secondary School Students in Giwa Educational Zone,** is a result of my personal work. To the best of my knowlegde, it has not been presented in previous application for a higher degree. All quotations and sources of information are fully acknowledged by means of reference.

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AGBENYEKU, Peter	Sign	Date

CERTIFICATION

This thesis titled - **Effect of Advance Organizers on Performance and Retention of Ecology Concepts Among Senior Secondary School Students in Giwa Educational Zone by PETER AGBENYEKU** meets the requirements governing the award of Masters Degree in Science Education of Ahmadu Bello University, Zaria and it is approved for its contribution to knowledge and literary presentation.

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Prof. J.S Mari

Chairman Supervisory Committee Date

---------- ----------

Dr. (Mrs) T.E Lawal

Member Supervisory Committee Date

---------- ----------

Dr Mammam Musa

Head of Department of Science Education Date

---------- ----------

Prof. A.A Joshua

Dean, Postgraduate School Date

DEDICATION

This research work is dedicated to God Almighty for giving me the Grace to undertake this work, and to my parents Major and Lady Emmanuel Agbenyeku for their steadfast love and desire to see me succeed.

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OPERATIONAL DEFINATION OF TERMS

Advance Organizers:	an advance organizer is a brief, general statement prepared by the teacher, which provides a link between what is to be learnt and what students know or in absence of prior knowledge.
Integrative Reconciliation:	this is the ability to understand interconnections among the basic concepts of the domains.
Progressive Differentiation:	this is using a spiral approach to teach the main points in some given topics.
Subsumption:	a process of learning in which new materials is related to relevant ideas in the existing cognitive structure on a substantive, non verbatim basis

ABSTRACT

The purpose of this study was to examine the effect of advance organisers on the performance and retention of ecology concepts among senior secondary school students in Giwa educational zone. The study was conducted using a population of 145 students from G.S.S Kwangila (n=70) and G.S.S Basawa (n=75), using intact classes. The subjects through random sampling by balloting were assigned to experimental and control groups. A Quasi-experimental non-equivalent control group of pretest, post-test and delayed post-posttest design was used. The subjects were taught for six weeks using advance organisers and lecture methods for the experimental group and lecture method only for the control group. For the pretest, post test and delayed post posttest, the instrument used was the Ecology Concept Achievement Test (ECAT). Four null hypotheses were tested, t-test statistics was used to determine the level of significance of the two groups at $P \leq 0.05$. The major findings from the study indicates that: there is a significant difference in the mean academic performance scores of the experimental and control groups. There is a significant difference in the retention level of the students taught using advance organisers compared to those taught using lecture method only. Hypothesis 3 and 4 regarding gender issues; the use of advance organizers also favoured female students over the male students and female students slightly retained more than male students. Based on the findings of the research it was recommended that there should be training and retraining of biology teachers on the use and design of advance organizers, secondly advance organizer should be used by biology teachers in teaching in schools, also the use of advance organizers should be encouraged in co-educational schools since it is gender friendly.

CHAPTER ONE

THE PROBLEM

1.1 Introduction

Learning as a process focuses on what happens when learning takes place, and the explanations that describe what happens constitute learning theories. A learning theory attempts to describe how people and animals learn; thereby helping us understand the inherently complex process of learning. Learning theories have 2 chief values according to Hill (2002). One is in providing us with vocabulary and conceptual framework for interpreting the examples of learning that we observe. The other is in suggesting where to look for solutions to practical problems.

Learning had been defined by different people in different ways, Adedoyin and Adegbija, (2000) describes learning as a life-long process which takes place at all times, anywhere and through anybody. Learning is also defined as acquiring new knowledge, behaviors, skills, values or preferences. It may be goal-oriented and may be aided by motivation. Learning may also occur as a result of habituation or classical conditioning, or as a result of more complex activities such as play, learning may also occur consciously or without conscious awareness (Fadul, 2006).

Everyone has a unique frame work of knowledge base; such frame work of knowledge is called the Cognitive Structure. The learners' cognitive structure is organized in a hierarchical fashion so that ideas and concepts are held in such a way that broad overall concepts have links to several related subservient ideas. These in turn have their related subservient ideas, which go on to depend on other subservient ideas.

According to Ausubel (1963), meaningful learning, takes place when what is to be learnt is related to what is already known. In other words, meaningful learning occur when there is interaction between the new concepts, ideas or knowledge with the concepts, ideas or knowledge already existing in the cognitive structure of the learner. A focus on meaningful learning is consistent with the view of learning as knowledge construction in which students seek to make sense of their experiences. In constructivist learning, students engage in active cognitive processing, such as paying attention to relevant incoming information, mentally organizing incoming information into a coherent representation, and mentally integrating incoming information with existing knowledge (Mayer, 1999).

A primary process in learning is subsumption in which new material is related to relevant ideas in the existing cognitive structure on a substantive, non verbatim basis. Cognitive structures represent the residue of all learning experiences. To subsume is therefore, to incorporate new material into one's cognitive structures. From Ausubel's point of view, this is the meaning of learning. When information is subsumed into the learner's cognitive structure it is organized hierarchically. New material can be subsumed in two different ways, and in both ways, no meaningful learning takes place unless a stable cognitive structure exists. This existing structure provides a framework into which new learning is related, hierarchically to the previous information or concepts in the individual's cognitive structure.

In the course of learning, rote learning can occur. Rote learning is where a student memorizes something without full understanding and does not know how the new information relates with other stored knowledge. When a student learns facts by rote, the brain stores them as distinct, unrelated knowledge that can only be recalled and does not

promote transfer, other facts that are related and aid learning are not activated at the moment (Bransford, Brown and Cocking, 1999). Therefore, rote learning occurs when subsumed new material lacks a stable cognitive structure to be anchored to. Hence, an existing cognitive structure provides a framework into which the new learning is related, hierarchically, to the previous information or concepts in the individual's cognitive structure. The absence of this cognitive structure or a prior knowledge leads to rote learning. To tackle the problem of rote learning, different instructional strategies have been proposed and some of these include group/individual instruction, large/small group instruction, problem-solving, cooperative learning, critical thinking, simulations e.t.c. Ausubel (1963), however proposed the meaningful learning model were he advocated for the use of advance organizers.

According to Bromley (1995), "The mind arranges and stores information in an orderly fashion. New information about a concept is filed into an existing framework of categories called schemes that contain specific information about a concept. So when prior knowledge is retrieved, it provides a frame work on which to attach new knowledge. However, if no prior knowledge is available, advance organizers are developed by the teacher to help the student's ensure there is anchorage of new information (Shaibu 2008), hence meaningful learning can take place. Therefore, advance organizers is seen as a cognitive instructional strategy used to promote learning and retention.

Literature search indicates that advance organizers are used in providing support for new information. Woolfolk (2001) argued that advance organizers can "direct attention to what is important in the coming new material". The use of advance organizers helps the students to build their cognitive structure to ensure proper anchorage

of new information. Advance organizers highlights relationships among ideas that will be presented; and remind one of relevant information he/she may have. Ausubel in 1963 promotes the idea that the most important issue influencing learning is what the learner already knows and how it can be associated with new learning. A point on Ausubel's assimilation theory promotes the use of advance organizers to bridge the gap between prior knowledge and new knowledge to be learnt: this is by using advance organizers to help learners organize upcoming learning topics. This in turn gives the learners some meaning and the beginnings of a knowledge schema about new concepts. Advance organizers introduce subsuming concepts that scaffold and enhance integration of new concepts (Ausubel, 1961).

The objective or aim of education and learning is to have a meaningful learning. The concern of most, if not all teachers is to improve the retention of their students. The idea of forgetting cannot be completely ruled out but could be lessened by the use of concrete objects. However, learning and forgetting in rote learning are not equivalent to learning and forgetting in meaningful Learning. Ausubel (1968 & 2000) coined the term 'obliterative subsumption' to represent forgetting in meaningful learning. By obliterative subsumption, a meaningfully gained knowledge is not forgotten entirely. Residual concepts remain after subordinate concepts and details are lost. The residual concepts form anchoring ideas in the cognitive structure. These anchoring ideas will be useful to facilitate new relevant meaningful learning when required.

This process can only happen when meaningful learning took place originally. As noted earlier, meaningful learning can occur only when subsumption has taken place. To aid the process of subsumption when there are no relevant anchoring ideas or prior knowledge advance organisers are used. This will aid subsumption and make learning

meaningful and hence achieve obliterative subsumption. Furthermore, when students lack residual concepts, advance organisers can also serve to provide these residual concepts, which form the anchoring ideas needed for meaningful learning. But can advance organisers really serve to provide residual concepts that will provide the anchoring ideas that will enhance meaningful learning which is a sine qua-non for retention, is the focus of this thesis. As Taylor et-al (1970) noted what is imperfectly registered cannot be perfectly retained.

Due to the wide nature of the curriculum in biology, and bearing in mind that biology as a science subject, is taught to all students in the senior secondary schools. It is imperative to develop teaching strategies that will enhance the performance and retention of students and also help teachers to quickly complete the curriculum. There is a need to teach it effectively and as quickly as possible to meet up with the time frame of the senior secondary school examination. Ecology as a topic in biology is very wide and there are elements of ecology throughout SS1-3. Ecology describes the environment and the interactions that take place between the living and non living components of the environment. It is taught progressively from simple to complex, from senior secondary 1 to senior secondary 3. It is therefore necessary to lay a solid foundation for the learners to build on, for the years ahead. The researcher uses advance organizers to find out if it can help the learners build the foundation necessary for helping them retain more concepts in ecology that will be used in their senior secondary 2 and 3.

Also, gender issues in science and in particular Biology; have been the concern of many educators and series of researches have been going on this area. There have been differences in learning between males and females. Some instructional strategies promote learning more in males than in females. Ausubel advocates that advance organizers is

effective in promoting learning and retention this research intends to find out if it truly promotes learning more in males than in females. Some people are of the view that boys perform better in science than girls. Some researchers Aigbomian (2002) and Njoku (2007) reported that boys perform better than girls in Science, Technical and Mathematical subjects. Isa (1992) reported that boys and girls exposed to more practical activities do not differ significantly in their academic performance which implies that gender does not affect student's academic achievement when exposed to intensive practical activities in integrated science. From the foregoing it can be seen that some studies support differences while others do not. It is the intention of this research to find out if advance organisers support gender performance or not.

Although researchers have found advance organizers to be a useful tool for teaching students new concepts when they lack prior knowledge, the use of advance organizers in the absence of prior knowledge is seen to enhance meaningful learning and when learning is meaningful, concepts learnt can be easily remembered. According to Ausubel, in the absence of prior knowledge, advance organizers can be used to provide a general statement to guide students. He proposed that these advance organizers are as effective in promoting learning as subsumers, however there are those who feel the advance organizers are not beneficial. Thus, the study focuses on finding out if the use of advance organizer enhances academic performance and retention of learnt concept or not.

1.2 Theoretical framework

In the course of learning, the creation of new knowlegde is facilitated by the availability of pre-acquired ideas in the cognitive structure. The presence of relevant, clear and stable pre-acquired ideas in the learner's cognitive structure facilitates

meaningful learning (Ausubel 1968). When current knowledge interacts with relevant background knowledge in the cognitive structure and is assimilated, it forms a new knowledge structure. This new knowledge base or cognitive structure develops through the process of meaningful learning, thereby becoming more complex and helping students to solve problems. Therefore, a well developed cognitive structure enhances students' performance.

However in learning, it is not every time a new concept to be learnt has a point of integration to the cognitive structure. When there are no pre-acquired ideas in the cognitive structure for students to link the new concept to, this presents a learning problem. To provide a solution to this problem, Ausubel proposed the use of advance organiser. These advance organisers now serve as the prior knowledge or the pre-acquired ideas that will be the link between the new concept to be learnt and the cognitive structure. Thus the advance organiser now serves as the prior knowledge and the base upon which new learning is to be built. As feasible as it may seem to provide advance organiser to serve as prior knowledge, it is generally not easy to provide advance organizer that will serve as well as prior knowledge in the mind of the of the student. This necessitated the desire to carry out this research to find out if Ausubel's organiser can theoretically and practically serve as prior knowledge in the mind of the child.

1.3 Statement of the Problem

Learning is a continuous process and takes place at all times. When learning is guided as it is usually done in schools it is based on a foundation that is built gradually from simple to complex and as the child grows, his base of experience increases. This base of experience helps the child to easily link new concepts to past experience.

According to Ausubel's theory (1963), meaningful learning takes place when what is to be learnt is related to what is already known. In other words, meaningful learning occurs when there is interaction between the new concepts, ideas or knowledge with the concepts, ideas or knowledge already existing in the cognitive structure of the learner. A focus on meaningful learning is consistent with the view of learning as knowledge construction in which students seek to make sense of their expeeriences. A primary process in learning is subsumption in which new materials is related to relevant ideas in the existing cognitive structure on a substantive, non verbatim basis. This existing structure provides a frame work into which the new learning is related hierarchically to the previous information or concepts in the individual's cognitive structure.

Learners according to Bransford, Brown and Cooking (1999) bring with them a set of assumptions and beliefs that can serve as a mental framework for learning. In the construction of knowledge, students use prior knowledge to incorporate meaning into newly acquired material. In this way, prior knowledge influences how learners interprete new information. Therefore prior knowledge provides an anchor to assimilate new knowledge into the cognitive structure. Further more the importance of prior knowledge as a foundamental for learning was emphasised explicitely by Ausubel (1961). He pointed out that, for meaningful learning to occur, the learner has to recognise that what was being taught had some connection with existing knowledge. That existing knowledge is termed prior knowledge.

When learners cannot link in-coming new knowledge with an existing knowledge then rote learning as opposed to meaningful learning takes place. Rote learning is where a student memorises somethings without full understanding and does not knoew how the new information relates with others stored knowledge. Therefore rote learning occurs

when subsumed new material lack a stable cognitive structure to be anchored to. The mind arranges and stores information in an orderly fashion. New information about a concept is filled into an existing framework of categories called schemes, that contain specific information about a concept. So when prior knowledge is retrieved, it provides a framework on which to attach a new knowledge. However if no prior knowledge is available, advance organisers are developed by the teacher to help the student ensure that there is anchorage of new information. Since the theory of the use of advance organisers was proposed many researchers have shown that it can be effective in instruction where prior knowledge is lacking. This is because an advance organiser serves as the students prior knowledge for anchoring new materials to be learnt. If prior knowledge is available, the use of advance organisers may not be necessary (Mayer, 2003).

However, with the recent trends in educational achievement of students in various school subjects as seen in table 1.1

Table 1.1 Science Subjects Results 2002-2005

year	subject	no.that sat for exam	total pass grade 1-8	% pass	total failure	% failure
2002	Biology	285,690	155,258	54.34	130,432	45.66
	Chemistry	140,034	35,702	30.64	80,824	69.36
2003	Biology	355,582	210,321	59.15	145,261	40.85
	Chemistry	140,856	67,673	48.04	73,183	51.96
	Physics	122,809	57,100	46.49	65,709	53.51
2004	Biology	481,034	249,721	51.91	231,313	48.09
	Chemistry	170,537	90,641	53.15	79,896	46.85
	Physics	152,275	77,544	50.93	74,731	49.07
2005	Biology	508,384	196,707	38.70	311,677	61.30
	Chemistry	161,232	84,659	52.50	76,573	47.50
	Physics	146,000	61,904	42.40	84,038	57.60

SOURCE: WAEC Yaba Lagos. (2006)

From the above table we can see a fluctuation in students performance, students performance are not stable most especially in biology. What is responsible for this fluctuations and poor performance? Okeke (1997) observed that the poor performance of students most especially in biology could be caused by poor instructional strategies among other factors. Secondly when we look at the wide nature of the biology curriculum

we see that students have large amount of topics to be covered in three years and also some topics like ecology are very wide and are spread across the three years of the senior secondary school. Considering reports from (STAN, 1992; Adeyegbe, 1993; Eguabor, 2001; Chief examiners report, 2003) shows that students perform poorly in science subject. This has evoked much research aimed at evolving means of redressing the situation. According to Duyilemi (1982) if learners and teachers must understand concepts and principles in science and if concepts learnt must be retained for problem solving in science; which requires constructing new ideas from what is already there in the child's mind then careful consideration must be given to methods by which subject matter, learners and the teachers interacts. Another reason for students poor performance in science is that in the course of classroom interaction teachers do not make use of advance organisers when students lack subsuming or prior knowledge, this has led to rote learning because new knowledge is not linked to existing knowledge, hence poor retention of concepts. To solve the problem of poor performance different strategies have been put forward and tried, Ausubel put forward the advance organizer strategy to help solve the problem of poor performance. This study intends to use advance organizers to find out if it can serve as a bridge between the new knowledge and prior knowledge thereby making learning more meaningful and eventually improve performance and retention of concepts learnt

Ausubel supposes that when prior knowledge is lacking a bridge is required to link the in-coming new knowledge with the cognitive structure, or a strategy needs to be developed to serve as surogate concepts. This bridge is what Ausubel terms as advance organisers. This research therefore intends to find out if advance organisers can serve as

prior knowledge therefore aiding meaningful learning and the effects it has on the performance of students in ecology concepts.

1.4 Objectives Of The Study

The study has the following objectives, to;

1. investigate the effects of advance organizers on academic performance of students in ecology at the senior secondary level.
2. determine if their is any gender differences in achievement when senior secondary students are taught ecology using advance organizer.
3. determine if the use of advance organiser enhance retention ability of senior secondary school students in ecology concepts.

1.5 Research Questions

In meeting the objectives of the study the following research questions were raised for answering;

1. What is the effect of advance organizers on the academic performance of SS 1 students in ecology?
2 Is there any difference in the mean scores of male and female students exposed to advance organizers in ecology?
3 What is the effect of the use of advance organisers on retention ability of senior secondary school students in ecology concepts?
4 What is the effects of advance organizers on the retention ability of male and female secondary school students taught ecology concepts?

1.6 Null Hypotheses

The following null hypotheses were tested at $P \leq 0.05$

H_{01}: There is no significant difference between the mean scores of students taught with advance organizers and lecture method and those taught with lecture method only.

