EFFECTS OF INQUIRY-BASED INSTRUCTION ON ACQUISITION OF PROCESS-SKILLS, INTEREST AND PERFORMANCE IN ECOLOGY AMONG SECONDARY SCHOOL STUDENTS, IN LERE, KADUNA, NIGERIA

BY

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DEPARTMENT OF SCIENCE EDUCATION,
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AHMADUI BELLO UNIVERSITY,
ZARIA, NIGERIA

OCTOBER, 2017

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DEPARTMENT OF SCIENCE EDUCATION,
FACULTY OF EDUCATION
AHMADUI BELLO UNIVERSITY,
ZARIA

OCTOBER, 2017

DECLARATION

I hereby declare that this Dissertation entitled "Effects of Inquiry-Based Instruction on Acquisition of Process Skills, Interest and Performance in Ecology among Secondary School Students, in Lere Educational Zone, Kaduna, Nigeria" has been written by me, under the supervision of Dr. J.O. Olajide and Dr. S.S. Obeka (Very Rev)in the Department of Science Education. It is a record of my own work and it has not been presented in any previous application for a higher degree. All quotations and sources of information are fully acknowledge by means of references.

Danjuma Sunday _____ _____

P13EDSC8039 (Signature) (Date)

CERTIFICATION

This Dissertation entitled "Effects of Inquiry-Based Instruction on Acquisition of Process Skills, Interest and Performance in Ecology among Secondary School Students in Lere Educational Zone, Kaduna, Nigeria." by Sunday DANJUMA with registration number P13EDSC8039 meets the regulation governing the award of masters degree in Science Education of the Ahmadu Bello University, Zaria, Nigeria and is approved for its contribution to knowledge and literacy presentation.

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DEDICATION

This Dissertation is dedicated to Almighty God and to the memory of my beloved mother and wife. Late Mrs. Ladi Danjuma and Late Mrs. Juliet D. Sunday.

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First and foremost, I must express my special appreciation and thanks to the Lord Almighty for his abundant love, mercy and grace that made it possible for me to accomplish this work. I acknowledge the tireless and encouraging efforts of the supervisory team Dr. J.O. Olajide and Dr. S.S. Obeka (Very Rev) who were there for me both during and after office hours. May God shower such kindness to your children. The researcher will not forget the assistance, encouragement, guidance and motivation given by Prof. J.S. Mari, Prof. I. A. Usman, Prof. M.M. Atadoga, Prof. A.A.M. Shaibu, Prof. M.A. Lakpini, Prof. S.S. Bichi, Dr. Binta Abdulkarim, Dr. F.K. Lawal, Dr. T.E. Lawal, Dr. S.B. Olorukooba, Dr. M.K. Falalu, the PG Coordinator; Dr. M.O. Ibrahim and finally the Head of Department Prof. Mamman Musa for their valuable contributions towards making this study a success.

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LIST OF ABBREVIATIONS

AAAS: America Association for Advancement of Science

FME: Federal Ministry of Education

GALT: Group Assessment of Logical Thinking

MAN: Mathematical Association of Nigeria

NECO: National Examination council

NRC: National Research Council

NTI: National Teachers Institute

SAPA: Science A Process Approach

SECIQ: Student Ecology Concept Interest Questionnaire

SPSAT: Science Process Skills Acquisition Test

STAN: Science Teachers Association of Nigeria

TOPS: Test of Practical Skills

WAEC: West Africa Examination Council

WASSCE: West Africa Senior School Certificate Examination

ABSTRACT

The objective of the research was to investigate Effects of Inquiry-Based Instruction on Acquisition of Process Skills, Interest and Performance in Ecology among Secondary School Students. Four objectives, research Questions and Hypotheses guided the research. The hypothesis were tested at $p \leq 0.05$ level of significance. Pretest and posttest, experimental and control group design was used for the study. The population comprised all 1908 senior secondary school Biology students in Lere zone. A sample consisting of 118 students randomly selected from two coeducational schools in Lere Education Zone was used for the study. The experimental group was taught Ecology concepts using Inquiry-based method while the control group was exposed to lecture method. Three validated instruments called Student Process Skills Acquisition Test (SPSAT), with r=0.74,Ecology Performance Test (EPT) with r=0.76and Students Ecology Concept Interest Questionnaire (SECIQ) with r=0.84 were used to gather data. Data collected were analyzed using t-test and Kruskal-wallis statistics. The results of the study revealed that differences exist on acquisition of process skills when students are exposed to inquiry and lecture teaching method in favour of experimental group.Statistics revealed that significant difference exist in the interest shown by SSS Students when they are exposed to inquiry and lecture teaching method in favor of experimental group. Based on the findings the following recommendations were made; the use of inquiry-based instruction should be encourage among teachers of ecology to improve student's acquisition of process skills and Inquiry-based instruction should also be encouraged to promote the learning of Biology by both male and female students.

CHAPTER ONE
THE PROBLEM

1.1 Introduction

The desire to enhanceacquisition of science process skills through the use of more effective instructional strategies and the increasing awareness in recent years of the teaching-learning process has directed a lot of attention to understanding of how learners learn. Bichi (2002) defined science as intellectual activities carried out by scientists designed to discover information about the natural world in which we live and to discover ways in which this information can be organized to benefit human race. In this respect, the primary focus of science is to collect data and the ultimate purpose is to discern order that exist in natural phenomena and happenings around us.Shaibu (2014) observed that science is a complex human activity that leads to the production of a body of universal statements called laws, theories or hypotheses which served to explain the observable behavior of the universe or part of it and which in themselves have predictive characteristics. Hornbly, (2006) defined scienceas an intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment.

Science is a particular way of investigating the world and of forming general rules about why things happen by observing particular situation. (Raven & Johnson, 1996; Johnson & Raven 1998; Mader, 2000;Ajaja, 2007).Science is the foundation upon which the bulk of present day technological breakthrough is built. These days, nations all over the world including Nigeria are striving hard to develop scientifically, since the world is becoming scientific and all proper functioning of lives depends greatly on science(Mader,

2000). According to Alebiosu, (2003) science aimed at searching for causes and providing reasons for solution to phenomena or experiences in life.Oyewole, (2003) explained that some people view science as a means or instrument for technical and economic development of a nation.

Obioma, (2008) declared that every learner who has gone through nine years of basic education should have acquired appropriate levels of literacy, numeracy, manipulative, communicative and life skill, as ethical, moral and civic values needed for laying solid foundation for life-long learning as a basis for scientific and reflective thinking. From the definitions, science can be seen as not just mere acquisition of facts but rather the active involvement of students through activity-based methods such as, discussion method, project method, field trip, discovery, co-operative learning and inquiry instruction. Therefore, effects of inquiry-based instruction on acquisition of process skills, interest and performance in ecologyamong secondary school students in lere educational zone will be investigated.

The term "Biology" is derived from two Greek words: Bios and logos which simply mean life and study respectively. Biology according toSarojini, (2006) can simply be defined as a branch of science which deals with the study of living and non-living organism. Biology is a practical based subject, which equips students with concepts and skills that are useful in solving the day-to-day problems of life. Biology is central to many science related courses such as Medicine, Pharmacy, Agriculture, Nursing, Biochemistry, and so on. It is obvious that no student intending to study these disciplines can do without Biology.

The National Policy on Education, (FRN, 2013) stated that the aim of education is to inculcate in the child, thespirit of inquiry and creativity through the exploration of nature. According to James, (2000) the objectives of the National Policy on Education will not be achievedas desired, if appropriate teaching techniques and the principle of individual differences which exist among others are not closely monitored. In line with these objectives, the three major science subjects that are taught in Senior Secondary Schools level in Nigeria are Biology, Chemistry and Physics. Biology is considered as one of the core science subject made compulsory for all science students at Senior Secondary School of the Nigerian Education system

A cursory look at the secondary schools in Nigeria has shown that many teachers in the system still rely much on the traditional "chalk and talk" method of teaching rather than embracing the use of inquiry-based teaching strategy.Okebukola, (2008) identified some weakness exhibited by tertiary institution graduating teachers that lack practical skills, shallow knowledge of Biology and poor knowledge of teaching methodologies.Gilbert, (1998) observed that the difficulty perceived by science students is their inability to make reasonable connection between concept areas and its application in solving problems in Biology. In related studies, Yilwa, (1999), Jibril and Nura, (2007), independently identified poor methods of teaching and improper use of instructional materials as some of the deficiencies of science teachers. Okebukola (2009) also attributed the poor performance in Biology to the use of ineffective teaching and learning strategies and lack of appropriate learning environment under which Biology teaching takes place. This study therefore investigatesthe effects of inquiry-based instruction on

acquisition of process skills, interestand performance in ecology among secondary school Biology students. .

One of the most common methods of teaching science at the Senior Secondary level is lecture method. According to Bichi (2002) this is a method of teaching that emphasizes "talk and chalk" in the teaching of science subject. More than 80% of the scientific information and principles are delivered as lectures. Teachers embrace this method for easy coverage of the school syllabus. It is characterized by one way flow of information from the teacher who is always active, to the students who are always passive. In its true nature, lecture method is not effective for science teaching. James (2000), Usman (2000) and Bichi (2002) all argued against it because it does not promote meaningful learning. They further explained that the use of lecture method of teaching in science leads to rote learning. Achilles and Pate (1992) reported a decrees in skills acquisition when lecture method is used. However, lecture method of teaching should not be totally discouraged, but there is need to improve on it for effective teaching and learning of Biology. This can be done by use of inquiry-based instruction.

The National Research Council (NRC) reports (1996; &2000) called for inquiry-based methods that led to current reforms and an increased emphasis on inquiry in science curricula. Inquiry has been identified as a teaching and learning method that provides learners with motivation to learn and develop skills to be successful throughout life (Dewey, 1910; Lederman, 1998). NRC explained that students benefit by learning science through authentic investigations similar to those conducted by professional scientists. In theory, with the placement of science in a context through inquiry-based instruction, teachers and students begin to develop their approach to science, and this

investigative learning leads to better understanding (NRC, 2000). In this study, effects of inquiry-based instruction on acquisition of process skills, interest and performance in ecology will be investigated.

Inquiry method of teaching is a teaching method where the learner, with minimum guidance from the teacher seeks to discover and create answers to a recognized problem through procedure of making a diligent search (Callahan & Clark, 1977; Adedoyin, 1990). Inquiry is a term used in science teaching that refers to a way of questioning, seeking knowledge or information or finding out about phenomenon. Using this method students learn not only concepts and principles but self-direction, responsibility and social communication. It is a highly interactive step by step approach which involves student at all levels of discussion (Obeka, 2010). It is also the way people learn when they are left alone.

Some of the inquiry based instruction are guided discovery and self-learning strategies.Guided discovery is one of those teaching methods that employ exploration, manipulation and experimentation to find out new ideas (Akuma, 2008). The instructor devises a series of statements or questions that guide the learner, step by logical step, making a series of discoveries that leads to a single predetermined goal. The guided discovery strategy is activity oriented and involves practical demonstration, discussion and experimentation. During such instruction the students employ the processes of science like observation, classification, investigation, and critical interpretation of findings. In Biology, it is possible for guided discovery strategy of teaching to be enhancing student's performance. This is because of the activity oriented nature of the guided discovery strategy (Okoye, Momoh,Aigbomain, &Okecha, 2008).

The search for a more effective approach for the teaching and learning of Biology that will enhance the acquisition of process skills has persisted over the years. This is because the acquisition of science process skillsand the bases for science inquiry and development of intellectual skills and attitudes that are needed to learn conceptsare not utilized by Biology teachers. Nwosu in Ibe,(2004)asserted that science process skills are abilities which can be developed by experience and used in carrying out mental and physical operations.Hedges and Woodworth (1999) claim that by allowing students to learn science the way scientists practice science they will be able to gain an understanding of science content and develop science process skills. These process skills are fundamental to science due to the fact that it allows students to conduct investigations and from it conclusions are drawn.Bruner,(1961) suggested that learning can be meaningful by activity-based instructional strategy such as discovery method, problem-solving and inquiry method. Bichi,(2002) also observed that as students engage in solving problems; they acquire skills and confidence which aid their capacity to tackle future problem.

From the above definitions, inquiry-based teaching can also be seen as a pedagogical approach that invites students to explore academic content by posing, investigating and answering questions to the discovered problem or problems. Also known as problem-based teaching or simply as “inquiry,” this approach puts students questions at the center of the curriculum, and places just as much value on the component skills of research as it does on knowledge and understanding of content.

Nwosu (1994) opined that, science process skills development requires direct involvement in scientific activities and procedures in the laboratories and in the field.

Reading and activity oriented science emphasized the same intellectual skills and are both concerned with thinking processes. Ibe,(2004) report that, the American Association for the Advancement of Science (AAAS) developed a programme known as "Science A Process Approach" (SAPA). Thisprogramme sees science processes as true essence of science. The programme was designed to improve children's skills in the process of science. Ajunwa, (2000) reported that science educators and curriculum experts modified them by their expanding or condensing them to suit their special needs or expectations. Some of these science process skills include; Observation, measuring, classifying, operational definition, experimentation, communicating, among others. In this study, effects of inquiry-based instruction on acquisition of process skills, interest andperformance in ecology among secondary school students will be investigated.

Performance means accomplishment or proficiency of achievement in a given skill or body of knowledge. Ricarda (2015) academic performance is the outcome of educational output, the extent to which a person has accomplished specific goals that were the focus of activities specifically in school, college and university.

Popoola (2010), defined academic performance as an expression used to present students scholastic standing and which is a function of a various factors such as method of teaching, teacher qualification, child's home background, school environment, attitude, and interest among others. Adediwura and Taiwo (2007), opined that academic performance is the display of knowledge attained or skills developed in school subjects designated by test and examination scores assigned by the subject teacher. The researcher therefore, intends to

investigate the effects of inquiry-based instruction on acquisition of process-skills, interest and performance in ecology.

Apart from poor teaching strategy, another factor of concern that led to poor acquisition of process skills is lack of interest in science subjects (Biology inclusive) as observed by (Nweke, 2010). As a psychological variable, interest has a history. Walter and Hart (2009) defined interest as an individual's desire, power and tendency to act in a particular way.The development of interest has been the focus of the conceptualizations of(Hidi & Renninger (2006) & Krapp 2002 & 2007). They have each described interest as being a psychological state and predisposition to reengage particular disciplinary content over time that develops through the interaction of the person and his or her environment.

Krapp (2007) opined that once interest is maintained, repeated engagement can be either self-initiated or promoted by the environment, leading to the development of first an emerging and then a well-developed individual interest, while Renninger (2006) added that if interest of a student could be generated during learning process, academic performance is certain to be enhanced. In senior secondary school, students select a major field of study (Biology, Physics, and Chemistry are the science subjects that can be chosen).

Another important issue is that of the influence of students' gender and teaching strategies in science. Some studies, (Ogunleye, 2001, Adesoji 2008, and Bunkure, 2008) on the effects of instructional strategies on students' performance in science suggest that there is a relationship between gender and teaching approaches.Differences in the performance of both male and female students in science subjects when exposed to various instructional strategies are reported by Okeke (2001) to be insignificant. However, some research findings such as Mari (2001) revealed consistent differences between the performances of male and

female learners in achievement tasks in science. Mari (2001) for instance, reported that students' achievement in science was significantly high when taught by teachers of opposite sex. It is also on record however, that other researchers revealed conflicting results of no difference in performance, (Eya and Mbo, 1997; and Ogunleye 2001). The reasons researchers attribute to gender-related differences in achievement between male and female learners includes the innovative nature of the instructional strategy used, students cognitive ability levels, psychological and socio-cultural factors, (Okeke, 2001). It will therefore be interesting to find out if there may be a link between inquiry-based instruction and gender-related differences in achievement between male and female learners; because the activities involve in the inquiry instruction may be too cumbersome to the girls since they do not like practical work. That, notwithstanding, issues regarding gender and science still remain a controversy. One such controversy is that girls do not like practical work and can't handle the inquiry instruction (Adesoji, 2008). Therefore, the researcher seeks to investigate the effects of inquiry-based instruction on acquisition of process skills, interest and performance in ecology among Secondary School Students in Lere Education Zone.

1.1.1 Theoretical Framework

The theoretical framework that guided this study is the constructivist theory proposed byPiaget (1961) which is based on the active nature of learning. The constructivists' school of thought view learning as an active process in which students create their own maps and theories of the world. The constructivists' school of thought view learning as an active process in which students actively construct their own knowledge of the situation at hand based on the existing previous knowledge. Constructivism argues that students are not

passive absorbers, but active constructors of knowledge. According to this theory, students engage their minds very actively in constructing meaning out of their interactions with the environment. They make their own connections between experiences and the words other people are teaching them and they create their own network of relationship and patterns of thinking (Stanley, 2008). According to Piaget (1961)the child's mental process is limited to thinking. The child's concepts of quantity, time, space, conservation and reversibility develop when they are young. The learner can classify things at this stage and he acquires logical process of observation, describing, classifying, and measuring real objects. Learning should go from simple to complex and importantly the learner should deal with concrete materials first before going to complex and he can learn abstract concept and generalizations.This implies that when the learners are engage in an activity-based instruction the level at which they acquire process skill will be enhance.