H_{02}: There is no significant difference in the performance of male and female students taught ecology concepts using advance organizers and lecture method and those taught with lecture method only.

H_{03}; There is no significant difference in the retention ability of SS students taught ecology concepts using advance organizers.

$H_{O4;}$ There is no significant difference in the retention ability of male and female students taught ecology concepts using advance organizers

1.7 Significance of the Study

The findings of this study would hopefully be useful to the upliftment of science education in the following ways:

Enhance the performance of students in biology by guiding teacher on how to design advance organizers that will help link in coming new knowledge to the cognitive structure thereby fostering retention of learnt concept.

If this strategy is found to be useful it can be adopted and used in the teaching of every day science, also this study can be replicated and used in other fields of science thereby generally enhancing the performance of students in all spheres of science.

In the course of this study, advance organizers will be developed which will serve as models and guide teachers on how to construct and effectively use advance organizer to promote meaningful learning and retention of science concepts across content areas

A significant contribution is in helping curriculum planners sensitize teachers on the need to develop strategies of linking learning materials for easy assimilation and retention by students, and also to develop good anchoring ideas when planning their lesson.

Teachers can also use the advance organizers to help student's correct wrong assumptions about some concepts. Also textbook publishers in partnership with curriculum planners can design their texts and curriculum to follow Robert Gagne's heirarchy of learning.

In this study, advance organizer were designed which will serve as models that will guide inexperience teachers on how to design and use advance organizers to promote meaningful learning in classrooms.

1.8 Basic Assumptions

To effectively carry out this research the researcher has made the following assumption:

1 that all students used for the research have been taught elements of ecology in their basic science in the junior secondary school

2 that all students used for the research have been taught by teachers with similar qualifications

3 that all students used for the research have access to instructional materials such as charts.

1.9 Scope of the Study

The scope of this study is limited to Giwa Educational Zone of kaduna state, and to all Senior Secondary School 1 students offering Biology in public schools. The topics to be taught will be drawn in from ecology concepts because of its wide nature. Finally the type of advance organiser to be used is the verbal advance organiser.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The focus of this research is to find out the effect of the use of advance organizers and subsumers on the performance of SSI students in biology in Giwa Educational Zone. To effectively carry out this research the following literature will be reviewed, this is to enable us have a bearing and to give us a sense of direction on related issues that have been covered. In this chapter, the related literature relevant to this study is reviewed under the following sub headings

2.2 Theoretical and Conceptual Framework of Ausubel Theories of Learning

2.8 Academic Achievement in Biology

2.9 Influence of Gender Difference and Academic Achievement in Biology

2.10 Factors Influencing Retention Ability In Biology

2.11 Overview of Related Studies

2.12 Implication of Literature Reviewed on the Present Study

2.2 Theoretical and Conceptual Framework of Ausubel Theories of Learning

A key concept in Assimilation Learning Theory Ausubel (1963) is that new knowledge will mean something to a learner and will be remembered when it is connected to existing knowledge – what is already known. Although he recognized other forms of learning, his work focused on verbal forms of learning. He dealt with the nature of meaning, and believes the external world acquires meaning only as it is converted into the content of consciousness by the learner. Ausubel's work has frequently been

compared with Brunner's. The two held similar views about the hierarchical nature of knowledge, in the sense that, knowledge is built from simple to complex and that whatever is learnt meaningfully, is based on an existing knowledge. Therefore when students lack that existing knowledge then the need for advance organizer is necessary.

According to Ausubel (1963) when one encounters completely new unfamiliar material, then rote learning as opposed to meaningful learning, takes place. This rote learning may eventually contribute to the construction of a new cognitive structure which can later be used in meaningful learning. Ausubel's theory is therefore concerned with how individuals learn large amounts of meaningful materials from verbal or textual presentations in a school setting. A first prerequisite for meaningful learning, according to Ausubel and Robinson (1969) "is that the material presented to the learner be capable of being related in some `sensible' fashion" (p. 46). The new information must be fitted into a larger pattern or whole. "Second, the learner must possess relevant ideas to which the new idea can be related or anchored" (p. 46). The learner must already have appropriate subsuming concepts in his or her cognitive structure. "Finally, the learner must actually attempt to relate, in some sensible way, the new ideas to those which he presently possesses" (p. 46). If any of these conditions are missing, the end result will be rote learning. Hence a primary process in learning is subsumption in which new material is related to relevant ideas in the existing cognitive structures on a substantive, non-verbatim basis.

2.2.1 Concept of Cognitive Structure

Every person has a unique frame work of knowledge base; such frame work of knowledge is called the Cognitive Structure. Ausubel (1963a) emphasizes on the learner's cognitive structure in the acquisition of new information. Present experience is always fitted into what the learner already knows. "Existing cognitive structure, that is an individual's organization, stability, and clarity of knowledge in a particular subject matter at any given time, is the principal factor influencing the learning and retention of meaningful new material" (Ausubel, 1963a). A cognitive structure that is clear and well organized facilitates the learning and retention of new information. A cognitive structure that is confused and disorderly, on the other hand, inhibits learning and retention.

The learners' cognitive structure is organized in a hierarchical fashion so that ideas and concepts are held in such a way that broad overall concepts have links to several related subservient ideas. These in turn have their related subservient ideas, which go on to depend on other subservient ideas. Learning can be enhanced by strengthening relevant aspects of cognitive structure. Putting the mind in order is one of the principal objectives of all education. Having a clear and well organized cognitive structure, Ausubel (1968) believes, "is also in its own right the most significant independent variable influencing the learner's capacity for acquiring more new knowledge in the same field" (p. 130).

According to Ausubel's theory, meaningful learning, takes place when what is to be learnt is related to what is already known. In other words, meaningful learning occur when there is interaction between the new concepts, ideas or knowledge with the

concepts, ideas or knowledge already existing in the cognitive structure of the learner. Rote learning occurs when what is to be learnt, is not related to what is already known. In other words, rote learning occurs when there is no interaction between the concepts or ideas to be learnt and the concepts or ideas that exist in the cognitive structure of the learner. Rote learning takes place when subsumers are missing in the cognitive structure. If there are no related ideas or concepts already in the cognitive structure, the length of time the new ideas or concepts is retained is limited.

2.2.2 Ausubel Assimilation Theory

Ausubel's assimilation theory (1960, 1961 and 1978) states that new information is linked to relevant, pre-existing aspects of cognitive structure and both the newly acquired information and the pre-existing structure are modified in the process to form a more highly differentiated cognitive structure. Ausubel promotes the idea that the most important issue influencing learning is what the learner already knows and how prior knowledge can be associated with new learning.

The last point of Ausubel's assimilation theory promotes the use of advance organizers to bridge the gap between prior knowledge and new knowledge. The use of advance organizer helps learners organize upcoming learning topics; this in turn, gives the learner some meaning and the beginning of a knowledge schema about the new concepts. Advance organizers introduce subsuming concepts that scaffold and enhance integration of new concepts (Ausubel 1961). Advance organizers therefore act as substitute of prior knowledge; they are also quite good at organizing information so learners can easily find learning topics and resources.

2.2.3 Concept of Advance Organizers

The idea of the use of advance organizers was suggested by Ausubel (1978) well before the use of hypermedia and distance learning initiatives, became pervasive. Ausubel suggests that advance organizers might foster meaningful learning by prompting the students regarding pre-existing super ordinate concepts that are already in the student's cognitive structure, and by otherwise providing a context of general concepts into which the students can incorporate progressively differentiated details. Ausubel claims that by presenting a global representation of the knowledge to be learned, advance organizers might foster "integrative reconciliation" of the sub-domains of knowledge i.e. the ability to understand interconnections among the basic concepts of the domains.

Curran and Takata (2003) expressed advance organizers as extremely well designed and thought out unit outlines, presented before the actual topics to be learned. It is notable that the advance organizer is designed to prepare students for how to think about the lessons to come, giving some detail about terminology and connections but not giving the entire unit content. Advance organizers provide concepts and principles to the students directly, and help the learners to integrate new materials with what they already know; they "prepare" the learners for new information.

According to Rene (1998) an advance organizer is a cognitive strategy proposed by Ausubel in his subsumption theory, which allows the learner to recall and transfer prior knowledge to the new information being presented. This theory is based on the idea that learning is facilitated, if the learner can find meaning in the new information. If a

connection can be made between the new information and previous knowledge, the learning experience will become more meaningful to the learner. Therefore, the new information will be learned. The advance organizer is not a strategy used by the learner, but rather an instructional strategy used by the teacher.

In essence, the advance organizer is a brief, general statement prepared by the teacher, before presenting the new material, to introduce the new lesson. In designing the advance organizers recall of previous knowledge relevant to the new knowledge is important. It should provide a bridge that links the known to the unknown, by including an abstract outline of the new information and a restatement of old knowledge. Theoretically, this will encourage transfer and application of old knowledge, to make the new knowledge more meaningful to the learner (Rene, 1998).

According to Stone, Weil and Calhom (2000) advance organizers model has three phases of activity:

Phase I: Presentation of the advance organizer. This is done by

- Clarifying the aims of the lesson
- Presenting of the advance organizer
- Prompting awareness of relevant knowledge

Phase II: Making links to the organizer. This is done through

- Presentation of the learning task or learning materials.
- Making organization and logical order of learning material explicit.

Phase III: Strengthening of the cognitive organization. This is done through

- Integrative reconciliation and active learning. Example the teacher can ask learners to make summaries, to point out differences, to relate new examples with the organizer.
- Elicit critical approach to subject matter, that is to have students think about contradictions or implicit inferences in the learning material or previous knowledge. (Stone et al 2000)

The simple principles behind the use of advance organizers are that:

1. The most general ideas of a subject should be presented first and then progressively differentiated in terms of details and specificity .
2. Instructional materials should attempt to integrate new material with previously presented information through comparisons and cross-referencing of new and old ideas.

Based on the above principles advance organizers provide the necessary scaffolding for students to either learn new and unfamiliar material or to integrate new ideas into relatively familiar ideas. Ausubel contends that these organizing ideas, which may be single concepts or statements of relationship, are themselves important content and should be taught because they serve to organize everything that follows. Hence advance organizers are based on major concepts, generalizations, principles, and laws of academic disciplines.

Types of Advance Organizers

An advance organizer can be considered a procedure used by teachers to orient a student to the content of a lesson to ensure consideration of known information before processing new information, and to illustrate for the student the structure of the to-be-presented information or to-be-completed task.

Advance organizers may simply be provided by means of clear teacher's instructions on the introduction to a new topic, with the goal of giving students an overview, connecting new information to what the students already know, and illustrating the organization of the new concept on information to be processed and learned. According to Feeney and Yivisaker (2006) advance organizers can be a task planner designed to orient the learner to a task by providing organizational cues, like a sequence of steps to complete the task or a list of components of the task, or by showing what a product should look like.

Ausubel's theory of Advance organizers fall into two categories; comparative and expository.

Expository Organisers

Expository organisers is a type of Advance organizers that provides new knowledge that students will need to understand the upcoming information (Woolfolk, 2003). Expository organisers are often used when the new learning material is unfamiliar to the learner. They often relate what the learner already knows with the new and unfamiliar material, this in turn is aimed at making the unfamiliar material more plausible to the learner. An example which Ausubel and Robinson (1971) provided, is that of the Mendel's law of genetics. To make Mendel's law more plausible, an expository organiser

would have a combination of relatedness to general relevant knowledge that is already present, as well as relevance for the more detailed Mendel's laws. Example this can be done by asking the students to describe the similarities in appearance that exist between them and their parents and then relating and explaining the similarities in appearance that exist in terms of Mendel's law. Essentially an expository organiser furnish an anchor in terms that are already familiar to the learners.

Expository organisers can be used in different ways; it could be used as a narrative where the new information is presented in the form of a story to the students or a short passage which the students read before the lesson. Secondly expository organisers can be used as a graphic or visual display. Graphic organizers are highly effective thinking tools that illustrates the organization or structure of and relationship between concepts. Graphic organizers provide opportunities to track thinking and clarify both the content and the thinking processes used when creating problem – solving and evaluating. Graphic organizers are visual frameworks that help students to structure there thinking processes, organize their information, ideas and research and see both the whole and parts of a problem or issues. Examples of expository advance organizers for adults are the diagrams that accompany products which could be used as a guide to assemble the products. Even intelligent adults are unlikely to be able to assemble novel products from their parts in the absence of a clear sequence of pictures that explicitly present the steps needed to accomplish the assembly. These diagrams are graphic advance organizer (Nesbit and Adesope, 2006). Maps are also examples of graphic advance organizers.

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Comparative Organisers

Comparative advance organizers presents a study of the differences between items the students already knows and what they are about to learn. Comparative advance organizers can be used when anchoring ideas are available, that is when it is possible to precisely and explicitly draw out the principal similarities and differences between the new learning and the existing related concepts in the cognitive structure of the learner. The main goal of comparative organiser is to activate existing schemas. Similarly, they act as reminders that bring into the working memory of what a learner may not realise as relevant. By acting as reminder, the organiser points out explicitely "whether already established anchoring ideas are nonspecifically or specifically relevant to the learning material" (Ausubel and Robinson, 1969). similarly, a comparative organiser is used both to integrate as well as discriminate. It "integrates new ideas with basically similar

concepts in cognitive structure, as well as increases dicriminability betwen new and existing ideas which are essentially different but confusably similar" (Ausubel,1968)

2.2.4 Advance Organizers, Learning and Retention

Reviews of the advance organizer literature indicate that support for the efficacy of organizers in promoting learning is equivocal at best. One explanation for this may be that researchers are not using materials consistent with Ausubel's theory of advance organizers. In addition, a number of predictions and theoretical concepts basic to subsumption theory are not supported by the findings reported (McEneany 1990).

In the years since Ausubel proposed his theory of meaningful verbal learning, quite a few empirical researches based on that theory has accumulated. Much of these researchers focused on the role of advance organizers in promoting learning and retention. Review of the advance organizer literature reveals, however, that support for such organizers is equivocal at best. In a meta-analysis, conducted by Stone (1983) reported findings which support facilitative effects but failed to support a number of other predictions of subsumption theory. Clark and Bean (1982) suggested that these ambivalent results can be attributed to researchers' inconsistencies in the definition and construction of advance organizers. They state, "It is by no means clear that research efforts, designed to test the efficacy of a preconceived researcher or teacher constructed introduction to a passage are productive or even necessarily consistent with Ausubel's subsumption theory.

Egbugara (1983) investigated the effects of equivalent, non verbal advance organizers, in facilitating the learning of some physics concepts. The result of the study

revealed that advance organizers facilitated the learning of physics concept because of the improved scores of the test administered. In a similar research carried out by Abdullahi and Mba (1985), they investigated the relative effectiveness of pre- instructional strategy (advance organizer) of senior secondary one students in biology. Findings from this study revealed that the group exposed to advance organizers had a significantly higher scores than the control group.

In a research carried out by Lin and Chen (2007), compared the effects of different types of computer-generated visuals (static versus animated) and advance organizers (descriptive versus question), in enhancing comprehension and retention of a content-based lesson for learning English as a foreign language. The results showed that the animation group outperformed the static visual group in one of the four tests, and that animation embedded with a question advance organizer had a marginal effect in enhancing comprehension and retention.

Nesbit and Adesope (2006) estimated that more than 500 articles have been published in peer-review journals, most since 1997, with substantial reference to educational applications of graphic advance organizers. In their meta-analysis of 55 experimental studies Nesbit and Adesope concluded that there is a general positive effect of graphic advance organizers i.e. knowledge and concept maps in facilitating knowledge comprehension and retention, with effect sizes varying from small to large depending on how the organizers were used and on the type of comparison treatment. The students who were studied ranged from grade 4 to post-secondary education. Most of the studies were of regular education students. They also summarized data suggesting that low ability students experienced greater benefit than high ability students, suggesting a relatively

stronger positive effect for students with cognitive disability. Bulgren and Schumaker (2006) described 19 studies of advance organizers, all with adolescent participants. Five of the studies used only participants with learning disabilities, low academic achievers, and normal achievers. All of the organizers used in the studies had been developed by the Kansas University center for research or learning. The 19 studies reported uniformly positive results, interpreted both statistically and clinically, leading the authors to conclude that advance organizers can substantially improve the learning of adolescent students with learning disabilities, low achieving students, and average achieving students. The report of the National Reading Panel (2000) identified 11 experimental studies that met stringent methodological criteria and supported the use of graphic advance organizers to facilitate reading comprehension and memory for text.

2.2.5 Prior knowledge

Content knowledge or expertise influences how information gets mentally encoded and organized. Learners according to Bransford, Brown and Cocking (1999) bring with them a set of assumptions and beliefs that can serve as a mental frame work for learning. In "the construction of knowledge" they use prior knowledge to incorporate meaning into newly acquired material. In this way, prior knowledge influences how learners interpret new information and decide what aspects of this information are relevant and irrelevant. The influence of prior knowledge can be illustrated by comparing experts to novices. In a given domain, experts having a larger knowledge base, compared to novices, can chunk information into more meaningful chunks, which may facilitate learning (Chi, 1978).

2.2.6 Prior Knowledge As Foundation For Learning

According to cognitive learning theory, students build new knowledge based on their prior knowledge. Prior knowledge provides an anchor to assimilate new knowledge into cognitive structure (schemata). The notion of 'cognitive structure' can be defined as 'the facts, concepts, propositions, theories, and raw perceptual data that the learner has available to her at any point in time, and the manner in which it is arranged' (Taber, 2001, White, 1985, and Ausubel & Robinson, 1971).

Piaget's believed that learning is a change in the cognitive structure through the processes of adaptation: assimilation and accommodation. Assimilation involves the interpretation of new events in terms of existing cognitive structure. (http://tip.psychology.org/piaget.html) Assimilation increases knowledge while preserving cognitive structure, by integrating information into existing schemata; accommodation modify cognitive structure to account for new experience. For Piaget, learning as a process of adaptation does not replace prior knowledge, but rather differentiates and integrates prior knowledge into a more coherent whole. (Roschelle, 1995)

Further, the importance of the prior knowledge as a foundation for learning was emphasized explicitly by Ausubel (1961). He pointed out that for 'meaningful learning' to occur, the learner had to recognize that what was being taught had some connection with exiting knowledge. That existing knowledge is termed prior knowledge. Therefore, a paramount factor in any meaningful learning is what has previously been learned. In order for meaningful learning to take place, it is necessary both for the learner to hold some relevant prior knowledge, and for the teacher to 'make the connection' to help the

learner recognize its relevance. If either of these conditions is not met, then rote learning instead of meaningful learning will take place. (Taber, 2001, Ausubel & Robison, 1971) In order to overcome this problem, Ausubel(1960) suggested the "advance organizer" approach that urged teachers to use suitable organizing ideas in the introductory stages of new learning. In this case the advance organiser now serves as the prior knowledge to facilitate meaningful learning.

Likewise, many cognitive learning theorists emphasize the positive links between what has been learned and what is to be learned. They argued that because knowledge has logical and psychological links, the possibility of sequential and vertical transfer of learning would be enhanced by suitable arrangements and presentations. (Fensham, 1972) This means that without prior knowledge learning cannot occur or at least takes a lot of time to make some connection between existing cognitive structure and new information. For example, the adult who is unfamiliar with the possibilities of decentralized systems can't quickly be convinced that schooling fish have no leader. (Resnick, 1992) And there is no way to give the first-time jazz listener the enjoyment available to more practiced ears. (Roschelle, 1995) In short, prior knowledge determines what we learn from experience.

2.2.7 How Does The Idea Of Prior Knowledge As Foundation For Learning Affect Science Teaching?

In science, the degree of sequential dependence of the content is so great that the role of prior knowledge is considered as a starting point for subsequent learning. Gagne (1968) and White (1972) argued that some of the sequences were so definite that without mastery of a prior step there could be no further progress in the subsequent ones. Such a hierarchy of learning steps in a subject is then a useful guide for the arrangement of the

new material and also for developing checks to see just where learning is breaking down (Fensham, 1972). Bruner (1960) also believed that prior knowledge is the foundation for subsequent learning, thus a curriculum should be organized in a spiral manner so that the student continually builds upon what they have already learned. He argued that the spiral curriculum helped the students to master knowledge by revisiting the same basic ideas of the knowledge repeatedly in different ways of learning depending on his/her readiness for learning. (Smith, 2002)

In the educational settings, current curriculum reflects those ideas. As a result, the curriculum is organized in a simple-to-complex, general-to-detailed, concrete-to-abstract manner so that students repeatedly learn the key concepts of science in a course as they move up from the lower grades to higher grades in schools. This helps students master certain prerequisite knowledge and skills. This prerequisite sequencing provides linkages between each lesson as student spirals upwards in a course of a study. As new knowledge and skills are introduced in subsequent lessons, they reinforce what is already learned and become related to previously learned information. What the student gradually achieves is a rich breadth and depth of information that is not normally developed in curricula where each topic is discrete and disconnected from each other.

In this sense, prior knowledge can be defined as the pre instructional knowledge that students have learned form the previous lessons. That is, prior knowledge is the foundation for subsequent learning that should be mastered before new information is to be taught. The teaching sequence should be designed on the basis of a detailed conceptual analysis of the science to be taught and students' typical preinstructional knowledge. Through this analysis, curricular goals can be identified and teaching activities designed and evaluated. (Leach & Scott, 2003). This definition suggests two ways for teachers to

use of the prior knowledge: “Readiness” and “Diagnostic” types of tests (Fensham, 1972) Before instructions begin, using the former, the prior knowledge that is assumed by the new material should be checked to find out the readiness of students to learn. And students who need extra attention to reach the common starting point with others should be noted. After a period of new learning has occurred, the latter are used to determine the success of learning by comparing the achieved knowledge to the prior knowledge.

What you already know usually helps one to learn, but it can also impair learning. This is especially so if prior knowledge, assumptions or beliefs are misleading, plainly incorrect, or otherwise incompatible with new information. Learners, thus may be susceptible to committing systematic errors if their interpretations of newly presented material is based upon faculty logic or knowledge. Besides being possibly misled, having an extensive knowledge base is not adequate to guarantee optimal learning. In 1929, Alfred Whitehead coined the term, inert knowledge, to reflect the fact that relevant knowledge is not always applied in the right situations (Barttett, 1932). Thus it is important to cue students’ knowledge base i.e. explicitly reference relevant concepts that are already known, to ensure transfer of learning across situations and contexts. Although many find advance organizers to a useful tool for teaching students new concepts when they do not have prior knowledge of a concept, there are those who feel that advance organizers are not beneficial, especially to students who have a good understanding of concepts and come with prior knowledge. Although it seems that advance organizers do not benefit these good students, they may benefit slower learners and those that do not have a wide knowledge of topics available to them.

2.2.8 Prior Knowledge and Learning

Educators often focus on the idea they want their learners to have. But research has shown that a learner's prior knowledge often confounds educator's best efforts to deliver ideas accurately. A large body of findings shows that learning proceeds primarily from prior knowledge and secondly from the presented materials (Roschelle, 1995). Prior knowledge can be at odds with the presented material, and consequently, learners will distort presented materials. Neglect of prior knowledge can result in the audience learning something opposed to the educator's intentions, no matter how well those intentions are executed in a lecture.

In an example presented by Lewis (1991), considering a hypothetical book on wool production in Australia. Australian ranchers raise sheep in an extremely hot desert climate. The sheep are raised to have wool so thick that without yearly trimmings the sheep would be unable to walk. To many children, these facts together are absurd. Children think wool is hot; if you put a thermometer inside a wool sweater, the mercury would go up. Wouldn't sheep grow more wool in cold places where they need to stay warm? Or is wool hot because the sheep absorb the desert warmth? These are likely questions that could confound the educator. To help make the most of a new experience, educators need to understand how prior knowledge affects learning. To the child who does not understand heat and temperature, no quick explanation can possibly resolve the contradiction between the hot desert and the warm wool; it takes weeks to years for this understanding to emerge (Lewis, 1991). Therefore prior knowledge also forces a theoretical shift to viewing learning as a "conceptual change" (Strike and Posner; West and Pines, 1985). The juxtaposition of this point of view creates a paradox, how can students ideas be both "fundamentally flawed" and "a means for constructing

knowledge?" the question cuts to the heart of constructivism. Constructivism depends on continuity, because, new knowledge is constructed from old. But how can students construct knowledge from their existing concepts if their existing concepts are flawed? Prior knowledge appears to be simultaneously necessary and problematic. This version of the learning paradox Bereiter, (1985) is called the "paradox of continuity" (Roschelle, 1991).

2.2.9 Misconception of Prior Concepts

Studies of students prior knowledge in science and mathematics began in the 1970's and have since produced a voluminous literature (see reviews in Confrey, 1990; McDermott, 1984; Eylon and Linn, 1988). Interest in prior knowledge began with the careful documentation of common errors made by students in solving physics and mathematics problems. Analysis of interviews with these students reveals that the errors are not random slips, but rather derive from underlying concepts. (Roschelle, 1995). For example, when students are asked to explain a toss of a ball straight up in the air, they describe the motion in terms of an "initial upward force" which slowly "dies out", until it is "balanced" by gravity at the top of the trajectory, physicists, in contrast, explain the ball toss in terms of a single constant force, gravity, which gradually changes the momentum of the ball. On the way upwards, the momentum is positive and decreasing; at the top, it is zero; and going down, the momentum is negative and increasing. From analysis of students' thinking researchers have determined that this "mistaken" explanation is not peculiar to this problem. Students commonly give explanations in terms of "imparting force", "dying out", and "balancing" (DiSessa, 1993). From these common sense ideas, students can generate endless explanations for different situations. in many cases these explanations disagree with conventional Newtonian theory.

After studies have established the existence of prior concepts, researchers investigated the consequences of those concepts for subsequent learning. Roschelle (1995) looked at the role of prior knowledge in a conventional science course. The results depended on the nature of the task used to probe students' learning. If the task is procedural calculation, students can often learn to get the right answers independent of their prior knowledge. However, if the task requires students to make a prediction, give a qualitative explanation, or otherwise express their understanding, studies show that their prior knowledge "interferes". DiSessa (1993), for instance, found students who were receiving an 'A' grade in freshman physics at MIT, but could not explain the simple ball toss problem correctly using idiosyncratic, non conforming understandings of the scientific concepts.

The prevalence of this effect has been widely documented. Halhoun and Hesteness (1985a and 1985b) found that 30% to 40% of physics students who pass freshman physics of various universities misunderstood the concepts. This also has been found at the elementary and secondary school levels across both western and non-western cultures around the world. Indeed, some researchers suggest that 30% to 40% of physics teachers at the secondary school level misunderstand physics concepts because of their prior knowledge.

2.2.10 Investigation of Students' Prior Knowledge

By tapping their students' prior knowledge in concerned subject areas, teachers can plan lessons that will: clarify incomplete or erroneous prior knowledge, determine the extent of instruction necessary in a particular topic area, and discern necessary

adjustments to planned independent activities and assessment materials. (Kujawa and Huske, 1995) Besides,

once students are asked to elicit their ideas about science phenomena, they have an opportunity to articulate and clarify their ideas and to be motivated to find the correct science views. Providing tools, activities and learning environments for representing prior knowledge can enable learners to reflect more systematically on prior knowledge. (Roschelle,1995) First of all, pretest can be used for tapping students' prior knowledge. However, the test should ask students to express their understanding, not factual knowledge and the ability of mathematical calculations. The questions that require students to make a prediction and give a qualitative explanation, uncover their prior knowledge. Second, concept mapping and graphic organizer have proved themselves an effective tool to uncover prior knowledge. (Fisher, 2004, Roschelle, 1995) Such visualizations help learners think about their thinking. Students can use "semantic networks" to map the associations among ideas before, during and after learning. Fisher (2004) reported that his computer program named Semantica was a useful tool for capturing a learner's prior knowledge. For students to effectively express their prior knowledge in Semantica, three conditions must be met. First, students must be generating knowledge from their heads, without reference to texts or other instructional materials. Second, they must feel free to express their thoughts, knowing they will not be graded with respect to scientific correctness. Third, they must be sufficiently familiar with the software so as to be able to express their knowledge effectively. Under these conditions, students are willing to include personal as well as objective knowledge.

A clinical interview (Posner & Gertzog, 1982; White, 1985) also can be used as a tool to probe a learner's prior knowledge. The interview usually involves a task in which

the learner manipulates some physical materials. Good tasks are simple and focus tightly on the concept at stake. Thus, a strange set of actions in the task readily indicates a different sensibility. The interviewer then probes the learner's understanding by asking questions about things the learner has said or done and avoiding leading questions. As the interview progresses, it is often helpful to ask the learner to consider alternatives to see how stable a particular concept is. A transcript of the resulting interview provides a great deal of detail about prior knowledge. (Roschelle, 1995)

Researchers in information processing theory have developed the technique of the think-aloud protocol (Ericsson & Simon, 1984; Simon & Kaplan, 1989), which collects information about a learner's problem solving process. The learner is trained to "think aloud" while they perform on a simple task, like addition. Thinking aloud means simply verbalizing the stream of consciousness, and not explaining or justifying actions to the interviewer. The interviewer does not ask questions, but merely prompts the learner to "say what you are thinking" whenever the learner stops talking. Then the learner is given the target problem-solving task, and recorded on audiotape. The resulting "protocol" can then be analyzed for evidence of the prior knowledge and differences in thinking processes (Robertson, 1990).

Prior knowledge exists not only at the level of “concepts”, but also at the level of perception, focus of attention, procedural skills, modes of reasoning and beliefs about knowledge. Glaser (1990) studied how students perceive physics problems and found they often notice superficial physical features, such as the presence of a rope, whereas scientists perceive theoretically-relevant features, such as the presence of a pivot point.

In summary, prior knowledge comes in diverse forms. It affects how students interpret instruction. While it may not prevent them from carrying out procedures

correctly, it frequently leads to unconventional and unacceptable explanations. Prior knowledge is active at levels ranging from perception to conception to beliefs about learning itself. Moreover, its effects are widespread through lay and professional population, from young children through to adults, and from low to high ability students.

2.3 Academic Achievement in Biology

Academic achievement is the measure of students' learning or acquisition of certain skills at the end of teaching and learning activities. Due to the importance of academic achievement in school programmes, various science educators gave their definitions of academic achievements. Marshall (1971) defined academic achievement as the extent to which a person has achieved something, acquires certain information or mastered certain skills, usually as result of planed instruction or training. Academic achievement is essentially applied to what an individual can do within a specific criterion domain. It is assessed by outcomes and improvement in the performance resulting from education. Achievement as defined by Chibio (2002) is what students are able to gain in the Senior Secondary School Certificate Examination (SSCE) after completion of the senior secondary education. Academic achievement, to Imo (1997) is seen as a situation where the nation expects the students to make their contributions to the society after they leave school. Science achievement according to Nnachi (2002) is a quantitative indication we have of the positive result of behaviour accruing from the study of science.

Achino (2000) considers achievement to be the level of an individual's educational growth in a test when compared with the scores of others of the same level. Academic achievement is seen by ldowu (1990) as a student's acquisition of knowledge in school subjects such as Mathematics, English, Science, Social Studies etc. in schools,

while Akindehin (1999) viewed academic achievement as what students have been able to gain at the end of a given period of instruction. Achievement of students in process skills acquisition has also been investigated over the years. Studies by Okebukola (1985) and Ogunleye (1996) have revealed that science students generally exhibit low acquisition of science process skills. It might be that teachers and students are not using the available resources in the environment effectively.

In this study, the concept of academic achievement is considered to the level of individual's education attainment as determined by comparing the average score with other of the same age or peer group.

2.3.1 Factors Affecting Academic Achievement in Biology

Despite the relative importance of science (Biology in particular) to National development it is disturbing to note that the students achievement in the subject at both internal and external examinations has remained consistently poor. (Agwagah 2001; Betiku 2001) also, the following researcher (Adeyegbe 1994; Nwosu 1994; Oloruntegbe), reported not only the downward trend in the performance (achievement) in science but also the results getting worse and the recipients getting progressively unscientific in their thought pattern and approach to solving problems, Poor academic achievements towards science have been reported in literature, Adeniyi (1995) and Nwagbo, (1997), Kuppuswamy (2002) noted that an important factor in creating lower levels of achievement is the fear of failure. This, according to him will haunt some students to the point where they will not be able to make use of what they have learned.

Okafor and Nwosu (2000) reported the vexed issue of large classes in science classrooms which has resulted in high teacher- student's ratio which speaks nothing but

student under —achievement in the subject. Education therefore should not only be concerned with the subject matter but has to be well rounded. Education should be so arranged to help the processes of student's development.

Achievement in students is influenced by the human resource factors according to Kuppuswamy (2002). This implies that the fear of examination and the subject being examined may be uninteresting due to dislike for the teacher. This leads to failure to recall the knowledge acquired. The students may have the ability but unable to achieve due to lack of adequate application of method. For the student to be able to perform as well as his ability permits, it is necessary that the teacher apply all necessary method at his disposal. Ali (1989) indicated that the most important factor in the choice of goals and expected level of performance is the child's self concept. According him when achievements fall far short of the learner's expectations the learning process is disrupted. Britell (1999) concluded that in a large class, change is minimal among the students. On issues of factors that determine achievement researchers notably, Nicholas (1994) and Coleman (1966) have identified such factors to include the following:

a. Students show higher levels of overall achievement when teachers spend large amount of the time in direct teaching of reading, mathematics science and social awareness.

b. Secondly student's personal feeling of self — directed competence was one of the most important factors in determining achievement

Ashilley (2001) considered a number of variables to have influence in determining student's academic achievement. These include social class differences, race, pupil, teacher, and ratio, the number of books in the library and even the educational background of the teachers. Hillea (2002) said that academic achievement depended most

heavily on students' personal conviction of being in charged of their own fate in the learning situation.

In some of the above studies, attitude towards science, large class size and the set of feelings and cognition about oneself are some of the factors that affect academic achievement. How these factors affect achievement has not been fully explained, therefore the results on factors affecting academic achievement are not conclusive. This study attempts to find out how they use of advance organizers can improve the academic achievement of students in biology class.

2.4 Genders- Related Differences In Academic Achievement In Biology

Gender issues in science and in particular Biology; have been the concern of many educators and series of researches have been going on this area. There has been differences in learning between males and females some instructional strategies promote learning more in males than in females, although Ausubel advocates that advance organizers is effective in promoting learning and retention this research intends to find out if it truly promotes learning more in males than in females. Some researchers Aigbomian (2002) Njoku (2007) reported that boys perform better than girls in Science, Technical and Mathematical subjects. Isa (1992) reported that boys and girls exposed to more practical activities do not differ significantly which implies that gender does not affect students academic achievement when exposed to intensive practical activities in integrated science. In support some other studies like lnomiesa (1984), Eya and Mogbo (1997) cited by Uhmuavbi Oriahi and Olusi (2003) show that sex plays no significant role in performance and achievement in Science, Technology and Mathematics. Nwawu and Audu (2005) in the same vein agreed, that, the number of women enrolment in tertiary

education has increased at a slower rate than male enrolment. Nwawu and Audu (2005) viewed that gender gap in education to be at its highest with male enrolment at least three times higher than female. More so, girls and women tend to enroll in humanities and found to be under represented in science subjects and mathematics where male and men dominate. This development perhaps has resulted from the fact that girls still have the difficulty of understanding the physical sciences notably, physics as observed by (Aigbomian 2002) . Freeman (1966) reported a highly significant sex differences and extrasensory perception between secondary school boys and girls. Sigel (1963) pointed out that studies on cognitive processes showed no significant difference between males and females. Sigel observed that boys and girls may obtain similar end results by different routes. This was supported by Strange and Palmer (1963).