Schwab (1966) opined that students should view science as a series of conceptual structures that should be continually revised when new information or evidence is discovered. Schwab considered that science should be taught in a way that was to be consistent with the way modern science operates. He also encouraged science teachers to use the laboratory to assist students in their study of science concepts. He recommended that science be taught in an inquiry format. Besides using laboratory investigation to study science concepts, students could use and read reports or books about research and have discussions about problems, data, the role of technology, the interpretation of data, and any conclusions reached by scientists.

Ausbel (1968) claimed that for improvement and academic performance of students, teachers ought not to only provide both a conducive learning environment but also employ

good teaching techniques and strategies. He also found out that the interactive methodology teachers employ is a critical factor for student higher levels of achievement in both cognitive and affective areas. Hefurther reported that a significant improvement in science achievement is a result of instructional strategies that gives students the opportunity to explore, argue and discuss events and phenomena at first hand and be able to make generalizations or arrive at principles for themselves. When science teachers employ good teaching strategy the learners academic performance is enhance.

Therefore, the study seeks to investigate the effects of inquiry-based instruction on acquisition of process skills, interest and performance in ecology among secondary school studentsin Lere, Kaduna State.

1.2Statementofthe Problem

The curricular developmental aspect of Biology has focused more on rote learning over years which makes instruction teacher-centered. According to Gyuse (2009), vital abstract contents in Biology (like Ecology concept) can hardly be effectively communicated to the learners theoretically. Students' needs to be taught using innovative strategies like inquiry-basedinstruction and field trip method. Achilles and Pate (1992) reported poor skills acquisition when lecture method is used to teach Biology concepts and other science related subjects. Most teachers still prefer using the 'chalk and talk' method in instructing learners (the lecture method approach). But Swan et al (2008) observed that the problem associated with teaching of Biology can be effectively handle by teaching with inquiry instruction.

The need to find solution to students'poor acquisition of science process skills is therefore an obvious factor as Zayun (2008) opined that several factors have been responsible for low acquisition of science process skills. This include: Teaching methods,

learning materials, teaching factor, societal factors and strategies employed by teachers among others.Shehu, (2006) discovered that the major problem of science subjects is rooted in the difficult nature of the science subject as a result of using poor teaching method to teach science concepts. Yusuf, (2012) added that the difficulty perceived by science students is their inability to make reasonable connection between concept areas and its application in solving problem in Biology as a result of poor methods used by many science teachers. The need to use appropriate method that will boost the acquisition of process skills, interest and performance in Biology is a point of concern.

A critical look at students' academic performance in Biology in Secondary School Certificate Examination over the years showed that as the enrolment increases, the number of passes is not encouraging, the teachers' method of teaching may have been a major source of student's poor academic performance in Biology. Therefore something needs to be done to improve the performance (Gyuse, 2009). The performance of students can be seen from the statistical table of Biology results in May/June West African Examination S.S.C.E

Table 1.1 Students' Performances in Biology in Kaduna State WAEC May/June, 2012-2016

Year	Total Sat	No with A1-C6	% with A1-C6	No with D7-F9	% with D7-F9
2012	126,821	59657	47.04	67161	52.96
2013	134,852	56570	41.95	78282	58.05
2014	130,653	56155	42.98	74498	57.02
2015	150,925	72204	47.85	78722	52.17
2016	143,936	62008	43.08	81928	56.92

Source: West African Examination Office, Kaduna Office (2017).

In spite of the relevance of Biology as one of the major science subjects whose pass at credit level determines to a large whether students will be admitted or not to read a number of major professional science based course at the university, yet its failure rate is more alarming compared to Chemistry and Physics (Calderon & Gonzales, 2013).An attempt to improve on the academic performance of students in these science subjects, several factors have been identified to be responsible for the poor performance of the students. Ganal, Andaya and Guiab (2016) advanced some problems including lack of practical skills and shallow knowledge of the subject matter.Olayinka, (2016) identify poor method of teaching and improper use of instructional materials as being the cause. Gyuse (2009) observed that many students experience difficulty in science courses as a result of the lecture method used by their teachers.

This situation has created the need for more effective teaching method that will enable the students acquire the skills that will help them know the areas of strength and weaknesses to be able to acquire process skills, perform very well and have more interest in Biology.The researcher therefore, investigated the effectiveness of inquiry-based instruction on acquisition of process skills, interestand performance in ecology among SSS students in Lere, Kaduna, Nigeria.

1.3Objectives of the Study

The main objective of this study is to determine the effects of inquiry-based instruction onacquisition of process skills, interest and performance in ecology.

Specifically, the study intends to ascertain:

1. if using inquiry-based instruction will enhancestudentsacquisition of science process skills.
2. the difference in the interest shown in ecology by SSS students when exposed to inquiry-based instruction and lecture method.
3. the differences in the mean academic performance when SSS students are taught using inquiry-based instruction and lecture method.
4. determine whether there is gender related differences in the acquisition of science process skills when exposed to inquiry-based instruction.

1.4Research Questions

Based on the objectives of this study the following research questions were raised.

1. Does any difference exist in process skills acquisition between subjects taught using inquiry-based instruction and those taught using lecture method?
2. Is there any difference in the interest shown in ecology by SSS students when they are taught using inquiry-based instruction and lecture methods?
3. Is there difference in mean academic performance between subjects taught using inquiry-based instruction and those taught using lecture method?
4. Is there any gender related difference in the acquisition of science process skills between male and female subjects when exposed to Inquiry Instruction?

1.5 NullHypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance

HO_1: There is no significant difference in the process skills acquisition between subjects

Exposed to inquiryinstruction and those exposed to lecture method.

HO_2 There is no significant difference in the interest shown in ecology by SSS Students

When exposed to inquiry-based instruction and lecture method.

HO_3: There is no significant difference in the mean academic performance when SSS

Students are taught Biology using inquiry-based instruction and lecture method.

HO_4: There is no significant difference in gender when male and female subjects are exposed

Toinquiry-based instructionin the acquisition of science process skills.

1.6Significance of the study

The findings will hopefully be useful to teachers, students; curriculum planners, existing literature,professional bodies such as STAN,WAEC,NECO and other researchers, etc. in the following ways;

1. Biology teachers would know the value of using the inquiry method of teaching Biology concepts apart from the numerous methods or approaches of teaching Biology to enhance acquisition of science process skills. It would also be made clear to teachers that different methods could be used in teaching different concept in Biology instead of the traditional methods
2. The findings would improve student's inquiry skills on some scientific concepts.
3. These findings would assist educators and curriculum planners to understand and appreciate the way Biology would be taught using other strategies.

4. Professional bodies such as STAN and MAN will benefit by organizing workshops on the use of activity-based strategies for effective teaching of science subjects.
5. It would also prepare ground for interested researcher who might wish to conduct further research in related areas and could contribute to the existing literature.

1.7 Scope of the Study

The focal point of the study is to determine the effects of inquiry-based instruction in acquisition of science process skills, interest and performance in ecology among secondary school students in Lere Educational Zone. The schools covered for the study comprise of government senior secondary schools in Lere Educational Zone, the sample were randomly selected from the schools. The instruments used for data collection are Science Process Skills Acquisition Test (SPSAT), Ecology Performance Test (EPT) and Student Ecology Concept Interest Questionnaire (SECIQ). The concepts of this study are: ecology, ecosystem, habitat, environment and community. Teaching ecology as a concept using inquiry-based instruction allow the learners to actively participate and these promote acquisition of science process skills, enhances student performance and interest in the subject matter. The research study is restricted to test only eight process skills that the students are expected to acquire and this are; ability to observe, measure, classify,inferring, operational definition, identification, communication and designing experiment.

1.8Basic Assumptions

For the purpose of research work, the following assumptions are made:

i. The sample of the study is representative of the population to whom inference will be made.

ii. The Biology students are taught by qualified/experienced teachers as recommended in the National Policy on Education

iii. The curriculum used is the same for all Biology senior secondary school students in LereEducational Zone.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

The review of related literature is focused on the past studies that have been conducted on the effects of inquiry-based instruction on acquisition of process skills, performance and interest in ecology. In this chapter, the review therefore concentrates on the following sub headings:

2.2Teaching and Learning of Science

2.3 Biology as aScience subject

2.3.1Teaching Ecology at Senior Secondary Schools

2.4 Science Teaching Methods

2.4.1 Inquiry-Based Teaching Strategy in Science

2.4.2 Importance of Teaching Science

2.4.3 General Problems in the Teaching of Science

2.5Process skills acquisition and academic performance in science

2.6 Interest as a factor and performance in Science Education

2.6.1 Relevance of Interest in Teaching and Learning Science

2.7 Gender and Academic Performancein Sc

2.8 Overview of Related Studies

2.9 Implications of Literature Reviewed for the Present Study

2.2 Teaching and Learning of Science

Inquiry method is one of the strategies of teaching Science. According to National Research Council (NRC) (1996) scientific inquiry involves many different ways that Scientist investigates the natural world and findings from their research. According to the science education reform documents, improving students understanding of science and scientific inquiry is critical for developing a scientifically literate society (American Association for the Advancement of Science) (AAAS) (2006) and National Research Council (NRC) (1996 & 2000). Teaching and learning of science as inquiries not only grasp scientific information but also develop fundamental understanding and abilities to conduct scientific inquiry (NRC 1996 & 2000). The Publication inquiry and the National Science Education Standards (NRC. 2000) identified the following five essential features of classroom inquiry:

- Learners are engaged by scientifically oriented questions;
- Learners give priority to evidence in responding to question;
- Learners formulate explanations from evidence to address scientifically orientedquestions;
- Learners evaluate their explanations in light of alternative explanations particularly thosereflecting scientific understanding; and

- Learners communicate and justify their proposed explanations.

It has been reported that students who enrolled in inquiry-based science classes with meta-cognitive facilitation or a reflective assessment component outperformed their counterparts in similar classes without meta-cognitive facilitation (NRC, 1999 & 2005) in Liang and Richardson (2009).

2.3 Biology as a Science Subject

Biology as a separate science was developed in the nineteenth century as scientists discovered that organisms shared fundamental characteristics. Biology is now a standard subject of instruction at schools and universities around the world and over a million papers are published annually in wide array of Biology and medicine journals, (crystyl 2011). Also, Ambuno, Egunyomi and Osakwe, (2008) stated that Biology forms the basis of disciplines like human medicine, veterinary medicine, nursing, Agriculture, forestry, pharmacy, food technology, laboratory science technology, biological weapons and human nutrition to mention just a few.

Most Biological sciences are specialized disciplines. Traditionally, they are grouped by the type of organism being studied: Botany (the study of plants); Zoology (the study of animals); Microbiology (the study of microorganisms). The fields within Biology are further divided based on the scale at which organisms are studied and the methods used to study them (Adeniyi, 2004).

1. Biochemistry examines the fundamental chemistry of life;
2. Molecular biology studies the complex interactions of system of biological molecules;

3. Cellular biology examines the basic building block of all life, the cell;
4. Physiology examines the physical and chemical functions of the tissues and organ systems of an organism; and
5. Ecology examines how various organisms and their environment interrelate.

Biology is a very important part of everyday life. Any advances in medicine, dealing with environmental issues, or Biotechnology depend on an understanding of living organisms, great, medium, and small (Bichi, 2003; Kalu&Ndokwo 2006). Even if our main goal is simply ensuring the survival of the human race, we still must be able to understand and sustain the biosphere. We poison our land, air and water. The greenhouse effect and global warming are both threats that concern our biosphere (crystyl, 2011). According to Okeke, (2007), it would be utterly hopeless to try to sustain the diversity of life on earth in the future without a decent knowledge of Biology. In order to maintain the delicate balance of life on earth, we first must understand that we are not alone on this planate. We need to learn about the effect wehave on our environment and other living things. Also, the extinction of any specie can disturb the equilibrium of an ecosystem. Therefore, there is the need to understand that all of our actions have effects on other organisms and the environment (Crystyl, 2011).

Biological concepts (Physiology, Ecology, molecular Biology, Biochemistry, Chemical Biology among others) require more than one method or strategy to teach for effectiveness. For example, lecture method can be used alongside indoor laboratory teaching strategy in the teaching of Physiology which examines the physical and chemical functions of the issue and organ systems of an organism. This concept ecology deals with the science of the interrelationship between organisms and their environment. The teaching and learning

of this concept (Ecology) needs strategy that require direct measurement, identifying, communicating, predicting, observation of organisms in their natural surroundings, this strategy is called inquiry-based teaching strategy. This inquiry teaching strategy may help the students to use the process skills and study things in their natural environment. Therefore, the present study investigated the effects of inquiry-based instruction in acquisition of process skills,interest and performance in ecology among secondary school students.

2.3.1Teaching Ecology at Senior Secondary Schools

Ecology literary means study of living things in their natural surrounding or habitat. Usman, (2000) describe ecology as the study of the relationship of organisms with one another and their environment. And as such view ecology as being concerned with population of organisms with each other and their non-living or physical surroundings. With these definitions, all are pointing to the physical environment in which the organisms live and their biotic environment. It denotes that no organism can live in isolation instead it must interact with its environment which is simply referred to us “Ecology”.

The undoubted interest which youngsters have in living things is at once and advantage and a trap to the teacher of Biology (Jean, 2001). The teacher must make sure that the learners understand the ecology of the specimens under study and that they have some appreciation of its fellow species and possibly its place in the food chain.

Since ecology has to do with interactions of living organisms and the non–living components of the environment, it is necessary to create the awareness of ecology as a subject early in the life of the students (Nzewi, 2008). Certain aspects of basic ecological concepts like population density, habitat etc are expected to be taught in secondary schools require some basic measurements and calculations. Student and teachers have a natural phobia for anything that has to do with calculations. Such teachers and students would prefer a theoretical aspect require weighing and measuring. This trend has contributed to the general poor performance of candidates in question that deal with ecological concepts in the West African Senior Certificate Examinations (WASSCE) (Oyedokun, 2002). The senior secondary school Biology curriculum places the basic ecological concepts to be studied under year one. And some include the ecological system, environment, biosphere, habitat, biome, food web, food chain, measuring instruments etc. The curriculum specified the performance objectives to be achieved as well as the activities to be carried out in the course of teaching and learning to facilitate understanding of the concepts being taught (Nzewi,2008).

Student Ecology Concept Interest Questionnaire (SECIQ) adapted from Muoneme (2015), the instrument consist of twenty five (25) items was used in this study, therefore, an investigation was made on the effects of inquiry-based instruction in acquisition of process skills, interest and performance among secondary schoolBiology students' This may help the students to remember and understand what they have seen in its natural environment, thus improving the acquisition of process kills, interest and performance.

2.4 Science Teaching Methods

In education the word ‘method’ means the mode by which the material is communicated from the teacher to the student. It is the way teachers impart knowledge and skills while teaching and students comprehend knowledge and acquire the skills in the process of teaching (Rao, 2003). According to Gbamanja (1991) there is no one method of good teaching. The method to be employed will depend on the subject matter, the students, the teacher and the environmental variables. Therefore, it is very important to know the prevailing conditions regarding time, place and human nature in the shape of the learners, teachers, parents, and society generally.

Ogunneye (1992) mentioned that science teachers are to vary their teaching methods on the demands of the situation they may find themselves. A combination of two or more method may better achieve the desired effect than a single method. Rao (2003) observed that there are many methods of teaching but science selects a particular method based on the needs of the content, teaching facilities available, and ability of the students and the philosophy of the teacher. Rao (2003) categorized teaching into three; namely Oral methods which include: Narration, recitation, lecture and discussion method. Secondly, activity methods which include: demonstration method, activity method, project method, laboratory method, heuristic method, discovery learning/inquiry approach, problem solving method and supervised study. Thirdly, special methods which include: Programmed learning, team teaching, computer assisted learning and personalized system of instruction. Some of the teaching methods are as follows.

Field trip involves taking the students out of the classroom so that they can learn some science concept and themes as they occur in real - life situations. A possible site for field trip or excursion is school farm/garden. Playground and related science concept that

could be learn include insects, living organisms, seeds and plant, growth and types, food chain. Gbamanja (1991) sees field trips to include visits to various exciting places which can enrich learning. Field trips are meant to broaden student's general knowledge. Students are supposed to observe the application of certain scientific concepts learnt in class or to examine some process or special material in its natural environment. Such observations provide primary experience to the learner and this is very crucial in science. During this process of first experience or primary experience the learner is kept observing, collection, classifying, studying relationship and manipulating objects. This leads to the acquisition of science process skills and also to the scientific method of inquiry which form the basis for science teaching.

According to Ogunneye (1992) project method involves every member of the class, a learning task in science is sub–divided into some units and each unit is assigned to a group of learners to study and to report. Each group is expected to complete the unit of the project within a specified time. As each group is working on the unit assigned to it; teacher goes round to offer assistance where necessary. Aina (2007) stated that children are encouraged to investigate, collect specimens and analyze on their own. Each group later presents its report; all reports are collected by the teacher for an exhaustive discussion by the class. Discussion is another method of teaching in which teachers employ to teach science.

Discussion according to Gbamanja (1991) occurs when two or more people interact verbally with each other. A discussion becomes more meaningful if the persons involved in a particular discussion see each other's point of view and they are able to harmonize their ideas to arrive at a consensus. Gbamanja (1991) further stated that in teaching science therefore, the discussion method could be adopted deliberately in a learning situation. But

sometimes, it may occur spontaneously as a teacher uses one method of teaching or another. In fact, the discussion approach to teaching of science can enrich various types of teaching methods. Discussion at brief intervals to clarify certain points must be adopted during lecture, demonstration, inquiry, discovery, or even before and after excursion or laboratory exercises.

Discussion could be considered as a technique within a method. It is therefore more of a technique in teaching used to enhance effectiveness of various methods. Effective discussion s involves questioning and developing interaction between the teacher and the learners. A good discussion allows the students to pursue the idea being discussed so that they are made to arrive at the objective being sort. For effective discussion to take place the teacher should seek maximum participation from the learners. Students should be made to give their various points of view and the teacher should not communicate or dispense knowledge but act as a moderator. The teacher should not dictate or influence the view points of the students as lie, but moderates the discussion. Rather he should guide the students as they present their various viewpoints which should be harmonized and identified vividly with the teachers reference frame. In this way, the discussion technique is regarded as a student's centered approach to teaching science. In the teaching and learning of science, teachers employ inquiry method.

Abdullahi (1982) sees inquiry or discovery method as one of the strategies of teaching science. Many science educators have consistently advocated for this method as they believe that science should not be taught to a child but that he should be left to discover it. Rao (2003) defined discovery or inquiry method as a process of self-learning whereby learners generate concept and ideas with very little teacher intervention. The approach are

used to discover new knowledge through experimentation, problem solving or project work. There are two types of inquiry approach according to Ain (2007), namely guided and unguided. The guided inquiry approach is recommended for science teaching. In a guided inquiry class, the student tends to act more like adult by originating problems, formulating hypotheses, designing investigative approaches, testing ideas by experimenting, synthesizing the knowledge gained and developing certain attitudes. These according to Aina (2007) are possible if provisions for a science room with special conference area and a discovery corner. Another method of interest in science teaching is lecture method.

This method according to NTI (2006) involved a none-way flow of information from the teacher to the students. The teacher does most of the activities which the student are expected to listen with little or no involvement; it is otherwise referred to as teacher-centered type of instruction. Atadoga and Anaolapo (2008) mentioned that lecture is used for elaborating; simplifying, classifying and discussing new materials to learners, the material include facts or views on issues and problems related to the learners, which provide an aesthetically stimulating experience. Effectiveness of lecture method depends on the type of students, educational purposes and teachers own characteristics and skills. FME (2004) stated that lecture method have two merits:

i. It is a cheap method to use as no apparatus is required

ii. It does not consume time therefore a lot can be covered in a short time.

And the following demerits are:

i. it encourages memorization of facts

ii. It gives a wrong picture of science

iii. It stifles creativity and development of scientific process skills by students.

Demonstration is a process or means of showing how something works or is used. It is an act to display working of some experiment. The demonstration method is natural method of teaching and provides foundation for the initiative behavior through example. Similarly, demonstration provides foundation for apprenticeship training. When a chemistry teacher is showing the presence of carbohydrate in food materials, he is demonstrating. Thus, demonstration is one of the most common methods used by science teachers. Science is based on sensory experience and in learning by observation and experimentation a student uses his sensory organs. Demonstration can contribute to both. When properly utilized, demonstration method can be effective as well as useful. In science demonstration is significant method where students learn to do practical after the demonstrations are given by the teacher Rao (2003). Aina (2007) stated that demonstration involves carrying out science activities, and that demonstration can be carried out by the teacher alone, the teacher with a child, the child who is knowledgeable in the activity and an invited quest.

2.4.1 Inquiry-Based Teaching Strategy in Science

The teaching of science as inquiry is a process which encourages students to solve problems in a logical and systematic manner, using the process of science, Akinbobola and Afolabi (2010). These processes of science are characterized by various skills, such as Observing, Comparing, Inferring, Hypothesizing, Experimenting, Data collection, and interpretation of data; these are inquiry skills. Richard and Francis (2013) defined inquiry thus: “the total configuration of behaviours involved in the struggled of human beings for reasonable explanations of phenomenal about which they are curious”. In a similar report,

Richard and Francis (2013) defined inquiry as "the act of creating individual knowledge by gathering and processing information". Akinbobola and Afolabi (2010) were reported by Richard and Francis (2013) to have defined inquiry as a set of activities characterized by a problem-solving approach in which each newly encountered phenomenon becomes a challenge for thinking". They believed that the essence of the inquiry process lies in the questions asked. He defined inquiry as "the approach to an idea by students and teacher through questions asked of each other at various level of difficulty." He listed the kinds and level of questions to be asked as follows:

i. Those which can be answered readily from the experience and materials at hand, together with general knowledge.
ii. Those which can be answered but only after considerable investigation and thinking.
iii. Those which cannot be answered by either students or teacher.
iv. Those which probably cannot be answered at all with the present state of knowledge.

According to him, "it is the unanswered and sometimes unanswerable questions that form the heart of inquiry process".

He concluded by asserting that "at this point, the teachers can say I don't know the answer, and I doubt if anyone does. We can look for the answer, collect evidence and possibly make a judgment as to what the answer might be, but we cannot be sure. This is inquiry". Other authors like Stanovich and West (2010) pointed out that "in true inquiry, the individual tends to act more like a maturing adult. He formulates hypothesis about a problem, designs investigative approaches, carryout experiments, synthesis knowledge and develop certain scientific attitudes".

Schwab (1962) capped the inquiry process in science thus: “the product of scientific inquiry is the accumulation and systematized tested body of knowledge which includes concepts and principles. These form the basis which scientists use in their construction of broad conceptual strategy which Schwab called theories and laws”.

Richard and Francis (2013) also reported Stanovich and West (2010) to have distinguished between “inquiry as content” and “using the method of scientific inquiry to learn science” which he called “inquiry a techniques”. He said: “if all that is intended by the inquiry strategy is that we should encourage students to be inquisitive, curious, ask questions and try to find answer by himself then we are advocating no more than what good teachers have long believed in and practiced”. Inquiry instruction attempts to help students and discover answers to their questions. In inquiry, the emphasis is on learning principles, concepts and problem-solving skills rather than on mere memorization of factual information.

A variety of studies have investigated the effectiveness of inquiry teaching strategy as it enhances the academic performance of students, particularly in science subjects. Although, a few researchers have argued to the contrary; Stanovich and West (2010). The overwhelming evidence in the literature shows that the inquiry strategy is the most effective method of teaching science.

Richard and Francis (2013) in their research titled “A re-assessment of the effectiveness of inquiry-based science curricular of the 60s on students’ performance”. Arrived at three major conclusions:

a. That the new science curricular of the 60s and 70s (inquiry-based) were more effective in enhancing students' performance than the traditional textbook based progammes.
b. That inquiry-based science curricular of the 60s and 70s had significant positive effects on males but not on females at the composite performance level.
c. That at the criterion level, achievement and perception in inquiry-based science curricular were significantly positive but the female performance on corresponding criteria were not.

Tornquist, (2006) pointed out that the inquiry approach which they called the new science curricular enhanced the performance of students more than the conventional teacher centered approach (expository strategy). Nurshamshida, Abdullah and Yaamat(2013) in a research titled "Guided inquiry approach to science instruction versus lecture laboratory approach", found that the inquiry approach has proved to be a successful teaching methodology for high school science instruction. Nurshamshida, Abdullah and Yaamat (2012) concluded that, "the conventionally taught science courses are typically instructor-centered, in the sense that they provide the subjects with very little opportunity for self-initiated and self-directed study. Stanovich and West (2010) examines the relative effectiveness of a verbal approach (expository strategy) and a guided discovery approach (similar to inquiry) to the teaching of science principles at the seventh and ninth grades. They found out that the guided discovery approach was more effective than the verbal approach.

Here in Nigeria, James (2000) showed that the inquiry approach to the teaching of science was more effective than the traditional lecture method. In a related finding, Shuaibu

(1997) surveyed all the methods of teaching science in the secondary schools in Kaduna State. His findings revealed that the inquiry method of teaching was the most effective method of teaching science.

2.4.2 Importance of Teaching Science

A number of reasons have stated for the teaching of science, some of the reasons are as follows:

i. Biology as a school subject helps to prepare students for useful living in the society.

ii. It helps students learn what science is and how scientist work

iii. It makes the students scientifically literate.

v. Prepares the students for higher education at both polytechnics, Colleges of education and University level, as stipulated by the National Policy on Education (FRN 2005) and National Teachers Institute (NTI. 1990).

vi. Biology if properly taught is aimed at developing the learners all round abilities foster citizen who are potential leaders of tomorrow.

2.4.3 General Problems in the Teaching of Science

The teaching of science as an innovation in the country's educational system is expected to face one problem or another. There are series of problems that beset the teaching of science. In his presidential address at the 24th Annual Conference of science Teachers Association of Nigeria (STAN) in Jos, Bajah (1981) as cited in Gbamanja (1991) mentioned that most of the problems arise as a result of the inappropriate training background of the

science teachers which is not adequate for teaching science. Some of the problems are as follows:

i. Lack of Understanding the Philosophy and Methodology: Most science teachers today do not fully understand the philosophy and methodology of science. Science project is students centered, activity-oriented. But most teachers do not have the requisite skills to put these characteristics into practice.

ii. Large Class Size: science been a student's centered because is best taught in small class size. But most classes in our schools today are overcrowded. This makes classroom control and management difficult thereby affecting the teaching and learning of science.

iii. Insufficient Qualified Teachers: There is inadequate supply of teachers to teach science in all schools. In some schools, where there are no teachers, students are left without learning science subjects for one or two terms.

The effect is that students are denied the knowledge, skills and attitudes that they are expected to acquire.

iv. Lack of equipment and materials: Inadequate equipment and materials required for the activities is another problem facing the teaching and learning of science in Nigeria. Although this problem can be solved or minimized through improvisation, most of the teachers do not have the skills needed for improvisation

v. Inadequate Qualified Teachers: Most of the teachers lead ling science subjects in our schools do not have the necessary training in teaching science (Gbamanja, 1991 & National Teachers Institute (NTI) (1990).

2.5 Process Skills Acquisition and Academic Performance

The history of science process skill approach can be traced back to the successful launching of sputnik 1 in 1957 by the former U.S.S.R prompted the United State of America (U.S.A) to rapidly reform its science education policy and came up with programs such as Science A process Approach (SAPA), which was an experimental program in elementary school science, sponsored by the American Association for the Advancement of Science (A AA S).

There are several basic assumptions underlying the SAPA program. One of the assumptions is that science is best learned by doing science. Hands-on learning should be emphasized. Another assumption is that, the lesson must take into account the empirical findings of the developmental psychology of the learner (Lawlor 2008).

Science process skills are defined by Esomonu and Onunkwo (2004) as the processing strategies which scientists bring to bear in solving problems. They are the fundamental capabilities or intellectual skills utilized in sciencing. The (AAAS) identified 14 process skills. The study seeks to investigate the effects of inquiry-based instruction on acquisition of process skills, interest and performance in ecology.

Scientists engage in procedure of investigation to gain knowledge of natural phenomena. These tactics and strategies, the skills scientists use in their pursuit of

understanding are called science process (Karen 1998). There is however a general belief among science educators that the development of science process from part of attainment of the general objectives of education. This is because the acquisition of science processes plays a vital role in scientific activities (Akinmode 1992). They are often seen as the foundation of scientific inquiry since they can be generalized and are required for learning the facts, concepts and principles necessary for making valid inferences. Gagne (1968) a known Psychologist believed that a pre-requisite knowledge of concepts and principles can be obtained only if the student has certain underlying capabilities, such as the science processes which are needed to practice and understand science.

Hence process skills are acquired capabilities which can be learned through experience and applied for the understanding of nature and problem-solving. Observation is considered to be the fundamental skill by virtue of its position at the foundation of the skills needed to discover the broad knowledge required for inquiry. Shaibu and Mari (1997) share a similar view that the acquisition of science skills ought to be the search for scientific knowledge is process-oriented.

Some of the major features of the processes of science as identified by Aktamis and Ergin (2008) include the following:

- Each process is generalized across the content domains and contributes to rational thinking in every affair.
- Each process is an identifiable behavior of scientist that can be learned by students.
- Each process is specific intellectual skill used by all scientists and applicable to understand any phenomena.

The processes are hierarchically organized with the ability to use each upper level process depending on the ability to use the simpler underlying process (Ndukwe 1986). These science process skills have been identified as having the enduring quality of enabling the individual acquire and process information and solve problems even when the information base changes (Bybee 1989). This view apparently supports Wuyep (1996). Notion that concepts and contents of science will undoubtedly change, but the mental skills of the scientists or the students which are very vital in science and technology do not.

The significance of the science process skills maintained Nwosu (1994) has led to the expansion of the goal of science education to include and understanding and development of skills in all areas of curriculum, although the types and level of skills acquisition will depend on learner's stage of development.

Akinmade (1992) and Mari (2001) noted that, these process skills are categorized thus:

- Basic Process Skills i.e Observation, measuring, inferring, predicting, classifying, collecting and recording.
- Integrated process skills i.e integration of data, controlling variables, defining operationally, formulating hypotheses, experimenting and communicating.

According to Gagne (1971) the process skills are hierarchically organized with the ability to use each upper level process being dependent on the ability to use the simpler underlying process.

Abdullahi (1982) states that observation is the first process in scientific inquiry. It is made up of particular event and general principles are developed form a number of specific

and consistent cases. It is considered to be the fundamental skill by virtue of its position at the foundation of the hierarchy of skills needed to discover knowledge required conducting inquiry. Eniayeju (1994) describes it as the skills of looking and seeing which may be made directly. Thus, the active use of the sense organs during the process of observation according to Ogunleye (1996) enables one to determine the quantity and quality of things and events. Observations are influenced by post experiences often involving instruments (Microscope, hand lens, telescope, etc) and requiring careful recording and description (Karen, 1998). Abdullahi (2007) identifies three broad proficiencies that are logically necessary for achieving observational competence to include:

- Making observation well
- Reporting observation well
- Assessing report of observation

(Karen, 1998) maintains that, measuring involves assigning numbers to objects or events that may be arranged in a continuum according to set of values and expression of observation in quantitative terms adds precision and permits more accurate description. According to Eniayeju (1994) measuring employs the use of counting skills to man – made units of length, area, volume, weight and time. The units are initially those developed and applied by the pupil themselves. It is a process which involves the use of an instrument to determine the quantitative value associated with the properties of an object or event (Akinmade 1992, Ogunleye, 1996). Mari (1994), identifies seven (7) sub- process involved during the process of measuring, thus:

- Ordering objects by inspection in terms of magnitude of selected common properties such as a linear dimension area or volume.

- Comparing quantities such as length area, volume and weight to arbitrary unit, taking measurement using standard units.

- Taking measurement of quantities which depend upon more than one variable.

- Converting from one system of unit to another

- Using and division indirect means of measure quantities

To be proficient in the use of process of measurement according to Akinmade (1992), student should be able to measure time, rate of change and property of an object, represent an object by scale diagram, draw an accurate map and be aware of the limitations of the various measuring devices in use. In addition, students should be able to determine the area and value of one, two or three dimensional objects.

Inferring as perceived by Ogunleye (1996) is a skill of basing judgment on observed and measured event. Smith and Welliver (2005) see it as an interpretation of one's direct observing, past experiences are generally used as a basis for interpretation. According to Eniayeju (1994) inference implies the causes and effect relationship which may be based on preliminary or sketch data or very well founded data from experiment.

The following sub – processes are involved in the process of inferring as identified by Mari (1994) are:

- Distinguishing pertinent observation upon which given inferences are based and are extraneous

- Drawing an inference from a set of related observation

- Stating cause and effect relationship from observation of related events.
- Identifying and extending inference to include discrepant event.
- Developing plans to test the validity of inferences
- Using inferences from one set of observations to suggest forth observation.

According to Smith and Welliver (2005) interpreting is a process of using various forms of data to determine the validity of a hypothesis, to organize information derived from an experiment, or revise interpretation of data based on new information. When using the process of interpreting, students are required to determine the pattern or put meaning into it or as well as take meaning out of their experience. They are also expected to provide a justification for the measuring put into their experience and to generalize to other situations on the basis of sufficient evidence (Akinmade 1992). Mari (1994) views interpreting data as a process which involve identifying changes in size, shape, position ad judgment of validity and usefulness of data. However, Akinmade (1992) identifies what a student should be able to do to determine competence in the use of skill as follows:

- Make sound generalization from a set of data
- Identify cause and effect relationship
- Provide reasonable justification for any generalization made
- Draw us many plausible inferences as are permitted by a given data set
- Test an inference by collecting more data and
- Recognize which data lend support to an inference.

Eniayeju (1994) explains that, these skills help the students to collect data identify cause and effect, provide reasons for justifying generalization and draw inference from a data set.

Classifying objects according to Mari (1994), involves sorting and arranging objects according to their similarities and differences. During this process things or events are organized, categorized and grouped, based on observed or measured property to form an easily recognized pattern. Akinmade (1992) identifies six (6) characteristics of a child who attain certain level of competence in using the process of classifying thus the child is able to:

- Categorize object or system of objects using a given property
- Determine with reason an appropriate property and categorize objects or systems of objects according to that property
- Classify object or system of objects according to two or more given simultaneous properties
- Select and justify two or more appropriate simultaneous properties and group object or system of objects basis of those properties
- Identify the properties on which a given set of objects has been grouped and
- Regroup a given set of objects or systems using a rational procedure

Eniayeju (1994), see classification as a process of sorting, grouping and ordering objects by both their quality and quantity. The desired goal in this scientific process is for children/students to develop sensible reasons as bases of their grouping, sorting and ordering.