Foely (1953) found that in commonly used tests , sex differences in scores are slight but verbal tests do tend to favour girls, whereas numerical and spatial relation test tend to favour boys in intellectual functions. Amthaver (1963) also reported difference in achievement when he subjected three groups of secondary school boys and girls to twenty three psychological tests selected from their geometrical space and reasoning factor content. Usually in strategies of commonality and conservation method of solving problems, girls were found to be inferior to boys (Togatr 1967) Maier and Burke (1967) concluded that women were more prone to certain distracters and this subsequently reduces their achievement in test involving problem solving. In problem solving, Hoffman and Maier (1961) found differences in achievement. Haffman et al observed that problems are solved markedly more often by men than women when the individual is working alone. More so, in group situations, males were significantly more successful

than female in using discussion method to reach a solution Hoffman and Maier (1961) also observed that women did better in mixed groups than in all — female ones.

Miller 1983) and Nworgu (1988) reported significant gender differences in performance and achievement in science and related tasks in favour of the males. Miller (1983) attributed his results to historical gender stereotype of science as a male realm; while Nworgu (1988) attributed the significant gender differences to gender by content area interaction in science achievement. This implies that the male are more inclined to science than females. Nwagbo (2002) reported female science as much as their male counterparts but lagging behind in knowledge, application anti communication in science.

Bennie (2001) in line with Miller (1983) claimed that gender stereotyping which assigns science as male domain is a major cause of female low participation in science. Okeke (2001) agreed that this may have also contributed to the poor enrolment and achievement of girls in science and technology in tertiary institution. Lassa (1996) reported illiteracy rate in Nigeria to be quite high and it has found to be even higher for girls than for boys. For instance by 1990 the female literacy rate in Nigeria was 39.5% compared to 62.3% for males Nwagbo (2002) in addition to low achievement in chemistry has highlighted lack of commitment to the demands of science as a way of life, societal expectations and socio-cultural practices.

Olajide (1982) Using multiple questions to investigate the influence of some factors on the achievement of form 5 students in Biology test reported that there was no sex difference in students' performance. Adebayo and Adams (1983) in an attempt to establish the impact of sex and school types in the biology of 150 form 5 students used 50 multiple choice questions. Their results showed no significant difference in boys and

girls' scores. Daramola (1983) investigated the influence of location and sex difference on the knowledge of basic physics possessed by entering SS Ill students in Kwara State Secondary Schools. Daramola administered a basic physics test to the students whose total sample of boys and girls were 172 entering SS III. The results obtained revealed no significant difference in male and female students scores. Kahle and Lakes (1983) reported that there is no significant difference in the achievement of both boys and girls in science. Researches carried out by (Okonkwo 1983; Oyekan 1986; and Ogunboyede 2001) have also shown the difference between the cognitive structure and gender of students.

Ogunboyede (2003) on the study of sex difference and student achievement, at the primary school level indicated that boys are not better than girls in terms of educational achievement. Development of sex differences as seen from the foregoing discussion is intricately facilitated and intervenes with the gradual process of socialization in many families, peer group and age grades, religious institutions schools and mass media. Thus sex difference according to Scott —Jones and Peebles —Wilkins (1986) connotes the acquisition of distinct sex roles for boys and girls. Gender related difference in science education is a global phenomenon as it affects developing countries, Symmonds (1998) for instance reported that in a sub Saharan subsistence farming area of Africa, there was no tradition of education for girls. Girls are rather restricted to gender stereotyped functions in the home Aguokagbua (1997) in citing Tendai (1977) in the same vein reports the educational situation in Zimbabwe where women are encouraged to start work early and discouraged from going beyond grade seven and from taking to the study of sciences. Macdonald (1999) also noted that there is a great decline in the tiny number of girls choosing to study science Johnson and Bell (1987) warned against the danger of

girls not only limiting their educational experience but also in the process of closing the door to many future occupational opportunities. The different literatures cited have showed some sex differences with respect to achievement. In conclusion most people feel that females are poor academically therefore, they should not waste limited funds on them. However the use of advance organizers can slightly if not averagely improve their academic performance as this research may show.

2.5 Retention in Science Teaching

Retention is defined by Kundu & Tutoo (2002) as a preservative factor of the mind. The mind acquires the materials of knowledge through sensation and perception. These acquired materials in the mind need to be preserved in form of images for knowledge to develop. Whenever a stimulating situation occurs, retained images are revived or reproduced to make memorization possible. Hence ecology concepts need to be presented to the learners in a way or method that touches their subconsciousness which can trigger quick recalling of the concept being taught or learnt. There is the need that the science concepts which the students learn should be retained. Retention of concepts learnt would help in reflective thinking and the use of the retained concepts be used in creative way to solve novel problem. In the light of this Ochonogor (1997) had said that in depth retention and achievement in science; technology and mathematics is an important need that is becoming highly felt by the Nigerian populace. Taylor, Davis, Sluckin, Kee and Reason (1970) noted that the way children learn and perceive are reflected in retention scores, and that what is imperfectly registered cannot be perfectly retained.

2.9.1 Factors Influencing Retention of Learnt Concepts in Biology

Retention could be referred to as the act of recalling what he has stored in the memory. The condition between which the time a learner acquires and the time he remembers is referred to as retention (Abraham, 1985). The ability of a learner to remember things learned at a later time is retention and this occurs when information is coded with the memory (Oyedekun, 1998).

The level of retention is determined by the nature of material coded. Psychologists have not yet discovered the nature of the physical changes that presumably embody retaining – the so called memory traces of the Nervous Systems (Abraham S. 1985). According to the writer, since these infinitesimal rearrangements cannot be detected retention can be studied by measuring the rate at which it declines. Retention can be influenced by some factors such as retroactive inhibition – this is described as the interference of confusion of present learning by subsequent learning. It is explain as a situation when two learning situations involve similar associations. The objective aim of education and learning is to have a meaningful learning. The concern of most if not all teachers are to improve the retention of their students. The idea of forgetting cannot be completely ruled out but could be lessened by the use of concrete objects. There are various factors contributing to retention in students. Proactive and retroactive inhibition proactive inhibition results from already registered facts interfering with new idea. On the other hand retroactive inhibition means working backwards to block something else. Motivation of students by teachers can also enhance retention.

Retention level in relation to age has been investigated by some researchers Cross (1974) as cited in an unpublished thesis reported that retention increases from infancy

through teenage years by slow recession in middle age to old age. Thinking styles of individuals have also been studied in relation to retention; fast learners are seen as superior in both short and long term memory. Small class size also leads to high grade retention (Harvey, 1993). According to a report from a dissertation study conducted from "STAR" data, Harvey concluded that fewer students were retained in small classes and were passed to next grade with wider range of scores. It therefore demonstrates that small classes benefit students and gives the possibility of placement as an alternative to grade retention.

2.6 Review of Related Empirical Studies

The overview of related studies on the effects of advance organizers looked at Ausubels theory of meaningful learning. The over arching idea in Ausubel's theory is that knowledge is hierarchically organised; that new information is meaningful to the extent that it can be related or anchored to what is already known. Ausubel's theory is not particularly in vogue, perhaps because he seems to advocate a fairly passive role for learners, who recieves mainly verbal instruction. Various studies were reviewed on the use of advance organisers some of the reviewed studies include that carried out by Stone (1983) which reported findings which supported facilitative effects but failed to support number of other predictions of the subsumption theory. In other study carried out by Lin and Chen (2007), they compared the effects of different types of computer-generated visuals (static versus animated) and advance organizers (descriptive versus question), In enhancing comprehension and retention of a content-based lesson for learning English as a foreign language. The results showed that the animation group outperformed the static visual group in one of the four tests, and that animation embedded with a question advance organizer had a marginal effect in enhancing comprehension and retention. In

their meta-analysis of 55 experimental studies Nesbit and Adesope concluded that there is a general positive effect of graphic advance organizers i.e. knowledge and concept maps in facilitating knowledge comprehension and retention, with effect sizes varying from small to large depending on how the organizers were used and on the type of comparison treatment. Bulggren and Schumaker (2006) described 19 studies on advance organisers. The 19 studies reported uniformly positive results, interpreted both statistically and clinically, leading the authors to conclude that advance organizers can substantially improve the learning of adolescent students with learning disabilities, low achieving students, and average achieving students.

In a study carried out by Nyabwa (2005), the study demonstrated the effectiveness of using advance organizers in the teaching of mathematics in secondary schools. Their merit in facilitating meaning learning of expository materials has been recorded by Allen (1970); Lawton and Wagnaka (1977); White and Tishe (1986) who presented evidence suggesting that students who lack prior knowledge are most likely to benefit from the use of advance organizer. Weil and Murphy (1982) asserts that the use of advance organizer is a highly effective instructional strategy for all subjects areas where the objective is to achieve meaningful assimilation of concepts. Further more in another study carried out by Willerman and macHenry (1992) who investigated the effects of advance organizers on students conceptualizations of pollution in biology. The findings of the study revealed that students are not passive subjects in learning process if they use concept mapping as advance organizers.

Also from a study carried out by Balyun (2009) on the effects of advance organizers on learning and retention from a fully web based class, found out that students with advance organizers perform better than students without advance organizers, from

the same study it was also found out that advance organizers effect is as great in longer studies than in shorter studies and that graphic advance organizers are more efficient than text advance organizers. In a similar study carried out by Balyun and Astusi (2009) on the effects of advance organizers on learning for differentiated learners in a fully web based course, they found out that students of low ability using an advance organizers achieved higher learning outcomes in short term and long term knowledge based or performance based assessment. In another research carried out by Lenz and Alley (1983) on the effect of advance organizers on the learning and retention of learning disabled adolescents within the context of a co-operative planning model. The result of the investigations support the postulation that advance organizers can exert a positive influence in the performance of learning disabled adolescents.

In conclusion various studies were reviewed on advance organizers and generally the efficacy of the use of advance organisers has been equivocal at best.

2.7 Implication of the Literature Reviewed on this Present Study

Relevant literatures have been reviewed and findings from the literature review indicate that there is no clear cut agreement on the effectiveness of advance organizers on learning. While some researches indicate that advance organizers enhance and promote learning others conclude that it has no effect on learning.

This research will attempt to use different types of advance organizers during the course of instruction and will strictly be consistent with Ausubel's theoretical position. Which include that advance organizers are not designed for day to day use; instead, they are used to provide a structure at the beginning of a major unit of study. Therefore when advance organizers is designed for this research it is designed in such a way that it

provides a structure for students thinking, not just a structure for lessons. In this way, students are engaged in active learning, adding to the other potentially passive activeness that are offered in the classroom

CHAPTER THREE

METHODOLOGY

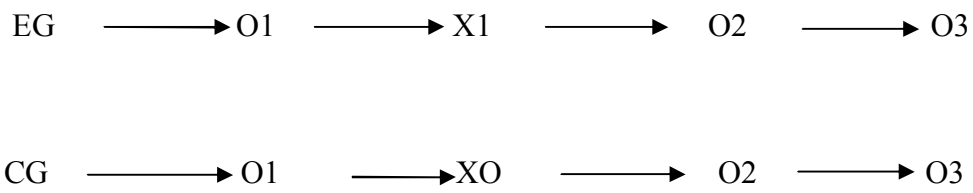
3.1 Introduction

The focus of this study is to investigate the effect of the use of advance organizers on the academic performance and retention in of SSI students in biology. The focus of this chapter is to examine the methodology used in conducting the study. Specifically, the chapter is presented under the following sub-headings.

3.2 Research Design

The research design employed in this study is the pretest, post test, quasi-experimental design. The samples were grouped into two, the control group and the experimental group. The control group (X2) were taught with lecture method only while the experimental group (X1) were taught with advance organiser and lecture method. The Ecological Concept Achievement Test (ECAT) was administered to the sample as pretest, before treatment to determine their equivalence in ability. Secondly the scores from the

pretest was used to place the students in the same prior knowledge range. This was to make sure that all the students used for the study had the same prior knowledge level regarding the concepts to be taught in ecology. The same test was administered as posttest and post-posttest. The design illustration of the study is represented figure 3.1



Adopted from Kerlinger (1973)
Figure 3.1 Research Design Illustration

keys

X1: use of Advance Organiser with Lecture method (Treatment)

XO: Use of Lecture method only (Control)

O1: Pretest Administration

O2: Posttest Administration

O3: Post-posttest Administration

EG: Experimental Group

CG: Control Group

3.3 Population of the Study

The target population for this study was the entire government senior secondary I students of Giwa Educational zone who are offering biology. There are 13 senior secondary schools in Giwa educational zone. 11 are co-educational and 2 are single sex. 4680 of the students are males and 5310 are females which bring the total number of students to 9990. The description of the population is presented in table 3.1

Table 3.1 Population for the Study

School	Boys	Girls	Total
GSS Fatika	450	320	770
Dr. S.L. GGSS Giwa		1500	1500
G.S.S Basawa	700	630	1330
G.S.S Giwa	640	520	1160
MAISS Giwa	320	400	720
G.S.S Jama'a	520	350	870
G.G.S.S. (Snr) Samaru		530	530
G.S.S. (Snr) Hunkuyi	340	280	620
G.S. Yakawada	220	150	370
G.S.S (Snr) Kudan	420	205	625
G.S.S.S. Iyatawa	250	120	370
G.S.S. Gangara	230	160	390
G.S.S. Kwangila	550	350	900
Total	**4680**	**5310**	**9990**

Source: Giwa Inspectorate Division 2010/2011

3.4 Sample and Sampling Technique

Two out of the 13 senior secondary schools were randomly selected by sampling using the balloting method. The SS1 students were selected for the study because there syllabus contains basic ecology concepts to be taught. The two schools randomly selected were Government Secondary School Basawa with an SS1 population of 300 students and

Government Secondary School kwangila with an SS1 population of 250 students. An intact class from each school selected was obtained by sampling method using draw from the hat method. A sample size of 145 students of approximately about 20% of the population of 550 SS1 students offering, biology was used as a sample for the study in accordance with (Roscoe, 1975). The details of the sample is presented below.

Table 3.2 Sample for the Study

School	Group	Boys	Girls	Total
G.S.S Bassawa	Ex	52	23	75
G.S.S Kwangila	Control	48	22	70
Total		**100**	**45**	**145**

The above table represents the two schools sampled for the study. They are both co-educational each with intact classes of a population of 75 students for G.S.S Bassawa and 70 students for G.S.S Kwangila and they represent about 20% of the senior secondary one students of the population sample.

3.5 Instrumentation

The instrument that was used for this study in generating data is the Ecology Concept Achievement Test (ECAT). This was adapted by the researcher by selecting ecology questions from past question papers of the West African Examination Council (WAEC) 2004-2009, School Certificate Examinations, to find out the extent to which students understand Ecology concepts taught in the SSI syllabus. The achievement test items were drawn from selected topics taught in ecology from past question papers of the West African Examination Council (WAEC) 2004-2009, School Certificate Examinations, because of their high level of validity and reliability. The ECAT consisted

of 25 multiple choice biology test items with four options from which the students will select the correct answer. The test items of the ECAT covered all the topics taught for the duration of the research

To ascertain the internal consistency of the ECAT items; a pilot version of the test was administered to 30 SSI students in a school other than the ones that was used in the study. The ECAT items were used on three different occasions.

- First, as pre-test, to determine the strength and equivalence of the sample at the begining of the study.
- Second, as post-test, to assess the performance of the students after the treatment.
- Thirdly, as post-posttest, to determine the level of retention of learnt concepts.

3.5.1 Validation of Instruments

The Ecological Concept Achievement Test (ECAT) was validated by two senior lecturers teaching science Education at Ahmadu Bello University, Zaria and three senior secondary school biology teachers. The validator's qualifications where degree holders in biology education and P.hD in science education. They were asked to:

a. study the items and certify if the questions were considered to be testing the achievements they were meant to test.
b. Certify if they are appropriate for the level of students for which it is intended
c. check for possible errors in the suggested answers.

For an item to satisfy the requirement of content validity, it must enjoy the unanimous agreement of all panel members in respect of each purpose. Discrepant items were re-written or dropped. In the final analysis, twenty five (25) items found suitable were

compiled and pilot-tested in order to further ascertain the suitability of the instrument. Based on the result of the pilot study, 25 items were selected for the final test of Ecology Concept Achievement test (ECAT) see Appendix B for the test items and table of specification.

3.5.2 Pilot Testing

To ascertain the internal consistency of the ECAT items; a pilot version of the test were administered to 30 SS1 students in a school other than the ones that was used in the study. The aim of the pilot study was to determine the characteristics of the test items which include`e their facility and discrimination indices and the reliability coefficient. The result of the pilot study were used to ;

1 assess the clarity of the items of the ECAT.

2 calculate the reliability coefficient of the ECAT. Also the facility and difficulty indices was determined using the scores of the students.

Pretest Administration for the Samples: pretest was carried out using the instrument for the study, which is ECAT. The pretest was done to determine equivalent on the comparability level of the ability of the study subjects.

3.5.3 Reliability of the Instrument

To determine the reliability of the instrument, a test-retest method was employed. The first test was given to students of a school that did not form part of the sample used for the study. After a 2 weeks interval, the second test was administered to the same students in line with Tuckman's (1975) recommendation on the use of two weeks interval for the test- retest method. Pearson Product-Moment Correlation Co-efficient statistic was used to analyze the reliability of the instrument, Based on the data obtained from the

pilot testing of the instrument, reliability co-efficient was found to be r = 0.75. This shows that the instrument is reliable and could be used for the study.

3.5.4 Item Analysis of ECAT

Item analysis was carried out on the scores obtained from the pilot study to determine the facility and difficulty indices of the items in the ECAT. The facility index (F1) of a test according to wood (1990) is the percentage of the students that got an item right. It is determined by using the formula:

$$F1 = \frac{R}{T}$$

Where R = number of correct responses

T = total number of students

Inyang (1988) and Usman (2008) recommended values within the range of 0.3 to 0.7 for good test item item values in assessing achievement. For the present study 0.3 to 0.7 was chosen.

The 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 calculation was done using the scores of the top twenty seven (27%) and bottom twenty seven (27%) of the total respondents. This was calculated using the formula given by (Furst in Olorukooba, 2001).

$$D1 = \frac{Ru - Ri}{1/2N}$$

Where D = discrimation index

Ru = number among upper 27% of respondents

Ri = number among lower 27% of respondents

N = total number of respondents

The discrimination index which ranges between 0.3 and 0.7 is regarded as moderately positive and is accepted for the present study. This was used in selecting the final items of the ECAT.