Making prediction according to Akinmade (1992), involve figuring what future observation will be on the basis of available previous information, identifying some proficiency associated to a person who achieves competence in using the process prediction. Akinmade (1992) suggested that such a person should be able to;

- Find out and explain trends in a given set of data
- Device appropriate procedures for checking the correctness of the prediction are made
- Present plausible argument and evidence to justify his prediction and
- Exercise restraint in making predictions in the absence of reliable and valid multiple observations.

Smith and Welliver (2005), see the skills of predicting as the process of determining or anticipating future events based on past observations and experience. To Eniayeju (1994), predicting is a scientific process which arises from a well-founded base of hypothesis, theory or even law. With regularly consistent data at hand, one can predict. According to Ogunleye (1996) and Mari (1994) predicting involves forecasting or extrapolating on the basis of past observations.

Communication is the process skill of transmitting acquired information from one person or group to another which may result in change in behavior. Scientific experiences in observation, data collection, discovery etc. according to Eniayeju (1994), need to be communicated to other people through the means of communication. This will give growth to knowledge and it could be in written word, diagrams, graphs or models. However, Mari,

(1994) identifies the following sub-process involved during the process of communicating thus.

- describing observation verbally
- Describing condition under which observation are made.
- Recording observation in a systematic way.
- Using table and graphs to communicate date
- Planning for communication procedures and result as an essential part of an experiment.
- Reporting experimenting procedure in a form so that other person can replicate the experiment.
- Using mathematical analysis to descried interpretation of data.

Experimenting is the testing of hypothesis to confirms our guess or disproves it. Initially, it might be in form of trial and error. According to Eniayeju (1994), experimenting involve chasing after answer along a path that appears faithful. Abdullahi, (2007) states that, designing experiment involve planning a serial of data gathering operation which will eventually provide the bases for testing hypothesis or answering a research question. The achievement of competence in the use of this process skill according to Akinmade (1992), implies that students are able to.

- Chose, clarify and state the primary variable being investigated in a way that could be tested.
- Confine the number of variable to a manageable.
- Competently control variables.

- Differentiate between independent and variables.
- Select or design data gathering procedures that are appropriate to the investigation.
- Use the process of observing, classifying comparing and measuring to gather relevant data.
- Ensure the reliability and validity of data gathering procedures employed.
- Record and organize data using tables, graphics representations and models.
- Use the process of inferring and predicting to interpret the collected.
- Find a rational answer to the research question posed.
- Raise new relevant question and
- Design new experiments to find a rational answers or the new research question rose.

Experimenting according to Mari (2001) involves designing an investigation to find out the effect of independent variable in dependent variables. Failure to identify significant variable and control them will affect the result.

In designing experiments, limitations of the method and apparatus must be considered.

Question is formed on the basis of an attempt to evaluate situation. They point to the specific problems to be solved. Hypothesis on the other hand, is based on questions under investigation. Okebukola (1985) defines hypothesis as making wise guesses as tentative and unproven answer to questions rose. It is usually statement that can be tested through experiment. In this study subjects led to how to use their hands and senses to manipulate the available materials to do as scientist do in the laboratory set up. Students should be involved

in science process oriented activities in the laboratory like; hands and minds on activities. Students should learn to use science process skills by engaging them in daily activities, while the teachers supervise their work.

2.6 Interest as a factor and Academic Performance in Science Education

The role of interest is usually not included in empirical applications as a consequence of the information availability. Interest could positively affect educational attainment by at least two different channels. On one hand, greater motivation/interest is directly related to students' effort (attendance, discipline, time devoted to homework, among others) (Bishop et al., 2003). On the other hand, interest could increase the perceived utility of learning. Several Studies, carried out at personal level, showed that the outcomes of cognitive skill tests are good indicators of pupil's future income (Bishop et al., 2003). All normally functioning persons have a neurological predisposition to seek information and develop interest (Hidi, 2006). Even if they initially have low self-efficacy, lack academic goals for learning, and/or are not able to self-regulate, their interest can develop (Palmer, 2009; Renninger, 2010). Hidi, (2006) declared, "One of our greatest defects is our lack of consistent or adequate theory of interest". This situation has not yet changed, but could.

Findings from the emerging field of neuroscience allow us for the first time to consider how interest as a theoretical construction could be related to the physiological functioning of humans and may eventually yield a new dimension for theory building. As a psychological variable, interest has a long history. In the late 19th and early 20th centuries, interest was referenced in the work of (James 1890; Baldwin 1897; Dewey 1913; Piaget 1940; and Thorndike 1935, among others).There have been multiple approaches to

describing interest; there are five characteristics of interest as a motivational variable on which many researchers agree.

First, interest is content or object specific (e.g., Chen, Darst, & Pangrazi, 1999; Holland, 1985/1997; Krapp, Hidi & Renninger, 1992; Silva, 2006). It refers to an individual's focused attention and/or engagement with particular events and objects. Second, interest involves a particular relation between a person and the environment and is sustained through interaction. The potential for interest is in the genetic makeup of the person, and the content and the environment determine the direction of interest development (Barron, 2006; Sansone & Thoman, 2005; Schiefel, Krapp, Prenzel, Heiland, & Kasten, 1983).Third, interest has both cognitive and affective components, although the relative amount of each may vary depending on the phase of interest (Ainley, Hidi, & Berndorff, 2002, Harp & Mayer, 1997; Renninge & Woznaik, 1985).

Fourth, a person is not always aware of his or her interest during engagement; the learner may not be aware of his or her interest being triggered, and in later phases of interest the leaner may be so absorbed that he or she is not metacognitively aware during engagement (Krapp, 2005; Renninger & Hidi 2002). Fifth, interest has a physiological/neurological basis; brain activations differ when a learner is and is not engaged with interest (e.g., Hidi, 2006; Kang et al., 2009; Palmer, 2009; Panksepp, 1998). In fact, Hidi (2011) specially argued that interest is related to the reward circuitry, and thus interest functions as a reward.

Interest is now recognized to be a critical cognitive and affective motivational variable that guides attention (Hidi, 2001; McDaniel, Waddill, Finstad, & Bourg, 2000;

Renninger & Woznaik, 1985; Silvia, 2005; Schaffner & Shiefele, 2007). Facilitates learning in different content areas (Ainley et al., 2002; Denissen, Zarrett, & Eccles, 2007; Renninger, Ewen, & Lasher, 2002) and for learners of all ages (e.g., Harackiewicz, Barron, Tauer, & Elliot, 2002; Johnson, Alexander, Spencer. Leibham, & Neitzel, 2004; Nolen, 2007; Palmer, 2009), and develops through experience (Azevedo, 2006; Krapp & Lewalter. 2001; Renninger & Hidi, 2002).

The way in which interest is generated and/or affects learning has been found to vary depending on whether a person is in an earlier or later phase of interest development (Harackiewicz, Durik, Barron, Linnenbrink, & Tauer, 2008; Hidi & Renninger, 2006; Krapp, 2007; Sansone &Thoman, 2005; Schiefele, 2009). The development of interest has been the focus of the conceptualizations of both Hidi and Renninger (2006) and Krapp (2002, 2007). They have each described interest as being a psychological state and a predisposition to reengage particular disciplinary content over time that develops through the interaction of the person and his or her environment. Hidi and Renninger have focused on the role of interest in learning and development, Whereas Krapp has been concerned with the relation between interest and the developing self over time.Given the importance of the role of interest in learning, understanding how interest unfolds and can be supported to develop in and out of school is critical (Barron, 2006, Hofer, 2010).

Renninger and Hidi, (2002) opined that as interest develops and deepens, knowledge and value develop. Consequently, from this perspective the measurement of interest in later phases of interest development needs to account for knowledge and value as well as for feelings.Based on findings from existing empirical studies, the four phases of interest (as developed by Hidi and Renninger (2006) in the description of their Four-Phase Model of

Interest Development) are triggered situational, maintained situational, emerging individual, and well-developed individual interest. They described the development of either a new or an existing interest as initiated when something catches the attention of a learner, a process called triggering (Dewey, 1913; Hidi & barid, 1986). The triggering process may be fleeting but can also allow interest to develop and yield maintained situational interest. Once interest is maintained, repeated engagement can be either self-initiated or promoted by the environment, leading to the development of first an emerging and then a well-developed individual interest.

Student have an interest in their own performance, when they weigh this objective against others such as the amount of leisure time or increasing social networks through studying less or more.The role of motivating student's interest and effort has not received the same attention in the economic literature as other aspects, due to the information availability of variables that reflect that conditions. Interest through self-motivation and effort can be induced by parent and teachers. Parents affect children's performance through many channels. First, they provide a set of resources available to them (books, computers, educative software and complementary classes, among others). Parent's educative background help to assist their homework's and it could foster their learning. They also have a clear interest in schooling resources being used efficiently when they assume that education is an investment and nor a consumption activity.

Interest is a complex concept with several distinct definitions associated. Walter and hart (2009) defined interest as an individual's desire, power and tendency to act in a particular way.Koaler et al, (2001) treat interest equally as motivation. In this sense, interest, preferences or positive attitudes could be synonyms. In a general approach, interest is

understood as an intrinsic and extrinsic process where individuals respond to internal as well as external stimuli which are sometimes associated with display of concepts through audio visuals, rewards, teacher's praise, and positive feedback, among others.

Chiu and Xinhua (2008) pointed out that students with more educational resources available at home could have more opportunities to learn and to have more intrinsic motivations which consequently arouse interest. Learning is an activity that requires, among other things, time and active engagement of students and this arouse the interest of the researcher toinvestigate the effects of inquiry-based instruction in acquisition of process skills, performance and interest in ecology among secondary school students.

Academic assets available at home, may have a positive impact on school achievement through the increase in the productivity of other resources used during the educational process (such as teachers and school's resources). Pupils with access to the internet at home are more likely to complement the lessons received at school, therefore are more likely to perform better. It is expected that the role of academic assets will be a complement and not a substitute of other 'inputs' such as parent's time or school resources. Stinebricker and Stinebricker (2007) examine the causal effect of the time used studying on academic performance by using video games as an instrument and they find that effort measured by time studying is positively related to the academic achievements.

The effect of interest and effort on the quality of education could be from different perspective:

1. When interest is aroused in students, it helps the student to see in learning an activity with a higher utility than leisure;

2. Interest increases in the number of questions the student may ask and this induces him/her further to look for answers;

3. Interest generates positive externality, for students evaluate the subjects they are studying and

4. The existence of central examinations changes the students' incentives (Bishop, 2006).

5. When the student only has his course as a reference point, his performance could be limited to the course level.

In specific area such as math and sciences the role of interest and effort is especially important as a consequence of the 'special pleasure for learning' because in these areas discipline and perseverance are associated with success. In many cases, effort is measured by the number of minutes or the amount of time dedicated to study. Both in mathematics and in science, homework frequency is negatively related to student performance, while homework length is actually positively related to student performance. In any event, there is clearly no direct positive relationship between minutes per week a student spends on homework and her test score performance. Student's interest motivation is crucial for better academic results when it is complemented with basic resources or assets. The relationship between student's test scores and school's capital stock is neither unique nor statistically significant. Altinok and Bennaghmouch (2008) using a database of international tests show that an increase in school resources do not imply an improvement in the quality of educational systems.

Fuchs and Woessman (2008) had the following analysis on academic achievement and interest: viz: that

- Boys outperform girls in math and science but not in reading

- There is a positive relationship between the Country's educational expenditure per student ad the final score in math and science.

- Having better equipment/modern instructional materials and well trained teachers increase student performance in science.

- Students in public schools perform worse than those in private schools. (Fuchs and Woessman, 2008). The study seeks to investigate the effect of inquiry-based instruction in acquisition of process skills, interest and performance in ecology among secondary school students.

2.6.1 Relevance of Interest in Teaching and Learning Science

People are bound to develop more interest and put more effort and energy to the activities they like or perceive most thus, when children are interested in an activity they persevere, spend more time and embark on venture to attain their desired objective. According to Obeka (2009) 'interest is more than a discipline, is the key to education successes'. For this submission, he further observed that, at any level of graduation, learners will learn better in subjects or courses if they have some degrees of likeness for such subject or the courses. This implies that learners will fail to learn little if they do not like the subjects. Interests therefore at a higher stage become subjective feeling of value which is experienced when striving. This feeling implies an end-point object, reward, purpose, or situation in which one is interested and for which an individual strives at (Johnson, 1972). This means that when one is interested in a thing one is ready to devote attention.

Okafor (2000), interest can be described as the attraction which forces or compels a child to respond to a particular stimulus. Osuafor (2001) in his opinion maintained that effective domain is primarily concerned with beliefs, attitudes, interest, motives, needs and

satisfaction, feeling and emotions. Thus it is generally believed that the effective disposition of the student has direct consequences on his acquisition of science process skills and academic achievement. Therefore the interest of the child has direct bearing to the quality of work and educational attainment.

Alao in Obeka (2009) opined that interest is indispensable for learning. He further opined that there can be no real education without interest. Alio (1997) was of the view that test of interest cannot be used with children below nine years to achieve any useful result. Similarly, Mehrens and Hehman in Obeka (2009) stated that interests tend to be relatively unstable for young children but become progressively more stable with age after adolescences.

In spite of student interest, Zeal, determination and ability can be dampened by the use of ineffective teaching method such as the traditional lectures. The researcher therefore deemed it feet to try out other instructional strategy towards improving teaching and learning.

2.7Gender and Academic Performancein Science

Gender issues in the context of education refer to the differences, both real and perceived, between boys and girls and their relative academic performanceand opportunities (Westminster Institution of Education, 2006). Gender in science is the classification of the roles males and females play in science. This is the consequences of genders stereotyped which have classified different roles for male and female in the society.

Gender differences may exist in many different areas of education from performance to attitudes, from classroom activities and course enrolment to perceptions about careers.

Ogunleyein Obeka (2009) stated that girls and women over the years have tended not to study science when compared to boys and men. Shaibu and Ameh (1982) Mari and Ajagun(1998), in Mari (2001) revealed superiority in performance of female students over their male counterpart in task involving science process skills.

Academic performance is affected by many factors such as interest, motivation, student's ability and the equality of secondary education received, etc. Educational achievement according to Raji (1994) can be considered to mean the successful outcome of accomplished activities to tasks in educational measurement in relation to accepted standards. Ditch and Scott in Bichi (2002) stated that one such controversy is that girls do not like practical work and can't handle the inquiry method.

Different instructional strategies have relative different effectiveness on student'sperformance. Olubunmi (1991) compared the effectiveness of laboratory approach and the traditional method of instruction on acquisition of process skills and found significant differences in favor of laboratory method. Bichi (2002) compared the effectiveness of problem solving instructional method and traditional method in promoting students' academic performance in evolution concepts and found the former to be more effective than the later.

Oraifa (1990) explained the patterns of performance among male and female students in science. The result showed that there is significant difference in the performance of male and female students in school science in favor of males. Njoku in Nworgu (2005) in a study of trends in student performance in science observed that male students perform significantly better than female students. Researchers such as Eriba and Sesugh (2006) and

Onekutu(2002) have reported that boys outperformed girls in science and mathematics performance.

Other researchers have report differently on this issue. For example Freedman (2002) Sungur and Tekkaya (2003), Oludipe (2008) have provided reports that there are no longer distinguishing difference in the cognitive, affective and psychomotor skill performance of students in respect of gender. According to Levi (2000) teacher plays a vital role in addressing the problem of gender equity in science education. To him, there are three main roles teachers most play, namely;

i. ensure provision of equal opportunities and respect for differences in the classroom.

ii. Ensure that boys and girls have the same expedience, that is treat boys and girls equally and

iii. Compensate for gender differences in society

In this study therefore sought to investigate effects of inquiry-based instruction on acquisition of process skills, interest and performance in ecology among secondary school students.

2.8 Overview of Similar Studies

This section looked at similar study in the area of Inquiry-based Instruction in Acquisition of Process Skills, Interest and Performance in ecology among secondary school students. Chukwuemeka (2008), worked on "the effect of practical activities on academic achievement and acquisition of science process skills among Biology students in Delta State Capital Territory (DSCT) Nigeria. The research design of the study was quasi experimental and the population of the study was 3,252 Senior Secondary three (SS3) Biology students' from twelve (12) secondary schools in Delta State Capital Territory

(DSCT). A sample of four hundred and five (405) was randomly drawn from the population.Three research question and two null hypotheses guided the study. Biology Assessment Test (BAT) was used for data collection. The data collected was analyzed using Z-test.

It was observed that the experimental group had a higher mean academic score (MAS) than the control group. Thus, the Z-test showed a significant difference in favour of the experimental group.The current study differs from the aforementioned study in that the experimental group in the just mentioned study already had pre-practical experience while in the current study none of the groups has pre-practical experience.

Chinwe and Chukelu (2012), investigated "Effects of discovery method on Secondary School Students' Process Skill Acquisition in Abuja Municipal Area Council, Nigeria. The research design of the study was quasi-experimental and the population of the study was 3245 Senior Secondary one (SS1) Biology students'. A sample of one hundred and eleven (111) was randomly drawn from the population. Three research question and three null hypotheses guided the study. Science Process Skills Acquisition Test (SPSAT) was used for data collection. The data collected were analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA) at 0.05 level of significance. The results revealed that practical activity method was more effective in fostering students' acquisition of science process skills and not gender related. The study used SPSAT to measure the acquisition level of SSI Biology students and was carried out in Abuja while this present study will use three instruments SPSAT, EPT and SECIQ to measure the acquisition level of SSII Biology students in Lere educational zone, Kaduna, Nigeria.

Nnamonu and Joel (2009), investigated 'Effects of Biology Practical on the Secondary Students Academic Performance in Biology in Enugu State Nigeria. (a case study of Enugu North Local Government Area of Enugu State)The design was quasi experimental. The population of the study was 2,745 senior secondary two (SSII) students. A sample of 160 students was randomly drawn. Three research questions and three null hypotheses guided the study. ANOVA and Post hoc Scheffe's test was used to analyze the result. The result revealed that there is high academic performance in the group exposed to practical activities than those exposed to lecture. Also male students performed significantly better than female when taught with practical activities. The study was carried out among SS2 Biology students in Enugu state. ANOVA and Post hoc Scheffe's statistical tool was used for result analysis. Hence this present study used SSII Biology students to investigate effects of inquiry-based instruction in acquisition of process skills, interest and performancein ecology among senior secondary students in Lere, Kaduna, Nigeria. T test and Kruskal wallis statistical tool was used to analyze the results which differ from the formal.

Internationally, Cephas and Seoi-Sekgethelo (2009), investigated "Acquisition of Scientific Process Skills in Botswana General Certificate of Secondary Education. The population of the study was 12,342 students. Sample of 860 students was randomly drawn from the population. Ex-post facto design was adopted. Two research questions and two null hypotheses guided the study. ANCOVA and t-test was used to analyze the result. The result indicated that basic process skills are significantly higher than the integrated process skills in senior secondary school science curriculum in Botswana. Also students perform better in the basic process skills than the integrated skills in Botswana General Certificate

Examination. The study was carried out in Botswana. The investigation was done on Physic, Chemistry and Biology among final year students while this present study was carried out in Biology among SS II students in Lere educational zone, Kaduna State, Nigeria.

Muoneme (2015), investigated the 'Impact of Enriched-Lecture Method with Interactive Multimedia Board on Academic Achievement and Interest of Students in Evolution Concepts in Rijau Educational Zone, Niger State. The design was quasi experimental with a population of 498 senior secondary school (SSII) students. A sample of 89 students was randomly drawn. Three objectives, three research questions and three null hypotheses guided the study. ANOVA was used to analyze the result. The results revealed that there was significant interest change towards Biology for the students exposed to enriched lecture method with interactive multimedia board.

Chukwuemeka and Nwosu (2008), investigated the 'Effects of inquiry method on Academic Achievement of Senior Secondary School Students in Enugu east local Government Area, Nigeria. The design was quasi experimental with a population of 2,974 senior secondary two (SSII) students. A sample of 180 students was randomly drawn. Two research questions and two null hypotheses guided the study. ANOVA was used to analyze the result. The result revealed that practical activities method was more effective in fostering students understanding of Biology concepts than the lecture method. The study was carried out in Enugu state, Nigeria. Hence this present study will be in Lere Educational zone, Kaduna State Nigeria and the study investigated the effectsof inquiry-based instruction in acquisition of process skills, interest and performance in ecology which differ from the aforementioned.

2.9Implications of Literature Reviewed on the Present Study

The review of the related literature indicated that science teaching in Nigeria (in spite of efforts by researchers to suggest better methods of science teaching) has been dominated by emphasis on factual knowledge. This is reflected on examinations, which depends almost exclusively on factual recall, recollection of formula and precise definitions as well as description of routine experiments. The process of science which requires the students to look for evidence is often neglected by most teachers; instead, they continue to pump factual information to the students which they memorized in order to pass their examinations. When scientific facts are memorized, they are easily forgotten and any examination question requiring application and synthesis of knowledge proves difficult to the students. The practical aspects of science are also neglected and the consequence of the neglect is shown in very poor performance of students in science examination.

In some of the studies reviewed, researchers who used Inquiry-based Strategy in correcting some of the concepts of Biology among students reported better, gain in academic performance of the subjects used as a result of improving of inquiry strategy. However, the use of the lecture method of teaching has been shown to be of little help to student's academic performance or alter inquiry strategy, and reports in literature have also indicated poor academic performance among learners Usman (2000) and Ahmed (2004). In the light of this literature reports, the researcher deemed it necessary to help students acquire the science process skills using Inquiry-based teaching strategy. It is hoped that, the lecture method students used, which make them achieve poorly in Biology will be enhanced.

Poor academic achievement and interest towards science has been reported in the literature by Adeniyi (1997). As earlier stated, it is as a result of ineffective teaching. Some of the factors identified as opposing teaching in Nigeria secondary schools include: Learning by rote Ajewole(1990:1991). Lack of conducive learning environment under which science is being taught lead to lack of opportunity for the child to have direct experience with learning materials, (Bajah, 1995). But science involves active participation of the learner in the learning process; consequently; science is about doing things; that is, activity-oriented and teaching method renders "empty" knowledge.

From all the studies however, the researchers were trying to find out or compare inquiry method and lecture method on student's performance. The aspect of inquiry-based instruction in acquisition of process skills, interest and performance in ecology as a concept especially in Nigeria was not addressed in the literatures cited. Therefore this study is conceived to fill this gap. As a result of these, this study is carried out to investigate the effects of inquiry-based instruction in acquisition of process skills, interest and performance in ecology among secondary school students.

CHAPTER THREE

METHODOLOGY

3.1Introduction

The purpose of this study isto investigatethe effects of inquiry-basedinstruction onacquisition of process skills, interest and performance in ecologyamong secondary school students in Lere Educational Zone. In this chapter the focus is to discuss the methodology that will be used for data collection. The chapter is presented under the following sub-headings;

3.2Research Design

3.3 Population of the Study

3.4 Sample and Sampling Techniques

3.5 Instrumentation

3.5.1Validity of the Instruments

3.6 Pilot Test

3.6.1Reliability of the Instruments

3.7 Administration of Treatment

3.8 Data Collection Procedure

3.9 Procedure for Data Analysis

3.2 Research Design

This study is a quasi-experimental design which adopts the pretest, posttest,and experimental and control groups designed (Kerlinger, 1973; &Adamu, 2014). The study is quasi-experimental because the researcher has no total control over the study subjects. The sample were grouped into two; the experimental and control group. The control group was taught using lecture method only while the experimentalgroup was taught using inquiry-based method. Science Process Skills Acquisition Test (SPSAT), Ecology Performance Test (EPT)and Student Ecology Concept Interest Questionnaire (SECIQ) were administered to the sample as pre-test, the test was administered to determine whether the treatment have any effect on the subjects. The design for the study is presented below as adopted from Kerlinger (1973).

Group 1 Experimental $O_1 X_1 O_2$ ⟶ ⟶ ⟶

Group 2Control $O_1 X_2 O_2$ ⟶ ⟶ ⟶

Figure 3.1 Research Design

Where:

O_1= Pretest Administration

O_2 = Posttest Administration

X_1 =Use of Inquiry-based (Experiment group)

X_2=Use of Lecture Method (Control group)

3.3 Population of the Study

The population of this study consists of all the coeducational Government Senior Secondary School Biology Students inLereEducational Zone, with a total population of 1908. The schools involved are the same with similar conditions in terms of recruitment, staff and staff training or workshop, provision of equipment/chemicals, instructional materials, students' enrollment, uniformity in terms of curriculum, same academic calendar among others.All the schools are co-educational except Government College Saminakawhich is single sex. The detailed of the population is presented in Table 3.1

Table 3.1: ThePopulation of the Study

S/No	Schools	Boys	Girls	Total
1	G.C. Saminaka	25	-	25
2	GSS Saminaka	33	17	50
3	GSS Garun Kurama	72	40	112

4	GSS Gure	99	106	205
5	GSS Lere	111	43	154
6	GSS Kahugu	34	19	53
7	GSS Ramin Kura	61	29	90
8	GSS Yarkasuwa	194	104	298
9	GSS Damakasuwa	61	21	82
10	GSS Geshere	33	23	56
11	GSS Kono	40	22	62
12	GSS Kayarda	71	25	96
13	GSS Ungwan Bawa	47	26	73
14	GSS Maigamo	53	29	82
15	GSS Bundu Kahugu	13	05	18
16	GSS Fadan Chawai	26	15	41
17	GSS Kusheka	20	05	25
18	GSS Kizakoro	17	18	35
19	GSS Federe	86	36	122
20	GSS Warsan Piti	08	03	11
21	GSS Dan Alhaji	38	06	44
22	GSS Gurzan Mariri	117	57	174
	Total	**1269**	**639**	**1908**

Source :(Lere Educational Zone, 2017).

3.4 Sample and Sampling Techniques

The sample consists of two schools with118 Senior Secondary Students. The schoolswereselected from the population of the study using simple random sampling technique.This was done by putting the names of all schools in the population inside a container and then picks the two schools. According to Williams (2005) random sampling is a procedure which ensures that each element in a population has equal chance of being selected. Table 3.2 gives the details of the sample of the study.

Table 3.2: Sample for the Study

S/No	Type	School	Boys	Girls	Total
1	Experimental	GSS Geshere	33	23	56
2	Control	GSS Kono	40	22	62

Total	**73**	**45**	**118**

3.5 Instrumentation

The instruments that were used for this study were;

1. Science Process Skills Acquisition Test (SPSAT) adapted from Ajagun(1998), SPSAT consisted of twenty (20) questions.
2. Student Ecology Concept Interest Questionnaire (SECIQ) adapted from Muoneme (2015), the instrument consist of twenty five (25) items.
3. Ecology Performance Test (EPT) developed by the researcher using WAEC past standardized questions. EPT consisted of forty (40) questions cutting across the topics.

Table 3.3 Table of specification for SPSAT Instrument

Content	**Weight**	**Knowledge**	**Comprehension**	**Application**	**Total**
	%	**27**	**33**	**40**	**100**
Ecosystem	35	1 (7)	1 (4)	3 (9,10,14)	5
Habitat	20	1	2	3	6
(11)		(8,14)	(6,12,13)		
Environment	25	1	1	2	4

(15) (16)		(1,2)			
Community	20	1	1	3	5
		(5)	(17)	(18,19,20)	
Total	**100**	**4**	**5**	**11**	**20**

Source: Researcher's Field Work (2017)

Table 3.4 Table of Specification for EPT Instrument

Contents	**Weight**	**Knowledge**	**Comprehension**	**Application**	**Total**
	%	**27**	**33**	**40**	**100**
Ecosystem	35	3	4	7	14
	(2,21,32)	(6,11,12,24)	(17,19,26,31,33,35,37)		
Habitat	15	2	2	3	7
	(10,23)	(9,25)	(3,7,18)		

Succession (22,15,8)	203 (13,27)	2 (38,39,40)	3	8	
Environment (28)	15 (34,36)	1 (4,16,20,)	2	3	6
Community (5,1)	15 (30)	2	1 (14,29)	2	5
Total	**100**	**8**	**12**	**20**	**40**

Source: Researcher's Field Work (2017)

Table 3.3and 3.4 shows the weight and percentages of the items distributed based on the concepts and according to the three levels of knowledge common to the level of students i.e knowledge, comprehension and application.

3.5.1 Validity of the Instruments

The Instruments were given to experts who are Ph.D holders with minimum rank of senior lecturer intheDepartment of Science Education and Psychology Department,Ahmadu Bello University, Zaria and a qualify Secondary School Biology teacher to validate the test items. The validators was asked to critically examine and assess all the items of the instrumentsby looking at:

1. Whether the questions are clear, precise and free from ambiguity.
2. Whether the questions match the ability level of the students.
3. Whether the test items conform with the subject matter.

The experts correction, criticism, and recommendations were effected on the basis of content and construct validity of the instrument to produce a new draft of the items.

3.6 Pilot Test

A pilot test was conducted using students of government secondaryschool Ungwan Bawa which was part of the study population but not used as one of the sample. Thetwenty (20) item instrument on Students Process Skill Acquisition Test, twenty five (25) item instrument on Students Ecology Concept Interest Questionnaire and forty (40) item instrument on Ecology Performance Testwere administered to the thirty (30) students with the assistance of the Biology teachers of the school. The pilot testing was conducted to:

- determine the reliability of the Science Process Skills Achievement Test (SPSAT), Student Ecology Concept Interest Questionnaire (SECIQ) and Ecology Performance Test (EPT) before administration.

- determine the appropriateness of the length of time required to take the test.

- determine the correctness of the working of the instrument.

- identify problems or difficulties that the subjects may encounter with the view to eliminating them in the final instrument.Then the data obtained from this pilot study were analyzed to determine reliability of the instrument.

3.6.1 Reliability of the Instruments

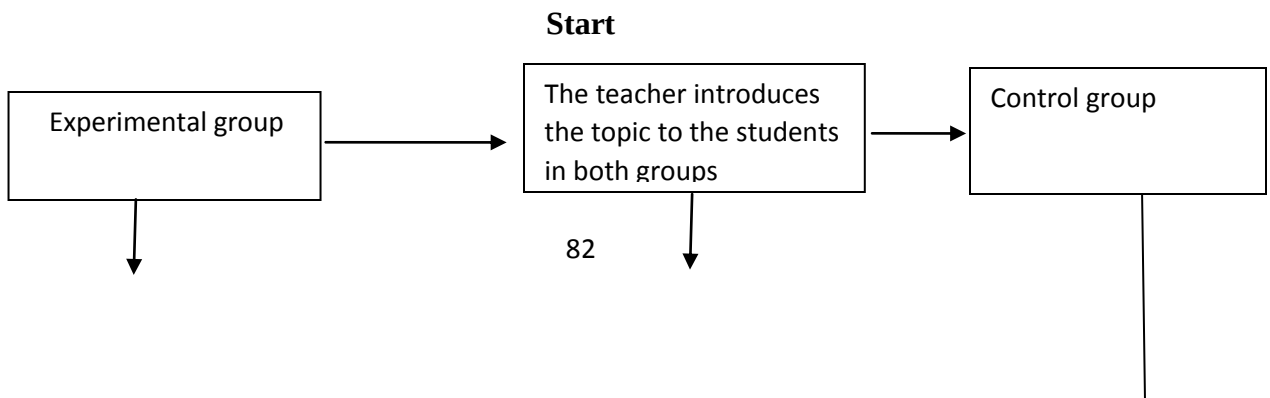
Three reliability tests were conducted. The instruments includedScienceProcess Skill Acquisition Test (SPSAT), Student Ecology Concept Interest Questionnaire (SECIQ) and Ecology Performance Test (EPT). A total of 30 students were used duringthe pilot testing

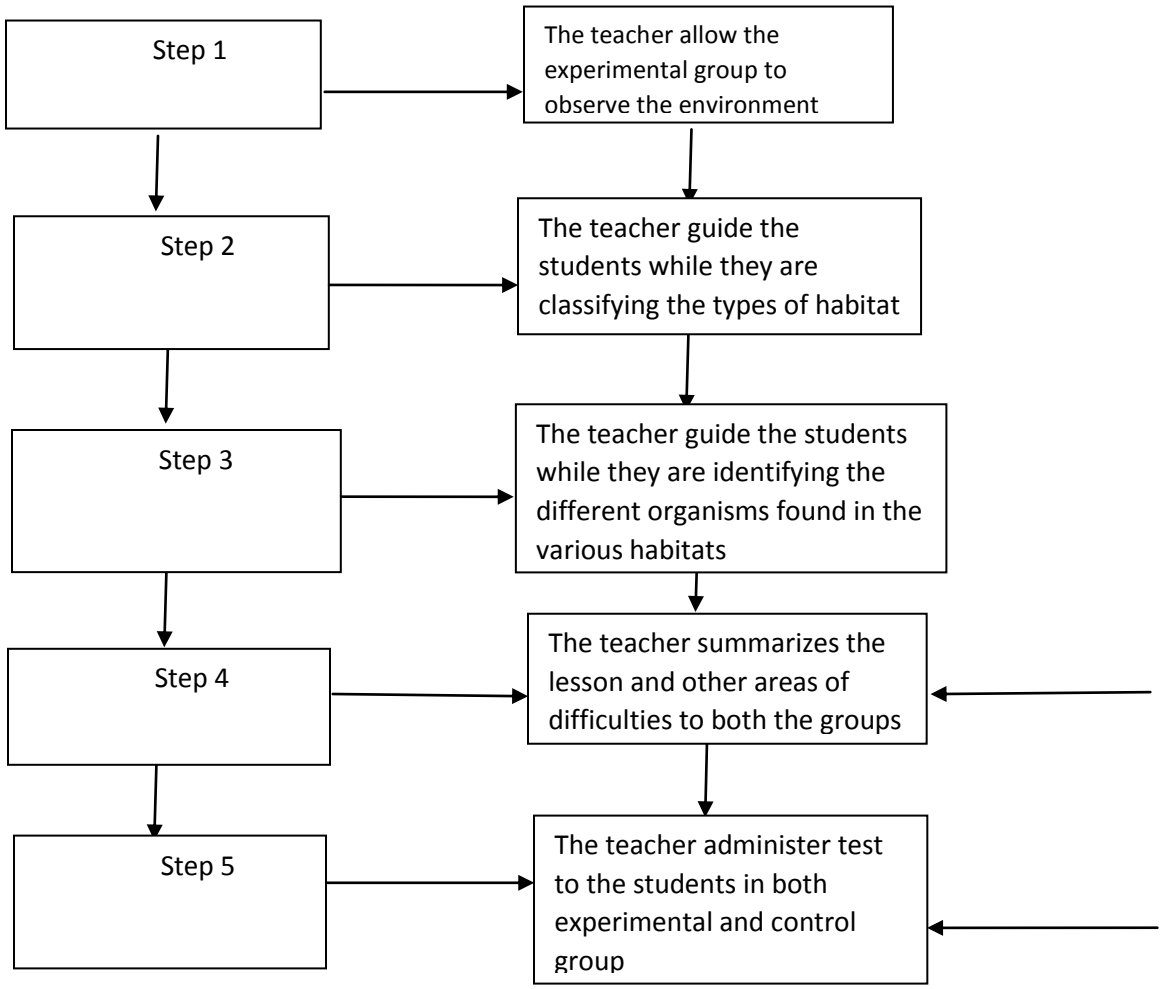
to establish the reliabilities. The first test was given to the subjects of the school which were not part of the sample. After two weeks interval the second test was administered in line with Tuckman (1975), recommendation of two weeks interval for test-retest procedure.