3.6 Administration of Treatment

The administration of the treatment was done by the researcher to remove any nature of biasness. During the period of administration of the treatment, the experimental group were presented with advance organisers two days before they received lecture, the type of advance organizer used was the expository advance organizer. The presentation of the advance organiser was in line with the model adopted from Stone, Weil and Calhom (2000) which has three phases of activity:

Phase I: The first phase includes presentation of the advance organizer. This is shortly before each lesson. This is to:

- Clarify the aims of the lesson
- Prompt awareness of relevant knowledge

Phase II: The second phase includes making links to the organizer. This is done during the lesson by:

- Presenting the learning task or learning materials.
- Making organization and logical order of learning material explicit.

Phase III: The third phase includes Strengthening of the cognitive organization. This is done after the presentation of the lesson. This includes

- Integrative reconciliation and active learning. Example the teacher can ask learners to make summaries, to point out differences, to relate new examples with the organizer.
- Elicit critical approach to subject matter that is to have students think about contradictions or implicit inferences in the learning material or previous knowledge.

The control group was taught using only lecture method. After six weeks of treatment (the lesson plan used is seen in appendix F) a post-test was administered to both the experimental and control groups. A post post-test was administered after a period of 3 weeks to determine their level of retention. The data collected were used to answer the research questions and test the hypotheses formulated in chapter one.

3.7 Data Collection Procedure

The ECAT items were administered to the samples of the two schools in their classrooms; first as pretest. The test was administered by the researcher for a duration of 40 minutes. After a 6 weeks period of instruction by the researcher, the ECAT item was then administered to the 2 groups in the form of an examination as a post-test which lasted for 40 minutes. The ECAT items was then graded by the researcher and the scores used as data to test the hypotheses. After 3 weeks duration a post-posttest was administered by the researcher to find the retention levels of the students. The data obtained were used to test the hypotheses on retention ability of the students.

3.8 Data Analysis

The data collected will be subjected to inferential statistical analysis, using the Statistical Package for Social Sciences (SPSS). On the basis of this, the most appropriate statistic to be used for testing the following hypothesis and level of significance will be as follows:

H_{01}: There is no significant difference between the mean scores of students taught ecology concepts using lecture method and advance organizers and those taught with only lecture method only. t- test statistics will be used, at a level of significance for the rejection and retention of the hypothesis set at $P \leq 0.05$.

H_{O2}: There is no significant difference in the retention ability of students taught ecology concepts using lecture method and advance organizers and those taught with lecture method only. t- test statistics will be used, at a level of significance for the rejection and retention of the hypothesis set at $P \leq 0.05$.

H_{03}: There is no significant difference in the performance between male and female students taught ecology concepts using advance organizers. t- test statistics will be used, at a level of significance for the rejection and retention of the hypothesis set at $P \leq 0.05$.

H_{O4}: There is no significant difference in the retention scores between males and females taught ecology concepts using advance organizers. t- test statistics will be used, at a level of significance for the rejection and retention of the hypothesis set at $P \leq 0.05$.

CHAPTER FOUR

ANALYSIS, RESULTS AND DISCUSSIONS

4.1 Introduction

This study was carried out to investigate the effect of advance organisers on students performance and retention of ecology concepts in secondary schools in Giwa educational zone. The analyses and results of the data collected were analysed using the Statistical Package for Social Science (SPSS) and the level of significance adopted for rejecting or retaining the stated hypotheses was set at $P \leq 0.05$.

4.2 Data Analysis

For the purpose of data collection, the Ecology Concept Achievement Test (ECAT) was used to measure the subject performance in the pre test, post test and post posttest for the experimental and control groups. The data that were obtained in the course of the study were:

1. Performance scores from pretest for both experimental and control groups
2. Performance scores from post test for both experimental and control groups
3. Performance score from post- posttest for both experimental and control groups

4.2.1 Hypotheses Testing

The data collected from scores as described in 4.2 above were used to test the stated hypotheses using t-test statistics. The results are presented in tables 4.1- 4.3

4.2.2 Comparism of the Academic Performance of the Experimental and Control Groups.

Null Hypothesis 1

H_{01}: there is no significant difference in the mean scores of students taught ecology concepts with advance organisers and those taught without advance organisers. To test this hypothsis the posttest scores of the experimental and control groups were compared using t- test statistics. Table 4.1 shows the results obtained.

Table 4.1 t-test Analysis of the Mean Scores of Experimental and Control Groups in the Posttests.

Variable	N	X	SD	SE	Df	t-cal	p-value	Remarks
Experimental	**75**	**9.76**	**1.97**	**.22**				
					143	**6.32**	**.000**	***S**
Control	**70**	**7.94**	**1.42**	**.17**				

*Significant at P≤ 0.05.

From the result shown in table 4.1, the p-value is .000 at P≤ 0.05 level of significance, with the experimental group having a higher mean tnan the control. There is therefore a significant difference between the experimental and control groups because the calculated p- value of .000 is less than the 0.05 level of tolerance. The null hypothesis of no significant difference between the academic performance of the experimental and control groups is rejected. The result obtained thus shows that teaching

with advance organisers is more effective in enhancing students performance in ecology concepts than without the use of advance organisers.

4.2.3 The influence of Advance Organisers on Retention of concepts Taught in Ecology

H_{02}: There is no significant difference between the stdents' retention level of ecology concepts taught using advance organisers and those taught without advance organisers. To test this hypothesis the post- posttest mean scores of the ecology concept achievement test of the experimental and control groups were subjected to t-test statistics. The result is shown in table 4.2

Table 4.2 t-test Analysis of the Mean Scores of Experimental and Control Groups in the Post- Posttest

Variable	N	X	SD	SE	Df	t-cal	p-value	Remarks
Experimental	**75**	**9.08**	**1.98**	**.22**				
					143	**5.62**	**.000**	***S**
Control	**70**	**7.50**	**1.30**	**.15**				

*Significant at P≤ 0.05.

The result from table 4.2 shows that there is a significant difference between the mean scores of the experimental and control groups as the calculated p-value of .000 is less than the 0.05 level of tolerance chosen. This shows that the retention level of the

subjects taught using advance organiser is significantly higher than those taught using lecture method only. The null hypothesis of no significant difference is therefore rejected.

4.2.4 Test for Gender-Related Difference in the Mean Scores of Male and Female Students in the Expeimental Group

H_{03}: There is no significant difference in the mean scores of male and female students taught ecological concepts using advance organisers. To test this hypothesis the posttest mean scores of the male and female students were subjected to t-test statistica analysis. The result is shown in table 4.3.

Table 4.3 t-test Analysis of Posttest Mean Scores of Male and Female Students Exposed to Advance Organiser

Variable	N	X	SD	SE	Df	t-cal	p-value	Remarks
Experimental	**52**	**9.53**	**2.01**	**0.27**				
					73	**-1.03**	**0.305**	**NS**
Control	**23**	**10.08**	**2.35**	**0.49**				

The results from Table 4.3 shows that the p-value is 0.305 at $P \leq 0.05$ level of significance. The result showed that there is no significant difference between boys and girls mean scores because the calculated p-value of 0.305 is greater then 0.05 level of tolerance chosen. The null hypothesis of no significant difference is therefore accepted.

4.2.5 Test for Gender Related Difference in Retention of Male and Female in the Experimental Group

H_{04}: there is no significant difference in the retention scores between male and female students taught ecology concepts using advance organisers. To test this hypothesis the post-posttest mean scores of the ecology concept achievement test of the experimental group was subjected to t-test statistics. The result is presented in table 4.

Table 4.4 t-test Analysis of Post-Posttest Mean Scores of Male and Female Students Exposed to Advance Organisers

Variable	N	X	SD	SE	Df	t-cal	p-value	Remarks
Experimental	**52**	**9.28**	**1.98**	**0.27**				
					73	**1.12**	**0.264**	**NS**
Control	**23**	**8.73**	**1.86**	**0.38**				

The results from Table 4.4 shows that the p-value to be 0.264 at $P \leq 0.05$ level of significance. The result showed that there is no significant difference in retention between boys and girls mean scores because the calculated p-value of 0.264 is greater then 0.05 level of tolerance chosen. The null hypothesis of no significant difference is therefore accepted.

4.3 Summary of Finding

The findings of the study are as follows

- There is a significant differrence in the posttest mean scores of the experimental and control groups in favor of the use of advance organisers.
- There is a significant difference in the post-posttest mean scores of the experimental group
- There is no significant difference in the mean scores of male and female students of the experimental group.
- There is no significant difference in the retention mean scores of male and female students of the experimental group.

4.4 Disscusion of the Results

The objective of this study was to investigate the influence of the use of advance organisers on the academic performance and retention of ecology concepts in Senior Secondary School Students in Giwa Educational Zone. For ths purpose the Ecology Concept Achievement Test was used to collect data on there performance. The data collected were analysed using the t- test statistics at $P< 0.05$ level of significance, to test the hypothses formulated. The results are discussed below.

Null Hypothesis One:

The result of testing hypothesis one showed a significant difference in the posttest performaance mean scores of the experimental and control groups. The experimental group achieved significantly higher than the control group in the posttest scores (table

4.1). The significant difference in favour of the experimental group suggests that, use of advance organisers enhance learning of biology concepts. One of the reason for the observed difference is that advance organisers can be as anchoring devices for enhancing learning, hence students can have better comprehension. Secondly the observed difference could be as a result that advance organisers provides a stable cognitive structure that enhances anchorage of new materials and leads to meaningful learning. Another reason for the observed difference could be that the advance organiser serves as a subsuming bridge between prior knowledge and incoming new knowledge which therefore aids assimilation of new knowledge. The results is in accordance with the findings of Lin and Chen (2007) who found out that the use of different types of computer- generated visuals and advance orrganisers enhances comprehension and retention. The result is also supported by the findings of Nesbit and Adesope (2006), who concluded that there is a general positive effect of graphic advance organisers that is knowledge and concept maps in facilitating knowlegde comprehension and retention.

Null Hypothesis Two

The result of hypothesis two which states that there is no significant difference in the retention level of the subjects taught ecology using advance organisers and those taught without shows that there is a significant difference in the post-posttest mean scores of the experimental group. The experimental group had a higher or better retention of concepts taught than the control group. This showed that the advance organisers presented to the experimental group enabled them to retain the ecology concepts taught. information is more effectively retained when it is fitted into a system of mutually supporting ideas. Learners who have well-organized cognitive systems tend to efficiently retain

information. On the other hand, learners who have poorly organized cognitive systems tend to rapidly forget information. It is largely by strengthening relevant aspects of cognitive structure that new learning and retention can be facilitated. This could be that the advance organisers allowed concepts to be properly anchored in the cognitive structure. When concepts are properly anchored students do not only recall concepts learnt easily, such concepts are meaningfully learnt and could be applied to solve problems. Advance organisers helps to aid memory recall resulting in higher performance of the students. This is supported by Davis, Sluckin, Kee and Reason (1970) who noted that the way that the children learn and perceive are reflected in retention scores, and that which is imperfectly registered cannot be perfectly retained. Also Kundo and Tutoo (2002) are of the view that how well students retain taught concepts in mathematics can be traced back to the teaching approach used.

Null Hypothesis Three

Hypothesis three states that there is no significant difference in the mean score of male and female subjects taughts ecology concepts using advance organisers. The results showed that there is no significant difference in the performance of males and females taught with advance organiser, that girls actually performed sligthly better than boys supports what Ogunboyede (2003) found out on the study of sex difference and subject achievement that boys are not better than girls in terms of educational achievement. We can conclude that one of the reason for the observed difference is that girls are more subceptable to the use of advance organiser than boys, and that advance organiser is gender friendly

Null Hypothesis Four

Hypothesis four states that there is no significant difference in the retention ability between mean scores of male and female subjects taught ecology concepts using advance organisers of the experimental group. This result showed that there is no significant difference in the retention ability of males and females taught with advance organisers, the hypothesis of no significant difference is therefore accepted. Girls slightly retained better than boys and this supports Ogunbayede (2003) who found out that in subject achievement boys are not better than girls. The learning habit that triggered this outcome could be because girls are more perceptive than boys when learning ecology concepts taught with advance organizers, therefore they can retain better. With regards to the use of advance organisers in this research we can conclude that use of advance organisers helps girls retain more concepts in ecology than boys considering that hypothesis three supports advance organiser as being gender friendly.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The study was carried out to find out the effect of the use of advance organisers on the academic performance and retention of Senior Secondary School Students Performance in ecology concepts. The data collected were analysed the mean and t- test statistics. This chapter is presented in the following sub heading;

5.2 Summary of the study

5.3 Major findings

5.4 Conclusion

5.5 Recommendations

5.6 Limitations of the Study

5.7 Suggestions for further Study

5.2 Summary of the Study

This study is an investigation into the use of advance organisers and the influence it has on the academic performance and retention of ecology concepts among Senior Secondary School Students in Giwa Educational Zone. An adopted model of the advance organiser of Stone, Weil and Calhom (2000) was used to enhance the performance and retention in ecology. 145 students were used for the data collection. The study involved teaching with an advance organiser, as the treatment in an attempt to compare the performance and retention in ecology concepts of students taught ecology concept with the use of advance organiser and those taught with lecture method and lecture method.

The concepts selected for the study were from topics form Basic Ecological Concepts, Ecological factors and functioning ecosystem. Four null hypotheses were stated and tested. Ecology concept achievement test made up of 25 multiple choice questions were used to measure performance and retention of ecology concepts by students after treatment

The data collected from the achievement test was analysed using t-test statistics to test the stated hypotheses. The results and discussion are reported in chapter four. The finding revealed the following:

i. There is a significant difference between the mean academic performance scores of students taught using advance organisers and those taught using lecture method of in ecology concepts in favour of the experimental group (i.e taught using advance organisers)

ii. There is a significant difference between the retention mean scores of students taught ecology concepts with advance organisers, and those taught using lecture method in favour of the experimental group.

iii. There is no significant difference in the mean academic performance scores of male and female students taught ecology concepts using advance organisers.

iv. There is no significant difference between the retention mean scores of males and females taught ecology concepts in the experimental group

5.3 Major Findings

i. There was a significant difference between the posttest mean scores of the experimental and control groups in favour of the experimental group.

ii. The retention level is significantly higher for those taught using ecology concepts than those taught using lecture method alone. However there was no significant difference in the retention level between males and females taught ecology concepts using advance organisers.

iii. There was no significant difference in the academic performance of male and female students who were taught using ecology concepts.

5.4 Conclusion

- The use of advance organisers enhance performance in ecology concepts in senior secondary schools.
- Advance organizers promote meaningful learning and retention of ecological concepts in learners at secondary school level.
- The use of advance organizers is gender friendly as it promotes meaningful learning of concepts, retention and academic performance of both genders.

In conclusion, advance organisers has the potential of enhancing Senior Secondary School Students academic peerformance in ecology concepts, particularly at helping female students perform better. We can therefore assume that the use of advance organiser apart from enhancing performance and retention is also gender friendly.

5.5 Recommendations

From the findings of this study, the following recommendations are made:

1. The study found the use of advance organisers effective in enhancing meaningful learning in ecology, thus teachers should be encouraged to use advance organisers in teaching ecological concepts where prior knowledge is lacking.

2. Professional associations such as Science Teschers Associations of Nigeria (STAN), and research centers like Nigerian Educational and Research Development Council (NERDC) should develop advance organiser packages that teachers can use to bridge the gap between prior knowlegde and new material to be learnt. Also the STAN and NERDC should train teachers on how to design advance organizer and use it in the classroom to promote meaningful learning of ecological concepts.
3. Biology teachers should adopt the use of advance organisers in the teaching of difficult and wide topics in biology such as ecology.
4. Teacher trainers should take note and incorporate development of advance organiser into the teacher education curriculum.
5. There should be training and re-training of biology teachers on the use and design of advance organisers through workshops.
6. The use of advance organizer should be encouraged in co-educational schools, being gender friendly, all gender could maximally benefit from its use during instructions.

5.6 Limitations of the Study

The limitation observed during the course of the study:

- The study was limited to only SS1 students of two secondary schools in giwa educational zone, thus the findings cannot be generalized to other educational zones

5.7 Suggestions for Further Studies

The study has the following suggestions;

- This study could be extended to other institutions, colleges of education, polytechnics and universities in Nigeria for widening and generalizing the scope of this study.
- The results obtained in this research were for ecology concepts in Biology, the method can therefore be tried in other discilplines such as mathematics, physics and chemistry in senior secondary school.
- This study should also extend to the use of different types of advance organisers such as graphic and visual advance organisers
- There is a need to use different methods of instructions for the teaching of ecology concepts such as process approach or discovery with advance organisers.

References

Achino, C. (2000). The Importance of Class Motivation to Learning Achievement *Journal of Curriculum Studies*, 7(1), 62 – 67.

Adeniyi, E.O. (1995). Science as a way of knowing the NSSSP Experiences *26th Annual Conference proceedings of the Science Teachers Association of Nigeria.* Heinamann Educational Books (Nig). Plc 101 – 111.

Adeyegbe, S.O. (1991). The Senior Secondary School Curricula and Performance; *An Appraisal of 1st cycle of Operation a paper Delivered at the WAEC Monthly Seminar on* 25th April 1991.

Aguakagbuos, C. (1997). The Dearth of Women in Science, causes and Constraints in Science Mathematics and Technology Education in Nigeria in Badmus G. A and Ocho L.O. (eds) *the Nigeria Academic of Education* 195), 10 –

Agwagah, U.N.V. (2001). The Teaching of Number Bases in Junior Secondary School Mathematics: The use of the Base board ABACUS. *The Journal of Mathematical Association of Nigeria. Mathematics Education Series* 26(1).

Aigbomian, D.O. (2002). *Science for all: implication for the teacher and National Development* Ambik Press Benin City.

Ajayi, D.O. (1998). Communicating Science: Implication for Science Teachers. *Proceedings of the 33th Annual conference of STAN* 105-108

Akindehin, F. (1999). *Assessment and Evaluation in Education,* Ondo the light of life publications.