The reliability coefficient of Student Ecology Concept Interest Questionnaire (SECIQ) was found to be 0.84 using Split-half method. On the other hand, the reliabilities of Student Process Skills Acquisition Test (SPSAT) and Ecology Performance Test (EPT) were calculated usingPearson Product Moment Correlation Coefficient(PPMC) after test-retest method applied, the reliabilities were found to be 0.74 and 0.76 respectively.Olayiwola, (2010) asserted that an instrument is considered reliable if it lies between 0 and 1, and that the closer the calculated reliability coefficient is to zero, the less reliable is the instrument, and the closer the calculated reliability co-efficient is to 1, the more reliable is the instrument. The fact that the reliability of the three instruments are closer to one than to zero confirmed that all the instruments were reliable.

3.7 Administration of Treatment

The experimental group were taught by the researcher on: ecology, ecosystem, habitat, environment and community, for six weeks using the steps of the activities involved in the flow chart. The pretest was administered before the commencement of the teaching.





Flow Chart for Inquiry-based Instruction

Source: Adapted from Joel (2010)

Inquiry-based instruction is a teaching method where the learner, with minimum guidance from the teacher seeks to discover and create answers to a recognized problem through procedure of making a diligent search (Callahan & Clark, 1977; Adedoyin, 1990).The flow chart was used to prepare lessons use to teach the experimental group because of the activities involved while the control group was taught using lecture method.The experimental group was taught using inquiry-based instruction by the researcher, this was done by engaging the subjects in activities that foster the acquisition of process skills, interest and academic performance as stated in the experimental lesson plan.

Science Process Skills Acquisition Test (SPSAT), Student Ecology Concept Interest Questionnaire (SECIQ) and Ecology Performance Test (EPT) wereused for both pre-test and post-test. The experimental group were taught ecology concept,involving the learners to foster their interaction with theenvironment, and the teacher. Lesson plans for the experimental and control group were the same in terms of contents, basic instructional objectives, and length of time for teaching and mode of evaluation except for the activities in the experimental group.

At the end of the six (6) weeks of six periods, the researcher administered the posttest to the subjects in the experimental group using Science Process Skills Acquisition Test (SPSAT), Student Ecology Concept Interest Questionnaire (SECIQ) and Ecology Performance Test (EPT). The scripts from both pre-test and post-test of the experimental group was marked and scored using the marking guide.

3.7.1 Teaching the Control Group

The control group was taught the same concepts by the researcher using lecture method alone. The pretest was administered to the subjects before the commencement of the teaching. The lesson was presented by defining the term or concept then followed by the explanation and important points were writing on the chalk board. The subjects were referred to relevant Biology textbooks for more information. After teaching the control group also

like the experimental group, posttest was administered to the control group using SPSAT, SECIQ and EPT. The subject scores was collected and the data was subjected for analysis.

3.8Procedure for Data Collection

After teaching the experimental and the control groups for period of six weeks, a post test using Science Process Skills Achievement Test (SPSAT), Student Ecology Concept Interest Questionnaire (SECIQ) and Ecology Performance Test (EPT) was administered by the researcher. The SPSAT was marked and scored over 100 and each question carried five marks, SECIQ response was marked over 125 according to ranks while the EPT was marked and scored over 80 and each question carried two marks. After marking the scripts of the two schools, and the questionnaire response collected, the scores were recorded accordingly based on the experimental group as well as control group. After scoring, the data were subjected to inferential and descriptive statistical analysis using SPSS.

3.9Procedure for Data Analysis

The null hypotheses are restated here along with the appropriate statistical tools to be used in testing them. The statistical tools include descriptive statistics mainly mean, standard deviation and frequency used to answer the research questions and inferential statistics mainly t-test, Kruskal-wallis to test the null hypotheses at 0.05 level of significance

H_{O1}: There is no significant difference in the acquisition of process skills when students

are exposed to inquiry-based teaching method.

t-test statistics was used to test this hypothesis. At $P \geq 0.05$ level of significance.

H_{O2}: There is no significant difference in the interest shown in ecology by SSS Students

when exposed to inquiry-based instruction and lecture method.

This hypothesis was tested using Kruskal-wallis.

H_{O3}: There is no significant difference in the mean academic performance when SSS students

are taught using inquiry-based methods.

t-test statistics was used to test this hypothesis. At $P \geq 0.05$ level of significance was set for retaining or rejecting the null hypothesis.

Ho_4: There is no significant difference in gender when SSS students are exposed to inquiry

method on the acquisition of science process skills.

For this hypothesis, t-test statistical tool was used to test it. At $P \geq 0.05$ level of significance was set for retaining or rejecting null hypothesis.

CHAPTER FOUR
DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This study is titled the Effects of Inquiry-based Instruction on Acquisition of Process Skills, Interest and Performance in Ecology among Secondary School Students in Lere Educational Zone, Kaduna Nigeria. The analysis essentially involved statistical testing of the

hypotheses stated in chapter one and three. The level of significance adopted is P≤ 0.05 level which form the basis for retaining or rejecting each of the null hypothesis stated. t test and Kruskal-wallis statistical tools was used for the analysis. In this chapter, results and discussion are presented in the following sub-headings;

4.2 Data Analysis and Result Presentation

4.3 Summary of findings

4.4 Discussion of Results

4.2 Data Analysis and Result Presentation

4.2.1 Answering Research Questions

Question One:does any difference exist in process skills acquisition between subjects taught using inquiry-based instruction and those taught using lecture method?

In order to answer this research question, a descriptive statistics of mean scores and standard deviation were used.

Table 4.1:Summary ofPosttest Mean Sco ıe Acquisition of Process Skills for Experimental and Control Gr..p.

Groups	N	Mean	Std. Dev	Std. Err	Mean Diff
Experimental	56	52.650	7.2589	1.3253	11.167
Control	62	41.483	3.9072	.7133	

In Table 4.1 the results of thestatistics showed that there was difference in acquisition of process skills when students were exposed to inquiry-based and lecture teaching methods.Their computed mean acquisition of process skills were52.650 and41.483 for the experimental and control groups respectively indicating a mean difference of 11.167 in favor of Experimental group. This showed that the group exposed to inquiry method have higher mean score for the acquisition of process skills than their counterparts taught using lecture teaching method and this answers the research question one.

Question Two: is there any difference in the interest shown in ecology by SSS students when they are taught using inquiry-based instruction and lecture methods?

In order to answer this research question, Kruskal-wallis was used.

Table 4.2: Mean Rank Test Difference in the Interest Shown in Acquisition of Process Skills by SSS Students in Experimental and Control Group.

Groups	N	Mean Rank	Mean difference
Experimental	56	97.65	
			14.3
Control			
	62	83.35	

Table 4.2 revealed that difference exist in the interest shown by SSS students when they were exposed to inquiry method and lecture teaching method in Ecology. Their mean interest Scores were 97.65 and 83.35 in posttest experimental and posttest control respectively. When the difference between their interest rates was computed, it was found to be 14.3 in favor of experimental group. This clearly indicated that students exposed to inquiry method i.e. experimental group showed more interest in Biology than the control group.

Question Three:is there difference in mean academic performance between subjects taught using inquiry-based instruction and those taught using lecture method?

In order to answer this research question, a descriptive statistics of mean scores and standard deviation mainly t-test were used.

Table 4.3: Summary of Posttest Mean Scores of Academic Performance of StudentsIn Experimental and Control Group.

Groups	N	Mean	Std	Std Err	Mean difference
Experimental	56	57.400	3.922	.716	20.13
Control`	62	37.266	3.838	.700	

Table 4.3 showed the results of the mean score of the academic performance of students taught Ecology using inquiry-based method and those taught with lecture method. Their mean academic performance were 57.400 and 37.266 by experimental and control group, implying a mean difference of 20.13 in favor of the experimental group. This shows that students who were taught with inquiry-based method performed academically higher than those taught with lecture method.

Question Four:is there any gender related difference in the acquisition of science process skills between male and female subjects are exposed to Inquiry Instruction?

Table 4.4: Difference in the Acquisition of Process Skills Between Male and Female Students.

Groups	**N**	**Mean**	**Std. Dev**	**Std. Err**	**Mean Difference**
Male	73	45.300	8.6239	1.5745	0.466
Female	45	45.766	9.9807	1.8222	

In Table 4.4, the outcome of the statistics showed that there was difference in gender when SSS students were exposed to inquiry and lecture method on the acquisition of science process skills. Their computed mean of skills acquiredwere 45.300 and 45.766 by male and female respectively, indicating a mean difference of 0.466in favor of female. This mean that female acquire process skills better than the males in the experimental group.

4.3 Hypotheses Testing

The hypotheses were tested using suitable statistical tools at p≥0.05 level of significance for retaining or rejecting the null hypotheses.

Hypothesis one: The null hypothesis state thatthere is no significant difference in acquisition of process skills when students are exposed to inquiry instruction and lecture method.

To answer the null hypothesis, t-test was used for the analysis at p≥0.05 level of significance for retaining or rejecting the null hypothesis.

Table 4.5: Independent t test Statistics on The Difference in the Acquisition of Process Skills in Experimental and Control Group.

Groups	N	Mean	Std. Dev	Std. Err	Df	p	Remark
Experimental	56	52.650	7.2589	1.3253			
					116	0.001	S
Control	62	41.483	3.9072	.7133			

p≤ 0.05

The result in Table 4.5 showed that the p-value of 0.001 was observedat df= 116. Since the p-value is less than the alpha value of 0.05, it means therefore that the difference in the acquisition of process skills when students are exposed to inquiry and lecture teaching method was significant in favor of the experimental group. Therefore, the null hypothesis which stated that there is no significant difference in the acquisition of process skills when students are exposed to inquiry and lecture teaching method wasrejected.

Hypothesis Two: There is no significant difference in the interest shown in ecology by SSS students when exposed to inquiry-based instruction and lecture method.

To answer the null hypothesis Kruskal-wallis Non Parametric statistical tool was used for the analysis at p≥0.05 level of significance for retaining or rejection of the null hypothesis.

Table 4.6: Kruskal-wallis Non Parametric Rank Test Difference in the Interest Shown by SSS II Students in Experimental and Control Group.

Groups	N	Mean Rank	Df	P	Remark
Experimental	56	97.85	116	0.001	S
Control	62	83.35			

p ≤0.05

In Table 4.6, the p-value of 0.001 was observed at df= 116. Since the p-value was less than the alpha value of 0.05, it means therefore that the difference in the interest shown by SSS students when exposed to inquiry-based instruction and those taught with lecture method was significant in favor of the experimental group. Therefore the null hypothesis which stated that there is no significant difference in the interest shown by SSS II Students when exposed to inquiry-based instruction and lecture teaching method in Ecology, is hereby rejected.

Hypothesis Three: The null hypothesis state that there is no significant differences in the mean academic performance of students taught ecology using inquiry-based and those taught with lecture method.

To answer the research hypothesis, t-test was used for the analysis at p≥0.05 level of significance for retaining or rejection of the null hypothesis.

Table 4.7: Independent t test Statistics on Differences in the Mean Academic Performance of Students in Experimental and Control Group.

Groups	N	Mean	Std	Std Err	Mean difference	df	P	Remark
Experimental	56	57.400	3.922	.716				
					20.13	116	0.003	S
Control `	62	37.266	3.838	.700				

P ≤ 0.05

The result in Table 4.7 showed that the p-value of 0.003 was observed at df= 116. Since the p-value was less than the alpha value of 0.05, it means therefore that the difference in the academic performance of students taught Ecology with inquiry-based instruction and those taught with lecture method was significant in favor of the experimental group. Therefore the null hypothesis which states that there is no significant differences in the mean academic performance of students taught Ecology with inquiry-based instruction and those taught with the lecture method was rejected.

Hypothesis Four: There is no significant difference in the acquisition of process skills between male and female students when exposed to inquiry-based instruction.

To answer the null hypothesis, t-test was used for the analysis at p≥0.05 level of significance for retaining or rejecting the null hypothesis.

Table 4.8: Independent t-test Statistics on the Difference in the Acquisition of Process Skills Between Male and Female Students

Groups	N	Mean	Std. Dev.	Std. Err	df	P	Remark

Male	73	45.300	8.6239	1.5745			
					116	0.847	NS
Female	45	45.766	9.9807	1.8222			

P ≤ 0.05

The result in table 4.8 showed that the p-value of 0.847 was observed at df= 116. Since the p-value was greater than the alpha value of 0.05, it means therefore that the difference in the acquisition of process skills between male and female students when exposed to inquiry-based method was not significant. Hence the null hypothesis which stated that there is no significant difference in the acquisition of process skills between male and female students when exposed to inquiry-based instruction, wasretained.

4.4 Summary of Major Findings

From findings of the study it was observed that:

1. There was significant difference in acquisition of process skills when students are exposed to inquiry-based instruction and lecture teaching method.Students have significantly higher mean acquisition of process skills when exposed to inquiry.
2. There was significant difference in the interest shown by SSS students when exposed to inquiry and lecture teaching method. There was a marked increased difference in interest between experimental group and control group in favour of the experimentalgroup. The group that was exposed to inquiry-based instruction showed more interest than there counterpart taught using lecture method
3. There was significant difference in the mean academic performance of students taught Ecology with inquiry-based instruction and those taught with lecture method

in favour of experimental group. Students exposed to inquiry-based instruction performed academically higher than there counterpart taught using lecture method.

4. There was no significant difference in the acquisition of process skills between male and female students when exposed to inquiry-based instruction. The male and female had almost the same mean acquisition of science process skillswhen exposed to inquiry-based instruction. The mean difference between male and female showed that the female students acquire more skills than the male students.

4.5 Discussion of Results

This research work investigated the effects of inquiry-based instruction in acquisition of process skills, interest and performance in ecology among secondary school students. Four hypotheses were stated and tested based on the scores of the subjects obtained in Science Process Skills Acquisition Test (SPSAT), Student Ecology Concept Interest Questionnaire (SECIQ) and Ecology Performance Test (EPT).

Analysis of the data obtained are presented in Table 4.1 to 4.8 in accordance with the stated hypotheses. The findings are discussed below:

From the test of hypothesis one, and the data relating to research question one, the result of the findings showed that there was significant difference when students were exposed to inquiry and lecture teaching method in favour of experimental group and this could be as a result of used of inquiry-based instruction to teach the experimental group. The null hypothesis was therefore rejected.This agreed with Lederman (1998) who stated that Inquiry has been identified as a teaching and learning method that provided learners with motivation to learn and develop skills to be successful throughout life. The findings agreed with Chinwe and Chukelu (2012) who came out with similar finding on effects of discovery

method on Secondary School Students' Process Skill Acquisition in Abuja Municipal Area Council, Nigeria Chinwe and Chukelu found out that discovery method was more effective in fostering students' acquisition of science process skills.

The research agreed with that ofBichi, (2002) who observed that as students engage in activities; they acquire skills and confidence which aid their capacity to tackle future problem. This is also in line with the work of Ajewole and Okebukola, (1990) who found out that, science involves active participation of the learner in the learning process; consequently, science is about doing things; that is, activity-oriented. Active participation of the learner can help him acquire science process skills.

Hypothesis two tested significant difference in the interest shown in ecology by SSS students when exposed to inquiry-based instruction and lecture methods? The research question two was answered by testing the corresponding hypothesis which stated thatthere is no significant difference in the interest shown by SSS students when they are exposed to inquiry-based instruction and lecture method. It was observed that students taught using inquiry-based instruction had more interest towards Biology than those taught Biology using lecture method. This indicated that the use of inquiry-based instruction enhanced/boosted students' interest towards learning of Biology. Increased interest towards learning of Biology recorded could be due to use of inquiry-based instruction and the general fun experienced during the lesson when inquiry-based instruction is used. This support to the findings of Cogill, (2002) who observed that the use of inquiry-based instruction raises the level of concentration and enhances learning because it is fun. Furthermore, other reasons that could be adduced to be behind enhancement and boosting of students interest when taught with inquiry-based instruction could be that students who learned with inquiry were

more attentive and engaged in learning, participated more actively in the classroom, interacted much more with the teacher, their peers. This is in line with Silva, (2006) who found out that, an individual's attention and/or engagement with particular events and objects determine the direction of interest development. Therefore, with the empirical evidence in this study, it is shown that the use of inquiry-based instruction is necessary for boosting students' interest towards learning of Biology.

Hypothesis three tested for significant difference in the mean academic performance of students taught Ecology using inquiry-based instruction and those taught using lecture method. Students have significantly higher academic performance when exposed to inquiry. The results of the findings showed that there was significant difference in academic performance when SSS students were exposed to inquiry-based instruction and lecture method. It was observed that performances of students who were taught using inquiry-based instruction outperformed others taught using lecture method in favour of the experimental group. The null hypothesis was therefore rejected.

The findings conform to that of Chukwuemeka (2008) who came out with similar finding on the effect of practical activities on academic achievement and acquisition of science process skills among Biology students in Delta State Capital Territory (DSCT) Nigeria. Chukwuemeka found out that the experimental group had a higher mean academic performance score than there counterpart taught using lecture method; this could be as a result of exposure to practical activities. This is in line with Nnamonu and Joel (2009), revealed that there is high academic performance in the group exposed to practical activities than those exposed to lecture method. While it disagrees with the findings of Mari (1994), (whose work was on heterogeneous subject i.e mixed ability student, not the

slow learners). On academic achievement of the male and female students jointly exposed to activity-based method.

Hypothesis four tested gender difference in the acquisition of science process skills when SSS students are exposed to inquiry-based instruction and lecture methods? The research question four was answered by testing the corresponding hypothesis which states that there is no significant difference in gender when SSS students are exposed to inquiry-based instruction and lecture method on the acquisition of science process skills. Their mean acquisition of process skills were 45.300 and 45.766 by male and female respectively, indicating a mean difference of 0.466 in favor of female. The null hypothesis is hereby retained. This could be due to the fact that inquiry-based instruction method is gender friendly.

This conforms to the findings of Mari (2001) who revealed superiority in performance of female students over their male counterpart in task involving science process skills. This disagreed with the work of Wallace (2007) who revealed in a study that both males and females who were taught using inquiry-based instruction acquire same science process skills. However, Ogunleye (1999) revealed that, gender differences may exist in many different areas of education from performance to interest, from classroom activities and course enrolment to perceptions about careers.

Therefore, with the empirical evidence in this study, it is shown that the use of inquiry-based instruction is gender friendly in learning Biology.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter summarizes the investigation on the Effects of Inquiry-based Instruction on Acquisition of Process Skills, Interest and Performance in Ecology among Secondary School Students, in Lere Educational Zone, kaduna, Nigeria.

The chapter is presented under the following headings:

5.2 Summary

5.2.1 Summary of Findings

5.3 Conclusions

5.4 Contributions to Knowledge

5.5 Recommendations

5.6 Limitation of the Study

5.7Suggestions for Further Studies

5.2 Summary

This study investigated the effects of inquiry-based instruction on acquisition of process skills, interest and performance in ecology among secondary school students in Lere, Kaduna, Nigeria. The research was presented in five chapters. Chapter one presented the problem of this study which was prompted by poor acquisition of process skills, low interest and poor academic performance of secondary school Biology students. The study was guided by four research objectives, four research questions and four null hypotheses corresponding to the research objectives were also stated. Other aspects of the chapter are significant of the study, scope of the study and basic assumptions. The study was limited to only SSS II students of public secondary s offering Biology in Lere Educational Zone of Kaduna State.

Chapter two of this study reviewed literatures that were relevant in areas such as Teaching and learning of science, Biology as a Science Subject, Teaching Ecology at Senior Secondary Schools, Science Teaching Methods, Inquiry-Based Instruction in Science, Process skills acquisition and academic performance in science, Interest as a factor and performance in Science Education, Relevance of Interest in Teaching and Learning Science, Gender and Academic Performance in Science as well as Overview of Related Studies and Implications of Literature Reviewed for the Present Study

The chapter three of this study presented the methodology employed in carrying out this study and this includesResearch Design, Population of the Study, Sample and Sampling Techniques, Instrumentation, Validity of the Instruments, Pilot test, Reliability of the Instruments, Administration of Treatment as well as Data Collection Procedure and Procedure for Data Analysis.

Chapter four of the study presented the results and discussions of the findings. Four hypotheses were tested along the research objectives and questions. From the analysis of the data and test of the study's hypotheses, the following major findings were outlined:There was significant difference in acquisition of process skills when students are exposed to inquiry-based instruction and lecture method, there was significant difference in the interest shown by SSS students when exposed to inquiry-based instruction and lecture method, Significant difference existed in the mean academic performance of students taught Ecology with inquiry-based instruction and lecture method and there was no significant difference in the acquisition of process skills between male and female students when exposed to inquiry-basedinstruction and lecture method.

Chapter five summarizes the investigation on the effects of inquiry-based instruction on acquisition of process skills, interest and performance in ecology among secondary school students in Lere Educational Zone, Kaduna, Nigeria. The chapter looked at the following sub-headings: Summary of Major Findings, Conclusions, Contributions to Knowledge, Recommendations, Limitations of the Study and Suggestions for further Studies.

5.2.1 Summary of Findings

1. Significant difference exist in the acquisition of science process skills when students are exposed to inquiry-based instruction and lecture method. Students have significantly higher mean acquisition of process skills when students are exposed to inquiry-based instruction.
2. Significant difference exist in the interest shown by SSS Students when exposed to inquiry-based instruction and lecture method in Ecology. There is a marked increased difference in interest between experimental group and control group in favour of the experimental group.
3. Significant differences exist in the mean academic performance of students taught Ecology with inquiry-based instruction lecture method. Students have significantly higher academic performance when exposed to inquiry-based instruction.
4. There is no significant difference in gender when SSS students are exposed to inquiry-based instruction and lecture method in the acquisition of science process skills. The male and female had almost the same mean acquisition of science process skills and in the same vein, male and female had almost the same mean acquisition of science process skills when exposed to inquiry-based instruction.

5.3 Conclusions

On the basis of the findings from this study, the following general conclusions could be deduced:

1. Students have higher mean acquisition of process skills when exposed to inquiry-based instruction.
2. There is marked increased difference in interest shown between experimentalgroup and control group in favor of the experimental group.
3. Students have higher academic performance when exposed to inquiry-based instruction.
4. Inquiry-based instruction enhanced acquisition of process skills equally well in both Male and female students.

5.4 Contributions to Knowledge

The concern of this study was to explore the Effects of Inquiry-based Instruction in Acquisition of Process Skills, Interest and performance in Ecology among Secondary School Students. The findings of the study have the following significant contributions to knowledge;

1. The study established that inquiry-based instruction promote acquisition of science process-skills among Secondary School Biology Students.
2. Participation in inquiry-based instruction enhances Senior Secondary Students' interest in learning of Biology
3. Inquiry-based instruction was established to be gender friendly as it promotes the learning of Biology by both male and female students.

5.5 Recommendations.

The following recommendations are suggested:

1. The use of inquiry-based instruction should be encouraged among teachers of ecology to improve student's acquisition of process skills.
2. Both male and female senior secondary school students should be taught Biology with inquiry-based instruction as both acquire science process skills when used.
3. Teachers of Biology should be sponsored by government/private school owners to attend regular courses, workshops, seminars and in-house training on the use of inquiry-based instruction for the maximum students' acquisition of process skills.

5.6 Limitation of The Study

1. The students and research assistants were not too familiar with inquiry-based instruction. A lot of explanations were done on it before commencement of the exercise.

5.7Suggestions for Further Studies

1. It is suggested that further studies be carried out on effects of inquiry and fieldtrip teaching methods in acquisition of process skills, interest and performance towards ecology among secondary school students.

2. The study was carried out using senior secondary schools as the research population and sample. Other researchers may replicate this study by using tertiary institutions.

3. This study covered only Lere Educational Zone in Kaduna state. The study could be expanded to cover other Zones and the whole of Kaduna State.

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APPENDIX A

SCIENCE PROCESS SKILLS ACQUISITION TEST (SPSAT)

Gender:_____

Instruction: Answer all questions *Time allowed: 1 hour*

Below is a record of the number of flowers found on pride of Barbados plants growing in two different sites, **A**and **B.**

Site **A** Sunny and dry	Site **B** Shady and damp
Number of flowers	Number of flowers
7 12 9 5 9 7 18	3 0 11 7 4 3 6
7 8 3 7 11 4 15	5 4 2 4 3 5 5
11 9 7 6 9 5 6	8 4 3 1 6 2 4
8 13 4 8 7 18 15	5 9 4 5 4 7 3
9 7 8 18 13 9 9	10 3 8 4 7 3 5

1. Complete the table below to show how the plant in the different sites flowered.

Number of flowers

Site	0-3	4-7	8-11	12-15	16-18
A B					

2. The most frequent number of flowers on a plant in site B is.....……...……..

3. The percentage of plants with more than three flowers in site A is……..

4. Define ecology

5. List the biotic component found in abandoned farmland habitat

*Select a suitable area in your school, Observe the area at regular intervals over a period of 3-5 days. Use what you have observed and answer question **6-9** below*

6. Record the plants and animals observed in the area

7. List the possible food sources

8. Collect any evidence of animal presence

9. Construct a possible food chain

10. Identify the characteristics of hill habitat

*Observe the school pond in biology garden and answer question **11-13** below*

11. List the animals found in pond habitat

12. Construct a food chain of the animals identified in pond habitat

13. Differentiate between aquatic habitat and terrestrial habitat

14. List the characteristics of abandoned farmland

15. What are marshes?

16. List the adaptations of organisms in marshes habitat

17. List the plants and animals that lives in marshes

*Given two different lower jaws **A** and **B** of frog and toad respectively. Look at them carefully.*

18. State two differences between the teeth in jaw **A** and those in jaw **B**

……

……

……

……

……*Th*

*e animals in **C** were collected in a school garden. They are grouped into two groups as shown below;*

Group C1	Group C2
Housefly, Clothe month, Beetle	Ant, Silver fish

19. List two differences you can see between these animal groups

……

……

……

……..**.....**

Snail is a mollusk. Johnson collected 50 snails and measured the length of their shells. The results are shown below.

16 18 25 19 20 15 25 20 19 17 23 30 12 25

22 10 18 14 24 14 23 17 24 11 15 17 24 31

22 23 22 18 28 23 26 13 26 27 20 8 10 23

29 23 16 21 11 13 19 20

20. Complete the table below to show the number of snails with different shell lengths.

Shelllength	8-11 cm	12-15 cm	16-19 cm	20-23 cm	24-27 cm	28-31 cm
Number of snails						

APPENDIX B

MARKING GUIDE

FOR SCIENCE PROCESS SKILLS ACQUISITION TEST (SPSAT)

1.

Site	0-3	4-7	8-11	12-15	16-18
A	1	13	13	6	3
B	11	18	5	0	0

Any five point $1 \times 5 = 5$ marks

Skills: experimenting, classifying.

2. The most frequent number of flowers on a plant in site B is = between 4-7 = 18

Good answer = 5 marks

Skills: observation, measuring.

3. The percentage of plants with more than three flowers in site A is =

$35 \times 100 / 36 = 97.2\ \%$

Clear and good working = 5 marks

Skills: observation, classifying, inferring

4. Ecology is defined as the study of inter-relationship between organisms and their external environment.

Any relevant definition = 5 marks

Skill: operational definition.

5. Biotic components found in abandoned farmland habitat include; Lizard, grasses, insect, rat, trees, worms, larvae, dormant seeds etc

Any relevant example $1 \times 5 = 5$ marks

Skills: observation, identification.

6. Plants and animals observed in the area: plants; iroko trees, palm tree, grasses; animals: toad, earthworm, snail, bird etc

Any five example $1 \times 5 = 5$ marks

Skills: observation, identification, recording.

7. Food source in the area are: berries, flowers, leaves, insects, and water source.

Any five example $1 \times 5 = 5$ marks

Skills: observation, identification, classifying.

8. Evidence of animal presence in the area include: feathers, shell, birds dropping and remains of animals etc.

Any five example $1 \times 5 = 5$ marks

Skills: observation, identification, classification, record.

9. The possible food chain: Grass → grasshopper → Toad

Any good example = 5 marks

Skills: observation, identification, classification, order.

10. Characteristics of the Hill habitat

- Presence of ant, toad, rat, snake, lizard, birds, chameleon
- Presence of grasses, shrubs
- Presence of iroko trees, palm tree, rainforest occur on the slopes of mountains

Any five example $1\times 5 = 5$ marks

Skills: observation, classification, identification.

11. Animals found in pond habitat include:

Crabs, insect, tree frog, water snake, beetles etc

Any five example $1\times 5 = 5$ marks

Skills: observation, identification, ordering.

12. Food chain of animals identified in pond habitat

Insect → tadpole → fish → water snake

Any good example = 5 marks

Skills: observation, identification, ordering.

13. Differences between aquatic and terrestrial habitat are:

AQUATIC HABITAT	TERRESTRIAL HABITAT
Aquatic habitat is a water living place of organisms	Terrestrial habitat is a land living place of organisms
Examples of aquatic habitat include marine-salt water and fresh water	Examples of terrestrial habitat include trees (arboreal) surface of the soil and even holes.

Any good example = 5 marks

Skills: operational definition, communication, observation.

14. Characteristics of abandoned farmland;

i. Animals like insect's eggs, larvae, worms, dominant seeds and some rhizomes are present from the outset.

ii. Grasses take over followed by hatched insects and herbs.

iii. Reptiles and herbivores emerge

i. Shrubs are seen, followed by trees.

ii. Higher animals like carnivores and some omnivores eg monkey are seen

iii. At a point, climax vegetation is reached.

Any five example $1 \times 5 = 5$ marks

Skills: observation, identification.

15. Marshes is a low, flat, land completely or partly covered by shallow water with silt frequently deposited.

Any good definition = 5 marks

Skills: observation, operational definition, communication.

16. Animals eg worm, crabs and bivalves burrow into the soft mud to avoid high temperature and drying up; Insect larvae, beetles and frogs come near the surface to gulp atmospheric air to survive the low oxygen content in water.

Plants; the grasses grow large branches to avoid being wash away by water movement; their leaves are long narrow and held above water for atmospheric gaseous exchange to compensate for poor aeration of the logged soil.

Any good example = 5 marks

Skills: observation, identification, operational definition.

17. Animals in the marshes habitat are: Frogs, crabs, worm, beetles, and tadpole's larvae

And the plants include water lettuce, water lily, azolla algae duckweed etc.

Any five example $1 \times 5 = 5$ marks

Skills: observation, identification, communication.

18. The two differences between the lower jaw of frog and toad are:

i. Frog has longer jaw while the toad has a shorter jaw compare to that of frog

ii. Lower jaw of frog is longer than the upper jaw while the lower jaw of toad is same with upper jaw in terms of length.

Any good example = 5 marks

Skills: observation, identification, operational definition.

19. Differences between C_1 and C_2

C_1- can fly

- Has wings

C_2- Cannot fly

- Has no wings

Any good point that correspond = 5 marks

Skills: observation, classification.

20.

Shell length	8-11 cm	12-15 cm	16-19 cm	20-23 cm	24-27 cm	28-31 cm
Number of snails	5	7	11	14	9	4

Any five points $1 \times 5 = 5$ marks

Skills: experimenting, measuring, inferring.

APPENDIX C

Student Ecology Concept Interest Questionnaire (SECIQ)

Gender:Male……., Female……..…

Instruction: Answer all questions Time allowed 40 minutes

S/no	ITEMS	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1.	I enjoy learning ecology concept of biology					
2.	Studies are interesting when ecology concept is taught					
3.	I understand better the learning of ecology concept in biology					
4.	I participate better in the lessons of ecology concept					
5.	Learning ecology concept of biology is difficult for me					
6.	I am not focus when ecology concept of biology is taught					
7.	The teacher involves me more in class discussion when ecology concept of biology is taught					
8.	Ecology concept of biology should be removed in biology curriculum from secondary schools					

9.	I enjoy discussing ecology concept of biology with my colleagues					
10.	Ecology concept of biology is relevant to me					
11.	There are less discipline problems in the class when ecology concept of biology is taught					
12.	Ecology concept of biology distract me from the lesson					
13.	Ecology concept of biology is connected to my life					
14.	I concentrate better in class when ecology concept is taught					
15.	I am bored during the lesson involving ecology concept of biology					
16.	I easily do my homework on ecology concept of biology					
17.	Ecology concept of biology is easily comprehended and understood					
18.	I invest less effort in learning ecology concept of biology					
	Less time is spent in					

19.	explanation when ecology concept of biology is taught					
20.	I feel like the lesson on ecology concept of biology shouldn't end quickly					
21.	I like receiving instruction when the teacher teaches ecology concept of biology					
22.	Learning ecology concept of biology makes me nervous					
23.	Learning ecology concept of biology is very frustrating					
24.	I can learn many things when my teacher teaches ecology concept of biology					
25.	I will study ecology as a course when I go to higher institution					

Scale: 5- Strongly agree, 4-agree, 3-undecided, 2-disagree, 1-Strongly disagree

Source: Adapted from Muoneme (2015)

APPENDIX D

ECOLOGY PERFORMANCE TEST (EPT)

1. Ecology is best defined as the study of
   a) The characteristics of an environment
   b) The inter-relationship between living organism and the environment
   c) Living organisms in a particular area
   d) The habitats and wildlife
   e) Man and the environment.