Ali, A. and Akubue, A. (1989). Approaches to Developing a Sound Science and Technologies Base on Nigeria School System, Perception of Nigeria School System, Perception of Educators, Scientist Technologist and Industrialist. *International Journal of Education Management* 1(1)

Allen, D.J (1970). Some effects of Advance Organizers and level of questions in the Learning and Retention of Written and Social Material. Journal of Educational Psychology, 61 (5) 333-339

Amathaver, R. (1963). The Contribution of Special Intelligence and Compensatory skills to achievement as demonstrated by an investigation of achievement differences of the sexes. *Psychology Research Journal* 14, 151 – 170

Ashilley, A. (2001). *Training the Mind for Greatness,* Ibadan Dotun Press.

Ausubel, D. (1960). The use of advance organizers in the learning and retention of meaningful verbal material. *Journal of educational psychology*, 51 (5), 267 – 272.

Ausubel, D. (1961). The role of discriminability in meaningful verbal material. *Journal or Educational Psychology*, 52 (5), 266 – 274.

Ausubel, D. (1963). *The Psychology of Meaningful Verbal Learning.* New York: Grune & Stratton.

Ausubel, D. (1978). In Defense of Advance Organizers: A reply to the critics. *Review of Educational Research*, 48, 251-257.

Balyun, C. (2009). Effects of Advance organizer on Learning and Retention From a Fully Web-Based Class. Ph D Thesis From the college of Education, University of Central Florida

Bartlett, F.C. (1932). *Remembering: A study in experimental and social psychology.* Cambridge, England: Cambridge University Press.

Bennie, S.B. (2001). *Educational Development in West Africa States*: a comparative Study Benin City Peakers Books ltd.

Berieter, C. (1985). Towards a solution of the learning paradox. *Review of educational Research*, 13, 233 – 341.

Bransford, J. D., Brown, A. L., and Cocking, R.R. (Eds.). (1999). *How people learn: Brain, mind, experience, and school.* Washington, DC: National Research Council.

Bristell, O.O. (1999). *Effective Teaching and Evaluation:* A Book of Reading, Shoso Educational Publishers Ibadan.

Bromley, K., Irwin – DeVitis, and Modlo, M. (1995). *Graphic Organizers.* Scholastic Professional Books: New York.

Bulgren, J.A., and Schumaker, J. B. (2006). *Teaching Practices that Optimize Curriculum Access.* In Deshler, D. D., and Schumaker, J. B. (Eds.), Teaching Adolescent with disabilities: Accessing the general curriculum (pp. 79 – 120). Thousand Oaks, C. A.: Corwin Press.

Chi, M. T. H. (1978). *Knowledge structures and memory development. I*n R. S. Seigher (Ed.) *Children's thinking: What develops?* (pp. 76 – 93).

Coleman, J.S. (1966). *Public School, Private Schools and the Public Interest*_the New Nation. Benin City, Bendel Press 2 (3), 41.

Curran, J., Takata, S. R. (2003). Ausubel's Advance Organizers. From Wikipedia, the free encyclopedia. Retrieved August 9 2009

Daramola, S.O. (1983). The Influence of Location and Sex differences as the knowledge of basic. Physics possessed by entering from III students in Kwara State Secondary Schools. *Journal of Science Teachers Association of Nigeria* 21(2), 126 – 132.

diSessa, A.A. (1993). *Towards en epistemologyof physics . cognition and Instruction,* 10(2&3), 105-225.

Driscoll, M. P. (2005). *Psychology of learning for instruction (*Third ed.). New York: Pearson.

Duyilemi, M. P. (1982). Relevance of Some Learning Theories to Primary School Science Teaching in Nigeria. *Proceedings of the 23rd Annual Conference of STAN* 80-82

Egbugara, O.U. (1983). Effects of three levels of advance organizers on achievement of some Nigerian secondary school physics students. Unpublished ph.D thesis University of Ibadan.

Fadul, J.(2006). "Mathematical formulations of Learning: Based on Ten Learning Principles". *International Journal of Learning.* 13, 139-152

Feeny, T., and Ylvisaker, M. (2006). Context – sensitive behavioural supports for young children with TBI: short – term effects and long – term outcome. *Journal of Head Trauma Rehabilitation*, 18(1), 33 – 51.

Feeny, T., and Ylvisaker, M. (2008). Context – sensitive behavioural supports for young children with TBI: A second replication study. *Journal of Positive Behaviour interventions,* 10(2), 115 – 128.

Fensham, P.J. (1972). Prior knowledge: source of negative factors for subsequent learning, *Research in science education,* 2(1), 50-57

Fisher, K, M. (2004). The importance of prior knowledge in college science instruction (chapter 5), Reform in undergraduate science teaching for the 21st century, Information Age Publishing. Retrieved March 3, 2007, from http://www.sci.sdsu.edu/CRMSE/ch_05_PriorKnowl_FINAL-SS.rtf

Freeman, J.A. (1966). Sex Differnces and Target Arrangement. *Journal of Parapsychology* 30, 227 – 235.

Gagne, R. M. (1968). Contributions of Learning to Human Development, *Psychology Review,* vol. 3 pp. 177- 191.

Hillae, H. (2002). *Eduation in the Sub Saharan Africa,* Khartoum: Pickerson Press. The New National Benin City, Bendel Press 2(3), 41.

Hill, H. (2002). Learning Theory: from the Wikipedia, the free encyclepedia

Idowu, A.B. (1990). The Road to Balanced Educational Achievement in Nigeria *Journal of Nigeria Educators,* 2(2) 15 – 20, Lagos, Lagos State University Press.

Inyang, N.E. (1988). The Constructing, Validation, Standardised Integrated Science, Achievement Test for Junior Secondary Schools. Unpublished Ph.D Thesis A.B.U. Zaria.

Isa, A. U. (1992). Effect of Practical Activities on Achievement in Integrated Science Among Secondary School Students in Zaria. *Unpublished M.ed Science Thesis* Ahmadu Bello University, Zaria.

Kahle, J.B., and Lakes M.K. (1983). The Myth of equality in Science classroom. *Journal of Research in Science Teaching* 20(2), 11 – 141

Kalyuga, S., Chandler, P., And Sweller, J. (1998). Levels of expertise and instructional design. *Human Factors*, 40(1), 1 – 17.

Kirschner, P. A. (2002). Cognitive load theory: Implications of cognitive load theory on the design of learning and instruction, 12(1), 1 – 10.

Kundu, C.L., and Tutoo, N.N. (2002). *Educational Psychology.* : New Delhi. Sterling Publishers

Kuppuswamy, B. (2002). *Advanced Educational Psychology,* Starting Publsihers Private Limited Kujawa, S., and Huske, L. (1995). The Strategic Teaching and Reading Project Guidebook (rev. ed.). Oak Brook, IL.

Lassa, P.M. (1996). Gender Stereotype Curriculum and Career Choice Paper Presented at the *8th Annual Conference at APOQEN October 1996, Kaduna.*

Lawton, J.T.,and Wagnaka, S .K. (1977). Advance Organizer as a Teaching Strategy. A Reply to Barnes and Clawson. Review of Educational Research 47, 233-244

Leach, J., and Scott, P. (2003). Individual and Sociocultural Views of Learning in Science Education, *Science & Education,* 12, 91-113.

Lenz, B.K., and Alley, G.R. (1983). The Effect of Advance Organizer on the Learning and Retention of Learning Disabled Adolescents Within the Context of a Co-operative Planning Model. www.eric.ed.gov/ERICwebportal/record retrieval date 22/11/2012

Lewis, E. L. (1991). The process of scientific Knowledge acquisition of middle school students learning thermodynamics. *Unpublished doctoral dissertation*. University of California, Berkeley.

Maier, N.R., and Burke R.J. (1967). Response Availability as a Factor in the Problem – Solving Performance of Males and Females, *Journal of Psychology* 5, 308 – 310.

McEneary, J. E. (1990). Do Advance Organizers Facilitate Learning ?: A Review of Subsumption Theory. *Journal of Research and Development in Education*. 23(2)

Moreno, R.,and Mayer, R. (1999). cognitive principles of multimedia learning: The role of modality and contiguity. *Journal of Educational Psychology.* 91, 358-368.

Mayer, R. (2003). *Learning and Instruction.* New Jersey: Pearson Education, Inc.

Miller, J.D. (1983). *Scientific Literacy in a Conceptual and Empirical Review* 112, (2), 1 – 28.

National Reading Panel, (2000). *Teaching children to read: An evidence – based assessment of the scientific research literature on implications for reading instruction.* Washington, D. C: national Institute of Child Health and Human Development and U. S. Department of Education.

Nesbit, J. C., and Adesope, O. O. (2006). Learning with concept and knowledge maps: *A meta–analysis. Review of Educational Research,* 76(3), 413 – 448.

Nicholls, K. (1994). The Place of Concept mapping in learning achievement *Education and the Society,* (391), 30 – 35.

Njoku, Z.C. (2007). *Engendering Learning Equity in Science and Technology Classroom for Sustainable Development Proceedings of the Science Teachers Association of Nigeria,* Heinemann Education Books (Nig) Plc. 24 – 31.

Nnachi, R.D. (2002). Relationship of Achievements Gender and Science Self Concept to Students Attitude of Science within South Eastern States of Nigeria *Journal of the Nigeria Society for Educational Psychologist (NISEP)*1 (i), 79 – 89.

Nworgu, B.G. (1988). Gender and Content Area Interaction in Physics achievement and discrepancies in gender differences in science achievement. *Institute of Journal of Studies in Education* 191), 119 – 122.

Nwagbo, C.R. (1997). Effects of two teaching methods on the achievement and attitude in Biology of Students of different levels of scientific literacy. *An unpublished PhD. Dissertation* University of Nigeria, Nssuka.

Nwagbo, C.R. (2002). "Level of Scientific Literacy of Secondary School Science Students". Implication for sustainable development in Nigeria *43rd Annual conference proceedings of Science Teachers Association of Nigeria* Heinemann Education Books (Plc) 73-77).

Nwawu, N.E., and Audu, B. (2005). Influencing Factors in Female Engineering and Technical Education in Nigeria. Knowledge Review, *A Multi Disciplinary Journal* 10(i); 8 – 11.

Nyabwa, R. A (2005). Effects of Advance Organisers on Form Three Students Mathematics Self Concepts and Performance in commercial Arithmetic in Selected Secondary School in Nakum District. Unpublished Masters Thesis. Egerton University, Njoro.

Ogunboyede, M.O. (2001). Women and Academic Achievement: A case study of Senior Secondary Agricultural Science Students in Ekiti State. Nigeria. *Journal of Educational Resources.*

Ogunboyede, M.O. (2003). Sex Differences and Students Achievement at the primary School Level. *The Nigeria Academic Forum.* 5 (1), 152 – 155.

Ogunleye, A.O. (1996). Levels of Acquisitiion of Process Skills Among some Physics Students and Implication for Science Education. *Journal of Science Teacher Association of Nigeria,* 31, (1&2), 39 – 46.

Oloruntegbe, K.O. (2000). Effect of Teacher Sensitization on Students Acquisition of Science Process Skills and Attitudes. *An unpublished Ph.D Dissertation* University of Benin.

Okebukola, P.A.O. (1985). Levels of process skills Development Among Students and Implications for Science in Nigeria. *Proceeding for the 26th Annual Conference of STAN at Sokoto.*

Okeke, J. (1997). Perceptions of Teachers Regarding the Strategic Learning Activities and Media for Primary Science Teaching. *Journal of perspectives on crucial issues on Nigerian and African Education*1, 104-111

Okeke, E.A.C. (2002). Gender and Science Technology and Mathematics Lead paper Presented at the 1st Annual Conference of the *1st Annual Conference of the Institute of Education,* University of Uyo, Uyo March 13 – 16.

Okonkwo, C.E. (1983). Mixed or Single sex Schools: A National Priority Re – Examined, *Education and Development* 50, 151 – 158.

Okafor, P.N. (2000). Laboratory Resources and Utilization as Correlates of Chemistry Students Learning Outcome *41st Annual Conference Proceedings of STAN,* 69 – 173.

Olajide, M.A. (1982). A Story of the Influence of Some Factors in Atonement in Biology in Some Secondary schools. *Unpublished M.Ed Thesis,* University of Lagos Nigeria.

Onwuakpa, F.W., and Akpan, B. (1999). A Descriptive Survey of Resource Concentration in Imo State Secondary Schools *Journal of STAN* 23 (1 and 2)

Oyekan, S.O. (1996). "Students: Cognitive Styles, Sex and Acheivement in Biology, *Journal of Education and Society* 1(1), 9 – 104.

Posner, G.J., and Gertzog, W.A. (1982). The clinical interview and the measurement of conceptual change, *Journal Science Education*, 66, 195-209.

Robertson, W.C. (1990). Detection of cognitive structure with protocol data: Predicting performance on physics transfer problems. *Cognitive Science*, 14, 253-280

Roschelle, J. (1994). Collaborative inquiry: reflections on Dewey and Learning about velocity and acceleration in a computer microworld. *Unpublished doctoral dissertation*, University of California, Berkeley.

Roschelle, J. (1995). Learning in interactive environments: prior knowledge and new experience. Public institutions for personal learning: establishing a research agenda. Falk, J. & Dierking, L. (eds.). Washington: American Association of Museums. Retrieved March 3, 2007 from *http://www.exploratorium.edu/IFI/resources/museumeducation/priorknowledge.html*

Rene, P.(1998). AdvanceOrganizers *http://www.lincoln.ac.nz/edu/hp/56.htm*. retrieved August 9 2009.

Resnick, M. (1992). Beyond the centralized mindset: Explorations in massively parallel microworlds. *Unpublished doctoral dissertation*. Massachusetts Institute of Technology.

Stone, j., Weil, M., Calhoun, E. : (2000). *Models of teaching,* 6th edition, Allyn and Bacon, 2000. ISBN 0205389279.

Sigel, I. F. (1963). Sex Differences in Cognitive Functioning Re – examined *A Functional Point of View Presented at the 1963 Binnial Meeting of the Society for Research in Child Development*, Berkeley, 186 – 208.

Symmands, L. (1998). UK and International School Science links. *Science education newsletter* 136, 1 – 2.

Strange, F.B., and Palmer, J.O. (1953). Note on Sex Differences on the Wechesler Bellevue Tests. *Journal Clinical Psychology* 9, 85 – 87.

Togatz, G.E. (1967). Effects of Strategies of Sex and Age on Conceptual Behaviour of Elementary School Children. *Journal of Educational Psychology* 58, 103 – 109.

Usman, I.A. (2008). Using a Selected Method of Teaching in Enhancing Slow Learners Academic Performance Among Junior Secondary School Integrated Science Students

Uhumuavhi, P.O., Oriahi C.I., and Olusi, F.I. (2003). Science Technology and Mathematics (STM) Education Catalyst for Women Development and Empowerment. *The Nigerian Academic Forum* 5(1) October 2003, 20- 26.

Vlaeminke, M., Mekeon, F., and Comber, C. (1997). Breaking the Mould – girls into Science Education, *Science Education Newsletter* 135, 6 – 7.

Willerman, M. and MacHenry, R. A. (1992). The concept Map as an Advance Organizer. Journal of Research in Science Teaching. 28, 705-712

Woolfolk, A. (2001). *Educational Psychology,(*8th ed). Boston: Allyn and Bacon.

APPENDIX A

Ecology Concept Achievement Test

Instruction: answer all questions

Time: 45 minutes

1. The word 'ecology' is a branch of biology concerned with the study of:
   a. Interrelationships between living organisms and their external environment.
   b. The study living organisms only
   c. The study of snails and snakes
   d. The capillary movement of water in plants

2. In ecology, the total surrounding or an organism is called its:
   a. Surrounding
   b. Environment
   c. Temperature
   d. None of the above.

3. The study of an individual organism or a single species of an organism and its environment is known as:
   a. Biosphere
   b. Synecology
   c. Autecology
   d. All of the above

4. The study of interrelationships between groups of organisms living together in an area is called:

a. Gyneacology
b. Autecology
c. Synecology
d. Topocology

5. The main kinds of habitats are

a. Arboreal and ground habitat
b. Underground habitats
c. Aquatic and terrestrial habitats
d. Salt and fresh water habitats

6. The factors which influence living organisms in their habitats and control their survival and distribution are called

a. Habitat factors
b. Ecological factors
c. A and B only
d. Physical factors

7. Abiotic factors refer to the following except

a. Physical factors
b. Biotic factors

c. Climatic factors
d. Edaphic

8. An example of topographic factors is:
a. Temperature
b. Rainfall
c. Elevation
d. Soil texture

9. A typical example of an edaphic factor is
a. Soil texture
b. Soil profile
c. Soil erosion
d. Earth crust

10. Animals that live both in water and on land are referred to as:
a. Aquatic animals
b. Sea anemone
c. Amphibians
d. Terrestrial animals

11. The ecological unit composed of organisms and their physical environment is:
a. Niche
b. Population
c. Ecosystem
d. Community

12. Organisms which breakdown the compounds of dead organism are called:
a. Phagotrophs
b. Saprophytes
c. Parasites
d. Producers

13. Which of these must be present in an ecosystem if the ecosystem is to be maintained:
a. Producers and carnivores
b. Producers and decomposers
c. Carnivores and decomposers
d. Herbivores and carnivores

14. The relationship between fungi and algae in lichens is known as:
a. Mutualism
b. Parasitism
c. Commensalisms
d. Saprophytism

15. All ecosystems have three basic living components. Which one of the following is not necessarily found in all the ecosystems?
a. "Producer" plants
b. Animal "consumers"
c. Decomposers
d. Parasites and communalists

16. A sequence of species related to another predator and prey is an (a):
a. Trophic level
b. Ecosystem
c. Food chain
d. Climax

17. Very low rainfall sparse vegetation, high day temperature and cold nights are the characteristics of the biome known as:
a. Swamp
b. Tropical forest
c. Southern guinea savannah
d. Desert

18. An association between two organisms in which both benefit is called:
a. Parasitism
b. Symbiosis
c. Commensalism
d. Predation

19. Which of the following is not structural adaptation of desert plants for water conservation:
a. Tiny leaves
b. Sunken stomata leaves
c. Stems and leaves with heavy cuticle
d. Broad leaves with numerous stomata

20. In cold climates or at high altitudes, some small mammals fall asleep in some specially prepared nests or burrows. This process is known as:
a. Hibernation
b. Masturbation
c. Conservation
d. Contraction

21. Fewer number of trees is a characteristic of the savannah zones of Nigeria because:
a. There is too much sunlight
b. They are usually exposed to grazing animals
c. There is limited amount of rainfall
d. The driest savannahs consist almost entirely of grasses.

22. The number of individuals in a habitat in relation to the unit space available to each organism is referred to as the:
a. Birth rate
b. Density
c. Mortality
d. Frequency

23. Predators are beneficial in pest control because they:
a. Are natural enemies of small mammals
b. Feeds on pests of crops
c. Devour farm animals
d. Compete for food with the pests.

24. Which of the following limiting resources is competed for by organisms in the desert?
a. Light
b. Temperature
c. Oxygen
d. Water

25. Water Guinea grass, grasshopper, toad, snake, hawk (Producer) (Primary consumer) (secondary consumer) (Tertiary consumer)
The above examples of a food chain belongs to:
a. Terrestrial habitat
b. Aquatic habitat
c. Ecosystem
d. Foods web

APPENDIX B

Ecology Concept Achievement Test (ECAT) Marking Scheme

S/N	Answers
1	A
2	B
3	C
4	C
5	C
6	B
7	C
8	C
9	A
10	C
11	C
12	B
13	B
14	D
15	D
16	C
17	D
18	B
19	D
20	A
21	C
22	B
23	A
24	D
25	A

Appendix C

Table of Specification

S/N	Topics	Total number of Questions	The question Numbers
1	Basic Ecological Concepts	8	1,2,3,4,5,9,10,15
2	Functioning Ecosystem	7	6,12,13,14,23,25
3	Ecological Factors	11	7,8,11,16,17,18,19, 20,21,22,24

APPENDIX D

Developed Advance Organisers For the Topics to be Taught

BASIC ECOLOGICAL CONCEPTS

The earth surface is different in composition from place to place in terms of soil structure, soil composition, land surface, atmospheric conditions and water bodies. As a result of these differences on the earth surface different areas are inhibited by different organisms that are most suited for its mode of life. Areas of extreme conditions are not inhibited.

Interactions take place within the different locations of the earth. Some of these interactions could be between living things and non – living things, as well as between living and living things. The study of these interactions helps to characterize organisms in the environment. The environment of an organism is essential for its survival, as it most provide all that the organism requires.

All organisms in a particular area have similar preference to environmental conditions. However even within the some environment some organisms are restricted to particular areas. There are organisms that live in streams, rivers, seas and ponds. Therefore each kind of organism has a specific place it occupies in the environment.

Organisms do not generally live apart from one another in nature. Each kind of organism may live in a particular environment with their own kind and also with other kinds of organisms, which allows interactions occur among them. It is however because

of these interactions that the total number of particular organisms in the environment could be affected either increased on decreased.

Functioning Ecosystem

There are interactions and inter – relation ships between the living parts of the environment and the non – living parts of the environment. For example, a plant which is a living part of the environment interacts with the soil, water and air which are the non – living parts of the environment, which leads to an exchange of materials.

The interaction between the living and non – living components will result in the formation of new chemical substances. For example, the interaction between plants and air, soil, light and water will produce a chemical substance that serves as food. The food is eaten by different animals and creates another kind of inter – relationship between living things within that environment. This inter relationships can be complex or simple depending on the number of organisms involved. This process leads to the transfer of energy from plants to other living organisms.

Ecological Factors

Organisms are prone to many environmental conditions around them. Some of these conditions are favourable others are not. It is under these conditions that the organism tries to survive. Some organisms attempt to cope with the environmental conditions by forming associations with other organisms. Some of these associations could be beneficial to the organism and those they are in association with, while some

may be beneficial to only one organism and harmful to the other. In other cases the association may be beneficial to one organism and neither beneficial nor harmful to the other organism.

When associations are not possible some organisms learn to adjust to the unfavourable conditions, thus enabling them to survive. Others develop modifications to enhance their chances of survival.

APPENDIX E

Lesson Plan for Experimental Group. Lecture Method with Advance Organsier

LESSON No: 1

Phase 1 Presentation of the Advance Organiser on Basic Ecological Concepts

The earth surface is different in composition from place to place in terms of soil structure, soil composition, land surface, atmospheric conditions and water bodies. As a result of these differences on the earth surface different areas are inhibited by different organisms that are most suited for its mode of life. Areas of extreme conditions are not inhibited.

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however because of these interactions that the total number of particular organisms in the environment could be affected either increased or decreased.

Date -

Subject - **Biology**

Topic **Ecology**

Sub-Topic - **Basic Ecological Concepts**

Class - **SS I**

Average age - **17 years**

Instructional Materials- Charts illustrating ecological, Essential Biology Textbook

Previous knowledge - Students have been taught the meaning and concept of biology which involves the study of plant and animals.

BEHAVIOUR OBJECTIVES: At the end of the lesson, the students should be able to:

1. Define ecology
2. Explain in their own words the following ecological concepts:
   (a) Autecology
   (b) Synecology
   (C) Lithosphere
   (d) Hydrosphere
   (f) Biosphere/Ecosphere
   (g) Atmosphere

Introduction: Class, in the previous lesson held, the discussion was centered on the relevance of biology to man. Have you ever heard of the word ecology?

Phase 2 **Making Links to the Organiser by presenting the learning tasks and logically ordering and linking**

learning materials to the organiser. This is done by asking students to list different examples of water bodies and then relating them to hydrosphere. Secondly by asking students to describe different land surfaces different soils then relating them to lithosphere.

Presentation: Based on the student's responses the teacher present the lesson in the following steps.

Step 1: The concept of "ecology: - a branch of biology that deals with the study of plants and animals in relation to their environment. Ecology is derived from a Greek word "Oikos" which means home or dwelling place.

Step II: Some schools of thought on the origin of ecology

(a) Defines ecology as a field of study which deals with the relationships of living organisms with one another and with the environment in which they live.

(b) Describes ecology as an environmental biology

(c) Classified ecology into two main branches namely, Autecology and synecology.

Step III (a) Define the basic ecological concepts, thus

(I) Autecology — is concerned with the study of an individual organism or a single species of organism and its environment. Example, the study of a single rat and its environment.

(ii) Synecology — is concerned with the study of the interrelationships between groups of organisms or species of organisms living together in an area. Example, the study of different organisms in a river in relation to their aquatic environment.

(iii) Biosphere or ecosphere: This is the zone of the earth occupied by living organisms. It is a layer of life which exists on the earth's surface.

(iv) Lithosphere: is the solid portion of earth. It is the outer most layer of zone of the earth's crust. It is made up of rocks and mineral materials, and it also represents 30% of the earth's surface.

(v) Hydrosphere: is the liquid/aquatic part of the earth or living world. It covers about 70% of the earth's crust. It holds water in various forms — solid ice, liquid (water) and as gases (water vapour).

(vi) Atmosphere: The atmosphere is the gaseous portion of the earth. It is a layer of gases surrounding the earth over 99% of the atmosphere within 30km of the earth surface.

Phase 3 **Strengthening of the cognitive Organisation by asking the learners to make summaries by relating concepts learnt in the learning tasks to concepts in the advance organisers. This is done by taking a statement from the advance organizer example 'the earth surface is different in composition from place to place in terms of soil structure, soil composition, land surface, atmospheric conditions and water bodies and relating them to hydrosphere and lithosphere.**

Evaluation: the teacher evaluates the lesson by asking the following questions

1 What is ecology?

2 Discuss the following terms

i biosphere

ii lithosphere

iii hydrosphere

iv autecology

SUMMARY AND CONCLUSION

Highlight the main points of the lesson along with the students.

Experimental Group: Lecture Method with Advance Organiser

Lesson 2

Phase 1 Presentation of the Advance Organiser on basic ecological concepts

BASIC ECOLOGICAL CONCEPTS

The earth surface is different in composition from place to place in terms of soil structure, soil composition, land surface, atmospheric conditions and water bodies. As a result of these differences on the earth surface different areas are inhibited by different organisms that are most suited for its mode of life. Areas of extreme conditions are not inhibited.

Interactions take place within the different locations of the earth. Some of these interactions could be between living things and non – living things, as well as between living and living things. The study of these interactions helps to characterize organisms in the environment. The environment of an organism is essential for its survival, as it most provide all that the organism requires.

All organisms in a particular area have similar preference to environmental conditions. However even within the some environment some organisms are restricted to particular areas. There are organisms that live in streams, rivers, seas and ponds. Therefore each kind of organism has a specific place it occupies in the environment.

Organisms do not generally live apart from one another in nature. Each kind of organism may live in a particular environment with their own kind and also with other kinds of organisms, due to the interactions that occurs between them. It is however because of these interactions that the total number of particular organisms in the environment could be affected either increased on decreased.

Date

Subject: Biology

Topic: Eccology

Sub-topic: Basic Ecological Concepts

Class: SS1

Average Age: 17 years

I**nstructional Material:** charts, Essential Biology

Previous Knowledge: students have been taught the meaning and concept of biology which involves the study of plants and animals.

Beh. Objectives: by the end of the lesson the students should be able to:
i-define biotic community
ii-define environment, ecological niche and habitat
iii- describe the different types of habitat

Introduction: the teacher introduces the lesson by asking the students to define ecology and to also list things they can see around them.

Phase 2 **Making Links to the Organiser by presenting the learning tasks as seen in the behavioral objectives and logically ordering and linking learning materials to the organisers. This is done by asking the students to link the statement from the advance organiser "all organism in a particular area have similar preferences to the**

	environmental conditions" to the learning materials on habitat.
Presentation:	based on the students responses, the teacher presents the lesson in the following steps.
Step 1	the teacher defines a biotic community as any naturally occuring group of different organisms living together and interacting in the same environment**.**
Step 2	the teacher goes forward to define an environment as the total sorrounding of an organism. These include all factors external and inernal, living and non-living factors which affect the organism. In the environment every organism has where it can be found. This is its habitat, a habitat is defined as an area occupied by a biotic community. In other words, a habitat is any environment in which an ogranism lives naturally. The specific portion of a habitat which is ocupied by a particular specie is referred to as its ecological niche. It is also the functional position of an organism within a community.
Step 3	the teacher then goes forward to lead the students to describe the kinds of habitat that organisms are found. There are three main types of habitats, these are terrestrial, aquatic and aboreal habitats.
Phase 3	**Strengthening of the Cognitive Organisation, this is done by asking learners to make summaries by relating concepts learnt in the learning materials to concepts in the advance organisers. Example taking the statement from the advance organiser "however even within the same environment some organisms are restricted to particular areas" and relating it to niche in the learning material.**

Evaluation: the teacher evaluates the lesson by asking the following questions

1-define the following concepts

i-ecological niche

ii-biotic community

iii- habitat

iv- environment

2- describe the three main types of habitats

Summary and conclusion: the teacher concludes the lesson by highligthing the salient points of the lesson

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Experimental Group: Lecture Method with Advance Organiser

LESSON NO: 3

Phase 1 Presentation of the Advance Organiser on Functioning Ecosystem

Functioning Ecosystem

There are interactions and inter – relation ships between the living parts of the environment and the non – living parts of the environment. For example, a plant which is a living part of the environment interacts with the soil, water and air which are the non – living parts of the environment, which leads to an exchange of materials.

The interaction between the living and non – living components will result in the formation of new chemical substances. For example, the interaction between plants and air, soil, light and water will produce a chemical substance that serves as food. The food is eaten by different animals and creates another kind of inter – relationship between living things within that environment. This inter relationships can be complex or simple depending on the number of organisms involved. This process leads to the transfer of energy from plants to other living organisms.

DATE

SEX

CLASS **SS1**

AGE **16**

SUBJECT **BIOLOGY**

TOPIC **ECOLOGY**

SUB – **TOPIC FUNCTIONING ECOSYSTEM**

INSTRUCTIONAL MATERIALS

Behavioral objective: By the end of the lesson the pupil should be able to

1. List the components of the ecosystem
2. List the biotic components of the ecosystem
3. Describe the biotic components of the ecosystem

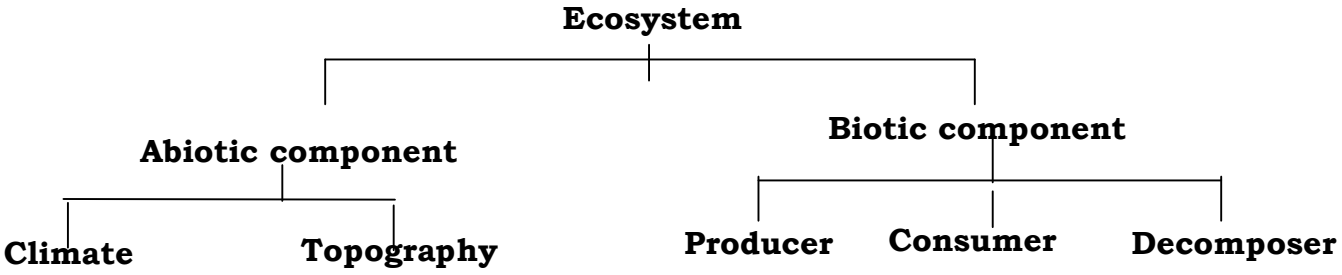
Previous knowledge: the pupils have been taught the ecological concepts

Introduction:- The teacher introduces the lesson by asking the pupils to make a list of all they observe in the environment.

Phase 2 **Making Links to the Organiser by presenting the learning tasks and logically ordering and linking the learning material to the organisers. This is done by linking interactions and inter- relationships between the living parts of the environments and the non-living parts of the environment in the advance organizer to components of the ecosystem in the learning material.**

Presentation:- Based on the pupils responses the teacher presents the lesson in the following steps

Step 1: The ecosystem is made up of abiotic and biotic components. The diagram illustrates the components of the ecosystem.



Step 2 the biotic components of the ecosystem are:

1. Producers
2. Consumers
3. Decomposers

Step 3 the teacher then goes forward to describe the biotic components of the ecosystem

-The produces are green plants which can make their own food through the process of photosynthesis these plants are autotrophs.

-Consumers are animals which feed on plants or on other animals. They are said to be heterotrophs consumers are sub – divided as follows

- Primary consumers are animals which feed directly on plant e.g cattle's, grasshopper
- Secondary and tertiary consumers are animals that feed on primary consumers examples hawks leopards.
- Omnivores are animals that feed on both plants and animals e.g man

-Decomposers are organism which feed on the carcasses of dead producers and consumers and in the process bring about the decay of such carcasses.

Phase 3 **Strengthening of the Cognitive Organisation by asking learners to make summaries by relating concepts learnt in the learning materials to concepts in the advance organisers. This is done by relating the statement 'interactions between plants as a living thing and air,**

soil, water and light as non living things to produce food' from the advance organizer to the learning material on components of the ecosystem.

Evaluation:- the teacher evaluates the lesson by asking the following questions

1. List the 2 major components of the ecosystem
2. Describe briefly the following terms

i. Produces

ii. Consumer

iii. Decomposer

Summary and Conclusion:- the teacher concludes the lesson by highlighting the salient points of the lesson.

Experimental Group: Lecture Method with Advance Organiser

Lesson 4

Phase 1 Presentation of the Advance Organiser on Functioning Ecosystem

Functioning Ecosystem

There are interactions and inter – relation ships between the living parts of the environment and the non – living parts of the environment. For example, a plant which is a living part of the environment interacts with the soil, water and air which are the non – living parts of the environment, which leads to an exchange of materials.

The interaction between the living and non – living components will result in the formation of new chemical substances. For example, the interaction between plants and air, soil, light and water will produce a chemical substance that serves as food. The food is eaten by different animals and creates another kind of inter – relationship between living things within that environment. This inter relationships can be complex or simple depending on the number of organisms

involved. This process leads to the transfer of energy from plants to other living organisms.

Date

Subject: Biology

Topic: Eccology

Sub-topic: Functioning ecosystem

Class: SS1

Average Age: 17 years

Instructional Material: charts, Essential Biology

Beh. Objectives: by the end of the lesson the students should be able to:
i-define food chain
ii- define food web
iii-illustrate the food chain and food web using diagrams

Previous knowledge: the students are familiar with the main components of the ecosystem.

Introduction: the teacher introduces the lesson by asking the students their main source of food.

Phase 2 **Making Links to the Organiser by presenting the learning tasks and logically ordering and linking learning materials to the organisers. Example this done by linking "food is eaten by different animals which creates another kind of inter-relationship" to the learning tasks that is food chain.**

Presentation: based on the students responses, the teacher presents the lesson in the following steps.

Step 1 the begins by asking the students how animals get their food. Animals survive in the environment by eating plantsand other animals. The teacher then defines food

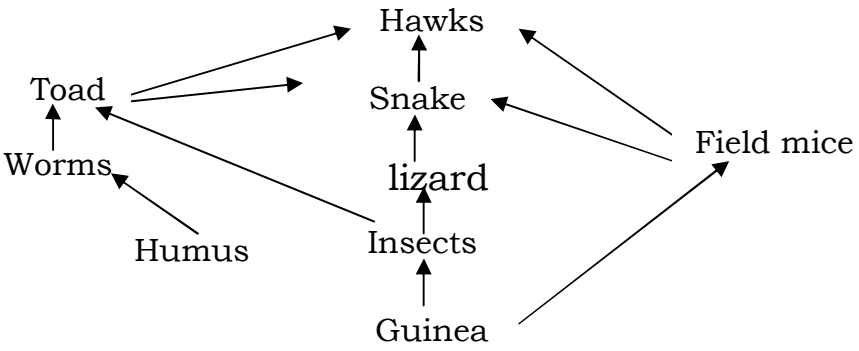
chain as the linear feeding relationship among organisms,in which one organism feeds on the one before it in the sequence.

Step 2 the teacher then goes forward to define a food web as a complex feeding relationship consisting of interrelated food chains.

Step 3 the teacher then goes forward to illustrate the diagrams of a food chain and food web.

Grass → grasshopper toad → snake → hawk →

A complex feeding relationship consisting of interrelated food chains is called food web. Example of a food web is shown below.



Phase 3 **Strengthening of the Cognitive Organisation by asking the learners to make summaries by relating concepts to the advance organisers. Example "this inter-relationship can be complex or simple depending on the nmber of organisms involved" from the advance organisers and relating it to the learning task on food chain and food web.**

Evaluation the teacher evaluates the lesson by asking the following questions

1-define a food chain and a food web

2- draw a diagramatic representation of a food chain and food web.

Summary and conclusion: the teacher concludes the lesson by revising all that he has taught.

Experimental Group: Lecture Method with Advance Organiser

Lesson no. 5

Phase 1 Presentation of the Advance Organiser on Ecological Factors

Ecological Factors

Organisms are prone to many environmental conditions around them. Some of these conditions are favourable others are not. It is under these conditions that the organism tries to survive. Some organisms attempt to cope with the environmental conditions by forming associations with other organisms. Some of these associations could be beneficial to the organism and those they are in association with, while some may be beneficial to only one organism and harmful to the other. In other cases the association may be beneficial to one organism and neither beneficial nor harmful to the other organism.

When associations are not possible some organisms learn to adjust to the unfavourable conditions, thus enabling them to survive. Others develop modifications to enhance their chances of survival.

Date

Subject **Biology**

Topic Ecology

Sub topic Ecological factors

Class **SS I**

Average age 17 years

Teaching Aids Essential Biology Textbook, Chalk and Board

Previous knowledge: the pupils have being taught on the biotic and abiotic components of the ecosystem.

Behavioural objectives

At the end of the lesson, students would be able to:

1. Define the term ecological factors
2. List ecological factors
3. Describe the following

- Symbiosis
- Parasite
- Commensalism
- Predation
- Mortality
- Migration
- Dispersal
- Disease

Introduction: The teacher introduces the lesson by asking the pupils in what ways organism interacts with each other and the environment.

Phase 2 **Making Links to the Organiser by presenting the learning tasks and logically ordering and linking learning materials to the organisers. Example asking students to link the statement "some organisms attempt to cope with the environmental conditions by forming**

associations with other organisms" to symbiosis, parasitism and so on.

Presentation: Based on the student's responses the teacher presents the lesson in the following steps.

Step 1

Ecological factors are those factors in the environment which can influence living organisms or cause changes that are found in your locality/community.

Step 2: The teacher proceeds by listing and describing ecological factors

Competition: Involves interactions among two organisms of the same species or different species in which one outgrows the other and survives while the other cannot grow nor survives.

Association: These are close relationships between organisms of different species some of these associations are harmful, beneficial and some are neutral.

Tolerance: - The ability of an organism to withstand or cope with all or some of the unfavoruable environmental factors in the habitat.

Adaptation:- Those features of an organism including modification of structure, functioning and behavior which fit them for life in their particular habitats and improve their chances of survival

Pollution: The release of harmful substances into the environment

Step 3 The teacher describes the following terms

Competition: Involves interactions among two organisms of the same species or different species in which one outgrows the other and survives while the other cannot grow nor survives.

Commensalisms: Commensalisms' is an association between two organisms living together in which only one (the commensal) benefits from the association while the other neither benefited nor is harmed.

Predation: Predation is a type of association between two organisms in which the predator kills the other called the prey and feeds directly on it.

Parasitism: This is a close association between two organisms in which one called the parasite, lies in or on and feeds at the expense of the other organism called the host. The parasite benefits from the association while the host usually suffers harm or dies.

Pathogens: These are microorganisms which can cause diseases in plants and animals leading to their reduction through death.

Mortality: Mortality is the death rate of organisms (plants or animals) in an environment. Mortality generally reduces the population of organisms in any habitat.

Migration: This is the movement of organisms either into a new habitat (immigration). These movements usually have effect on the other organisms in habiting that habitat.

Dispersal: Dispersal is the spreading of new individuals from their parents to new habitats so as to start a new life in the new environment. Such spreading habitats may affect the lives of other organisms in the new area.

Diseases: Diseases are known to reduce the population of organisms (both plants and animals) in any habitat.

Climatic factors: These are temperature, rainfall, wind, pressure, sunlight or sunshine, humidity, etc.

Chemical factors: These are made up of oxygen, carbon dioxide, mineral salts, water and nitrogen.

Edaphic factors: These consist of soil, its water, chemical and physical composition, its pH, its nutrients, profile, structure and texture.

Topography: These are caused as a result of the shape of the earth's surface, e.g. effects of rivers, hills, mountains and valleys.

Phase 3 **Strengthening of the Cognitive Organisation by asking learners to make summeries relating concepts learnt in the learning tasks to concepts in the advance organisers. Example relating "some of these associations could be beneficial to the organisms and those they are in**

association with" from the advance organisers and relating it to the learning tasks on symbiosis.

Evaluation: The teacher evaluates the lesson by asking the following questions:

1) Name four ecological factors that are found in your locality/community
2) Define the following terms
   (I) Mortality (ii) Symbiosis (iii) Parasitism (iv) Dispersal (v) Migration (vi) Commensalism
3) describe the relationship that exist between tick on a cow and the cow

Summary and conclusion -

To summarize the lesson by highlighting the main points of the lesson

APPENDIX F

Control group- Taught with Lecture Method Only

LESSON No: 1

Date -

Subject - Biology

Topic Ecology

Sub-Topic - Basic Ecological Concepts

Class - SS I

Average age - 17 years

Instructional Materials- Charts illustrating ecological, Essential Biology Textbook

Previous knowledge - Students have been taught the meaning and concept of biology which involves the study of plant and animals

BEHAVIOUR OBJECTIVES: At the end of the lesson, the students should be able to:

1. Define ecology
2. Explain in their own words the following ecological concepts:
   (a) Autecology
   (b) Synecology
   (C) Lithosphere
   (d) Hydrosphere
   (f) Biosphere/Ecosphere
   (g) Atmosphere

Introduction: Class, in the previous lesson held the discussion was centered on the relevance of biology to man. Have you ever heard of the word ecology?

Presentation: Based on the student's responses the teacher present the lesson in the following steps.

Step 1: The concept of "ecology: - a branch of biology that deals with the study of plants and animals in relation to their environment.

Ecology is derived from a Greek word "Oikos" which means home or dwelling place.

Step II: Some schools of thought on the origin of ecology

(a) Defines ecology as a field of study which deals with the relationships of living organisms with one another and with the environment in which they live.

(b) Describes ecology as an environmental biology

(c) Classified ecology into two main branches namely, Autecology and synecology.

Step III (a) Define the basic ecological concepts, thus

(I) Autecology — is concerned with the study of an individual organism or a single species of organism and its environment. Example, the study of a single rat and its environment.

(ii) Synecology — is concerned with the study of the interrelationships between groups of organisms or species of organisms living together in an area. Example, the study of different organisms in a river in relation to their aquatic environment.

(iii) Biosphere or ecosphere: This is the zone of the earth occupied by living organisms. It is a layer of life which exists on the earth's surface.

(iv) Lithosphere: is the solid portion of earth. It is the outer most layer of zone of the earth's crust. It is made up of rocks and mineral materials, and it also represents 30% of the earth's surface.

(v) Hydrosphere: is the liquid/aquatic part of the earth or living world. It covers about 70% of the earth's crust. It holds water in various forms — solid ice, liquid (water) and as gases (water vapour).

(vi) Atmosphere: The atmosphere is the gaseous portion of the earth. It is a layer of gases surrounding the earth over 99% of the atmosphere within 30km of the earth surface

Evaluation: the teacher evaluates the lesson by asking the following questions

1	What is ecology?
2	define the following terms
	i biosphere
	ii lithosphere
	iii hydrosphere
	iv autecology

SUMMARY AND CONCLUSION

Highlight the main points of the lesson along with the students.

Control group- Taught with Lecture Method Only

Lesson 2

Date

Subject: Biology

Topic: Eccology

Sub-topic: Basic Ecological Concepts

Class: SS1

Average Age: 17 years

Instructional Material: charts, Essential Biology

Previous Knowledge: students have been taught the meaning and concept of biology which involves the study of plants and animals

Beh. Objectives: by the end of the lesson the students should be able to:
i-define biotic community
ii-define environment, ecological niche and habitat
iii- describe the different types of habitat

Introduction: the teacher introduces the lesson by asking the students to define ecology and to also list things they can see around them.

Presentation: based on the students responses, the teacher presents the lesson in the following steps.

Step 1 the teacher defines a biotic community as any naturally occuring group of different organisms living together and interacting in the same environment**.**

Step 2 the teacher goes forward to define an environment as the total sorrounding of an organism. These include all factors external and inernal, living and non-living factors which affect the organism. In the environment every organism has where it can be found. This is its habitat, a habitat is defined as an area occupied by a biotic community. In other words, a habitat is any environment in which an ogranism lives naturally. The specific portion of a habitat which is ocupied by a particular specie is referred to as its ecological

niche. It is also the functional position of an organism within a community.

Step 3 the teacher then goes forward to lead the students to describe the kinds of habitat that organisms are found. There are three main types of habitats, these are terrestrial, aquatic and aboreal habitats.

Evaluation: the teacher evaluates the lesson by asking the following questions

1-define the following concepts

i-ecological niche

ii-biotic community

iii- habitat

iv- environment

2-list the three main types of habitats

Summary and conclusion: the teacher concludes the lesson by highligthing the salient points of the lesson.

Control group- Taught with Lecture Method Only

LESSON NO: 3

DATE

SEX

CLASS **SS1**

AGE **16**

SUBJECT **BIOLOGY**

TOPIC **ECOLOGY**

SUB – TOPIC ECOLOGICAL FACTORS

INSTRUCTIONAL MATERIAL

Behavioral objective: By the end of the lesson the pupil should be able to

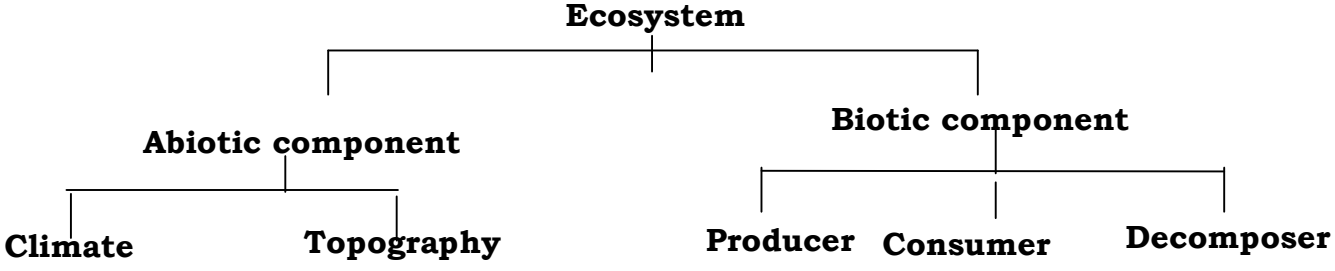
4. List the components of the ecosystem
5. List the biotic components of the ecosystem
6. Describe the biotic components of the ecosystem

Previous knowledge: the pupils have been taught the ecological concepts

Introduction:- The teacher introduces the lesson by asking the pupils to make a list of all they observe in the environment.

Presentation:- Based on the pupils responses the teacher presents the lesson in the following steps

Step 1: The ecosystem is made up of abiotic and biotic components. The diagram illustrates the components of the ecosystem.



-

Step 2 the biotic components of the ecosystem are:

1. Producers
2. Consumers
3. Decomposers

Step 3 the teacher then goes forward to describe the biotic components of the ecosystem

-The produces are green plants which can make their own food through the process of photosynthesis these plants are autotrophs.

-Consumers are animals which feed on plants or on other animals. They are said to be heterotrophs consumers are sub – divided as follows

- Primary consumers are animals which feed directly on plant e.g cattle's, grasshopper
- Secondary and tertiary consumers are animals that feed on primary consumers examples hawks leopards.
- Omnivores are animals that feed on both plants and animals e.g man

-Decomposers are organism which feed on the carcasses of dead producers and consumers and in the process bring about the decay of such carcasses.

Evaluation:- the teacher evaluates the lesson by asking the following questions

3. List the 2 major components of the ecosystem
4. Describe briefly the following terms

iv. Produces

v. Consumer

vi. Decomposer

Summary and Conclusion:- the teacher concludes the lesson by highlighting the salient points of the lesson.

Control group- Taught with Lecture Method Only

Lesson 4

Date

Subject: Biology

Topic: Eccology

Sub-topic: Functioning ecosystem

Class: SS1

Average Age: 17 years

Instructional Material: charts, Essential Biology

Beh. Objectives: by the end of the lesson the students should be able to:

i-define food chain

ii- define food web

iii-illustrate the food chain and food web using diagrams

Previous knowledge: the students are familiar with the main components of the ecosystem.

Introduction: the teacher introduces the lesson by asking the students their main source of food.

Presentation: based on the students responses, the teacher presents the lesson in the following steps.

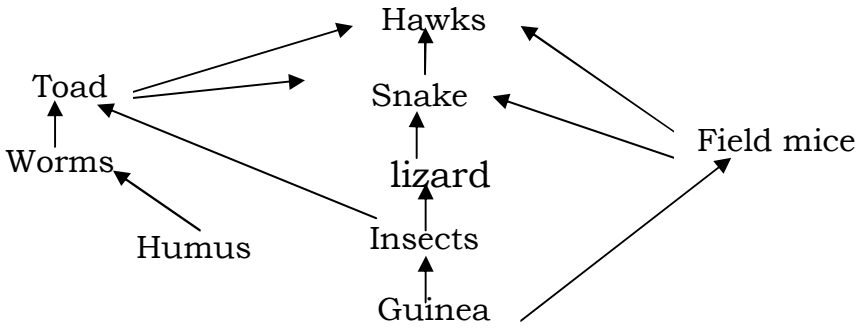
Step 1 the begins by asking the students how animals get their food. Animals survive in the environment by eating plantsand other animals. The teacher then defines food chain as the linear feeding relationship among organisms,in which one organism feeds on the one before it in the sequence.

Step 2 the teacher then goes forward to define a food web as a complex feeding relationship consisting of interrelated food chains.

Step 3 the teacher then goes forward to illustrate the diagrams of a food chain and food web.

Grass → grasshopper → toad → snake → hawk

A complex feeding relationship consisting of interrelated food chains is called food web. Example of a food web is shown below.



Evaluation the teacher evaluates the lesson by asking the following questions

1-define a food chain and a food web

2- draw a diagramatic representation of a food chain and food web.

Summary and conclusion: the teacher concludes the lesson by revising all that he has taught.

Control group- Taught with Lecture Method Only

Lesson no. 5

Date

Subject **Biology**

Topic Ecology

Sub topic Ecological factors

Class **SS I**

Average age 17 years

Teaching Aids Essential Biology Textbook, Chalk and Board

Previous knowledge: the pupils have being taught on the biotic and abiotic components of the ecosyste

Behavioural objectives

At the end of the lesson, students would be able to:

4. Define the term ecological factors
5. List ecological factors
6. Describe the following

- Synbiosis
- Parasite
- Commensalism
- Predation
- Mortality
- Migration
- Dispersal
- Disease

Introduction: The teacher introduces the lesson by asking the pupils in what ways organism interacts with each other and the environment.

Presentation: Based on the student's responses the teacher presents the lesson in the following steps.

Step 1

Ecological factors are those factors in the environment which can influence living organisms or cause changes that are found in your locality/community.

Step 2: The teacher proceeds by listing and describing ecological factors

Competition: Involves interactions among two organisms of the same species or different species in which one outgrows the other and survives while the other cannot grow nor survives.

Association: These are close relationships between organisms of different species some of these associations are harmful, beneficial and some are neutral.

Tolerance: - The ability of an organism to withstand or cope with all or some of the unfavoruable environmental factors in the habitat.

Adaptation:- Those features of an organism including modification of structure, functioning and behavior which fit them for life in their particular habitats and improve their chances of survival

Pollution: The release of harmful substances into the environment

Step 3 The teacher describes the following terms

Competition: Involves interactions among two organisms of the same species or different species in which one outgrows the other and survives while the other cannot grow nor survives.

Commensalisms: Commensalisms' is an association between two organisms living together in which only one (the commensal) benefits from the association while the other neither benefited nor is harmed.

Predation: Predation is a type of association between two organisms in which the predator kills the other called the prey and feeds directly on it.

Parasitism: This is a close association between two organisms in which one called the parasite, lies in or on and feeds at the expense of the other organism called the host. The parasite benefits from the association while the host usually suffers harm or dies.

Pathogens: These are microorganisms which can cause diseases in plants and animals leading to their reduction through death.

Mortality: Mortality is the death rate of organisms (plants or animals) in an environment. Mortality generally reduces the population of organisms in any habitat.

Migration: This is the movement of organisms either into a new habitat (immigration). These movements usually have effect on the other organisms in habiting that habitat.

Dispersal: Dispersal is the spreading of new individuals from their parents to new habitats so as to start a new life in the new environment. Such spreading habitats may affect the lives of other organisms in the new area.

Diseases: Diseases are known to reduce the population of organisms (both plants and animals) in any habitat.

Climatic factors: These are temperature, rainfall, wind, pressure, sunlight or sunshine, humidity, etc.

Chemical factors: These are made up of oxygen, carbon dioxide, mineral salts, water and nitrogen.

Edaphic factors: These consist of soil, its water, chemical and physical composition, its pH, its nutrients, profile, structure and texture.

Topography: These are caused as a result of the shape of the earth's surface, e.g. effects of rivers, hills, mountains and valleys.

Evaluation: The teacher evaluates the lesson by asking the following questions:

1) Name four ecological factors that are found in your locality/community

2) Define the following terms

(I) Mortality (ii) Symbiosis (iii) Parasitism (iv) Dispersal (v) Migration (vi) Commensalism

Summary and conclusion -

To summarize the lesson by highlighting the main points of the lesson