2. Which of the following is not classified as terrestrial habitat?
   a) Forest
   b) Guinea savannah
   c) Alfro alphine
   d) Litoral zone
   e) Desert

3. Which of the does not contribute to the biomass in an ecosystem?
   a) Producers
   b) Food chain
   c) Consumers
   d) Micro-organism
   e) Saprophytes

4. Which of the following is not a characteristics feature of tropical rainforest habitats?
   a) Trees with longer boles than those in savannah
   b) Fewer canopy strata than the savannah
   c) Many more trees and climbers than savannah
   d) Plenty of leaf litter on the ground
   e) More diverse communities than the savannah

5. Which of the following is not associated with aquatic habitat?
   a) Temperature
   b) Light intensity
   c) Humidity
   d) Turbidity
   e) Wave action

6. Which of the following statement is not true of a climax vegetation?
   a) It is an ecological phenomenon
   b) It is a stable community

c) It eliminates competition
d) It result from succession
e) It involves the colonization of a habitat

7. Which of the following steps would not be taken to protect or conserve fishing grounds from over-exploitation?
   a) Use of nets with all sizes of mesh
   b) Use of net with a particular mesh size
   c) Ban on harvesting of some species
   d) Regulating the size of ships allowed into fishing grounds
   e) Limiting the period of fishing in the waters

8. Which of the following is not part of the objectives of conservation of natural resources?
   a) To eliminate wild animals in order to enable other plants and animals survive
   b) To use our resources on sustain yield basis
   c) To guard against indiscriminate killing of plants and animals
   d) To guard against the extinction and exhaustion of natural resources
   e) To protect the environment.

9. Which of the types of soil has the highest water retaining capacity?
   a) Clay
   b) Laterite
   c) Loam
   d) Gravel
   e) Sand

10. Which of the following is not a way of conserving natural resources?
    a) Controlling farming practice
    b) Establishing forest reserve
    c) Establishing of parks and gardens
    d) Encouraging poaching in game reserves
    e) Protecting the endangered species

11. Which of the following best describes a marine habitat?
    a) A large body of water which has no distinctive colour or taste
    b) A large body of water with high concentration of salt
    c) A large body of water with little suspended materials
    d) A large body of water with no water weeds
    e) A large body of water which sustain no animal life.

12. The following are features of tropical rainforest except
    a) Abundant water supply
    b) Loose and moist soil
    c) Short trees growing beneath tall trees
    d) Scanty tree with small leaves
    e) Presence of many animals.

13. The following are features of northern guinea savanna except
    a) Presence of tall trees with thick bark
    b) Bare soil with very resistant trees
    c) Presence of fire resistant trees
    d) Abundant herbivores
    e) Predominance of woody trees

14. Which of the following explains the term pyramid of numbers?
    a) The number of organism in a trophic level
    b) The relationship between plant and different tropic level
    c) The number of saprophyte and parasites in a habitat
    d) The numbers of predators in a habitat
    e) Progressive decrease in the number of individuals from lower to high tropic level.

15. Which of the following is not a characteristic of overcrowding I plant and animal community?
    a) Population outstripping available space
    b) Population exceeding available food
    c) Competition within the population
    d) Increase in primary production
    e) Population increasing at the same rate at the birth rate

16. A climax community is characterized by
    a) A stable composition of plants and animals
    b) Rapid changes in the composition of species
    c) Constant changes in the appearance of the habitat
    d) Different species occurring at different times
    e) Gradual change in animal population.

17. The following agencies are responsible for conservation in Nigeria except
    a) Forestry departments
    b) Nigerian conservation society

c) Game reserve authority
d) Nigerian red cross society
e) Ministry of agriculture and natural resource.

18. The largest game reserve in Nigeria is the
    a) The kainji game reserve in Nigeria is the
    b) Zamfara forest reserve in sokoto state
    c) Yankari game reserve in Bauchi state
    d) Borgu game reserve in Niger state
    e) Kamuku game reserve in kaduna state.

19. All the following can illustrate the dynamic nature of the ecosystem except
    a) Nitrogen cycle
    b) Carbon cycle
    c) Water cycle
    d) Nutrient cycle
    e) Locomotion in organism

20. In complex food relationships in a community, the primary, the secondary and the tertiary consumers are referred to as
    a) Symbiosis
    b) Omnivores
    c) Heterotrophs
    d) Autotrophs
    e) Carnivores

21. Which of these statements about food chain is not correct?
    a) Animals in the chain are consumers
    b) A food chain usually begins with a green plant
    c) All organisms in the food chain are animals
    d) Living things are dependent on one another
    e) The food chain involves energy transfer in an ecosystem

22. The distribution of organisms in a fresh-water habitat like a stream or pond is determined by the following except
    a) Rainfall
    b) Temperature
    c) pH of soil
    d) light penetration
    e) tidal movements

23. Which of the following ecological factors causes food shortage?
    a) Low rate of reproduction
    b) Emigration
    c) Drought
    d) Topography
    e) Wind direction

24. Density, mortality rate, birth rate are the factors that affect
    a) Population
    b) Dominance
    c) Cover
    d) Habitat
    e) Abiotic community

25. Which of the following is not an aquatic habitat?
    a) Estuaries
    b) Ponds
    c) Rainforest
    d) Swamps
    e) Salt lake

26. Which of the following is an abiotic factor which affects a population?
    a) Predator
    b) Parasite
    c) Consumers
    d) Producers
    e) Temperature

27. Which of the following processes is not due to interaction between the biotic and abiotic components of an ecosystem
    a) Soil nutrient depletion
    b) Condensation
    c) Decomposition
    d) Osmosis
    e) Photosynthesis

28. In any food chain, the first member must be a
    a) Carnivore
    b) herbivore

c) zooplankter
d) autotroph
e) consumers

29. The total amount of energy entering a food chain is that which is present in the
    a) Consumer
    b) Ecosystem
    c) Producer
    d) Decomposers
    e) Heterotroph

30. The difference between community and population is
    a) A community is made up of organism of the same species while a population is made up of organisms of different specie
    b) A community is made up of population of living organisms while a population is made up of organisms of the same species
    c) An ecological niche does not exist in the community but it does in a population
    d) A community attract competitions but a population does not
    e) Number of community out way the numbers of population

31. Which of the following component makes up an ecosystem
    a) Decomposers, animals, and non-living factors
    b) Living and non-living factors
    c) Plants, and non-living factors
    d) Plants, decomposers, and non-living factors
    e) Animals and non-living factors

32. The total amount of energy entering a food chain is that which is present in the
    a) Consumer
    b) Ecosystem
    c) Producer
    d) Decomposer
    e) Competition

33. Which of the following terms ensures the survival of an organisms in its environment?
    a) Hibernation
    b) Succession
    c) Adoption
    d) Competition
    e) Habitat

34. Which of the following would be the primary producer in a food chain?
    a) Saprophytes
    b) Herbivores
    c) Carnivores
    d) Green plants
    e) Parasites

35. The adaptations for water conservation in organisms include the following except
    a) Scales in fishes
    b) Scales on leaves
    c) Thick leaves
    d) Spine in plants
    e) Succulent stems

36. Which of the following best describes a marine habitat? A large body of water
    a) Which has no distinctive colour or taste
    b) With high concentration of salt
    c) With little suspended materials
    d) With no water weeds
    e) Which sustains no animals

37. Which of the following represents the correct order in a possible food chain?
    a) crustacea→diatom→fish→man
    b) fish→crustacea→man→diatom
    c) man→fish→crustacea→diatom
    d) diatom→crustacea→fish→man
    e) man→diatom→fish→crustacea

38. Which of the following is not a conservable natural resources/
    a) water
    b) sunlight
    c) forest
    d) soil
    e) air

39. Which of these materials is not required for insect collection in an ecological field-trip?
    a) Pooter
    b) Seechi disc
    c) Spreading board
    d) Jar containing alcohol
    e) Sweep net

40. Which of the following is the correct sequence for energy transfer and nutrient cycling among living things in an ecosystems?
    a) consumers→producers→decomposers
    b) producers→decomposers→consumers
    c) decomposers→producers→consumers
    d) producers→consumers→decomposers
    e) consumers→decomposers→producers

APPENDIX E

MARKING GUIDE FOR

ECOLOGY PERFORMANCE TEST (EPT)

1. C
2. D
3. C
4. B
5. C
6. C
7. A
8. A
9. C
10. D
11. B
12. A
13. A
14. E
15. D
16. A
17. D
18. C
19. E
20. C
21. C
22. C
23. C
24. A
25. C
26. E
27. D
28. D
29. C
30. B
31. B
32. C
33. D
34. D
35. A
36. B
37. D
38. D
39. B
40. D

APPENDIX F

REQUEST LETTER

Department of Science Education,

Faculty of Education,

A.B.U Zaria.

15th Jan. 2016.

The Director,

Lere Educational Zone,

Ministry of Education, Science and Technology,

Kaduna State.

Sir,

REQUEST FOR PERMISSION TO VISIT SOME SCHOOLS TO GET DATA FOR MY RESEARCH

I write to seek for permission to visit some Secondary Schools under your division in order to get data for my research project.

Thanks for your usual co-operation.

Yours Faithfully

Danjuma Sunday
P13EDSC8039

APPENDIXG

STUDENT ECOLOGY CONCEPT INTEREST QUESTIONNAIRE (SECIQ)

Reliability

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	20	100.0
	Excluded	0	.0
	Total	20	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.836	.840	25

Item Statistics

	Mean	Std. Deviation	N
I enjoy learning ecology concept of biology	3.2000	1.67332	20
Studies are interesting when ecology concept is taught	3.5500	1.46808	20
I understand better the learning of ecology concept in biology	3.3500	1.34849	20
I participate better in the lessons of ecology concept	4.8500	.48936	20
Learning ecology concept of biology is difficult for me	4.6000	.82078	20
I am not focus when ecology concept of biology is taught	4.5000	1.23544	20
The teacher involves me more in class discussion when ecology concept of biology is taught	4.3500	1.26803	20
Ecology concept of biology should be removed in biology curriculum from secondary schools	4.4000	1.14248	20
I enjoy discussing ecology concept of biology with my colleagues	4.3500	1.26803	20
Ecology concept of biology is relevant to me	4.8000	.69585	20
There are less discipline problems in the class when ecology concept of biology is taught	4.3000	1.26074	20
Ecology concept of biology distract me from the lesson	4.4500	.88704	20
Ecology concept of biology is connected to my life	4.2500	1.29269	20
I concentrate better in class when ecology concept is taught	4.4500	.99868	20
I am bored during the lesson involving ecology concept of biology	4.5500	.88704	20
I easily do my homework on ecology concept of biology	4.2500	1.29269	20
Ecology concept of biology is easily comprehended and understood	4.6500	.98809	20
I invest less effort in learning ecology concept of biology	4.1000	1.37267	20
Less time is spent in explanation when ecology concept of biology is taught	4.5000	.88852	20
I feel like the lesson on ecology concept of biology shouldn't end quickly	4.2500	1.29269	20
I like receiving instruction when the teacher teaches ecology concept of biology	4.5500	.99868	20
Learning ecology concept of biology makes me nervous	4.3000	1.26074	20
Learning ecology concept of biology is very frustrating	4.4500	1.14593	20
I can learn many things when my teacher teaches ecology concept of biology	4.1500	1.46089	20
I will study ecology as a course when I go to higher institution	4.8000	6.9585	20

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	4.318	3.200	4.850	1.650	1.516	.168	25

Acquisition reliability using PPMC

Raw scores of the two sets of tests for determining the coefficient of reliability of the test instrument

S/NO	X	Y	X^2	Y^2	XY
1	34	37	1156	1369	1258
2	32	33	1024	1089	1056
3	30	33	900	1089	990
4	36	37	1296	1369	1332
5	38	37	1444	1369	1406
6	30	32	900	1024	960
7	29	31	841	961	899
8	29	29	841	841	841
9	30	28	900	784	840
10	32	35	1024	1225	1120
11	32	33	1024	1089	1056
12	33	32	1089	1024	1056
13	37	39	1369	1521	1443
14	32	33	1024	1089	1056
15	29	29	841	841	841
16	35	35	1225	1225	1225
17	37	37	1369	1369	1369
18	38	39	1444	1521	1482
19	39	35	1521	1225	1365
20	40	38	1600	1444	1520
N=20	∑X=672	∑Y=682	∑X2=22832	∑Y2=23468	∑XY=23115

Note: x and y are first and second tests scores for early child hood education pupils

(Statistics for finding reliability)

Pearson Product Moment Correlation computed for the Reliability index for the instrument used in the pilot study of the research.

The formula for Pearson Product Moment Correlation is given below:

$$R = \frac{N(\sum xy) - (x)\sum Y}{((N(X^2) - (NY^2) - (Y)^2)}$$

N=Number of respondents

X is test scores at pre test

Y is test scores at post test

$\sum x$ is scores at pretest is summed

$\sum y$ is scores at Post test is summed

$\sum x^2$ is scores at pre test is squared and summed

$\sum Y^2$ is scores at post test is squared and summed

$(\sum x)^2$ is scores at pre test is summed and squared

$(\sum Y)^2$ is scores at post test is summed and squared

Where:

N=20	∑X=672	∑Y=682	∑X2=22832	∑Y2=23468	∑XY=23115

Pearson Product Moment Correlation formula is:

$$r = \frac{N(\sum xy) - \sum (x)\sum Y}{((N(\sum X^2) - (N*\sum Y^2) - (\sum Y)^2}$$

$$= \frac{20*23115 - 672*682}{20*(22832)^2 - 20*23468-(682)^2}$$

=.699

r=.70

APPENDIX H

Scores for the Three Instruments in Experimental School

S/N	Gender	SPSAT pre-test scores (100)	SPSAT post-test scores (100)	SECIQ scores (125)	EPT pre-test scores (80)	EPTpost-test scores (80)
1	Male	35	75	114	28	74
2	Male	30	75	102	32	58
3	Male	32	65	100	32	68
4	Male	35	80	111	34	68
5	Male	35	60	110	32	78
6	Male	25	70	108	16	74
7	Male	30	75	108	18	76
8	Male	25	55	102	28	72
9	Male	30	60	112	26	58
10	Male	32	52	104	30	68
11	Male	30	50	90	26	70
12	Male	30	70	88	28	68
13	Male	35	65	104	24	72
14	Male	25	75	104	38	72
15	Male	20	55	104	44	72
16	Male	30	60	102	38	70
17	Male	32	65	98	40	72
18	Male	32	70	100	36	68
19	Male	30	65	102	32	68
20	Male	32	60	106	34	64
21	Male	30	65	88	38	60
22	Male	30	65	98	32	68
23	Male	36	55	108	28	70
24	Male	25	75	100	32	64
25	Male	20	70	88	28	68
26	Male	35	55	80	16	80
27	Male	28	70	98	28	66
28	Male	24	75	104	26	78
29	Male	28	70	105	18	70
30	Male	25	78	100	32	76
31	Male	30	70	102	34	74
32	Male	35	75	118	30	70
33	Male	30	70	112	32	70

Scores for the Three Instruments in Experimental School

S/N	Gender	SPSAT pre-test scores (100)	SPSAT post-test scores (100)	SECIQ scores (125)	EPT pre-test scores (80)	EPT post-test scores (80)
1	Female	30	90	102	28	52
2	Female	30	85	112	32	68
3	Female	30	75	116	46	72
4	Female	20	85	106	36	70
5	Female	30	85	114	32	74
6	Female	35	85	110	26	68
7	Female	35	75	118	24	70
8	Female	20	70	116	18	62
9	Female	35	90	100	32	68
10	Female	35	95	112	34	70
11	Female	25	80	102	32	70
12	Female	25	65	101	18	58
13	Female	35	65	109	22	70
14	Female	25	80	100	26	58
15	Female	30	75	118	36	66
16	Female	35	85	116	28	68
17	Female	25	65	112	24	64
18	Female	25	65	112	28	76
19	Female	20	55	114	18	72
20	Female	35	85	110	22	78
21	Female	25	85	110	26	78
22	Female	30	75	112	38	82
23	Female	25	95	110	32	80

APPENDIX I

Scores for the Three Instruments in Control School

S/N	Gender	SPSAT pre-test scores (100)	SPSAT post-test scores (100)	SECIQ scores (125)	EPT pre-test scores (80)	EPTpost-test scores (80)
1	Female	35	55	112	34	48
2	Female	35	50	102	36	50
3	Female	30	45	98	34	60
4	Female	35	45	111	36	56
5	Female	35	45	110	32	48
6	Female	30	55	108	32	50
7	Female	25	45	106	36	52
8	Female	25	45	100	36	48
9	Female	30	60	118	26	52
10	Female	35	50	100	30	48
11	Female	35	55	99	26	52
12	Female	30	45	88	28	46
13	Female	38	45	104	24	42
14	Female	30	40	104	38	54
15	Female	30	45	108	44	48
16	Female	25	60	102	38	62
17	Female	31	55	98	40	72
18	Female	39	60	100	36	68
19	Female	32	65	102	32	64
20	Female	31	60	106	34	62
21	Female	30	55	88	38	60
22	Female	35	55	98	32	68

Scores for the Three Instruments in Control School

S/N	Gender	SPSAT pre-test scores (100)	SPSAT post-test scores (100)	SECIQ scores (125)	EPT pre-test scores (80)	EPTpost-test scores (80)
1	Male	30	61	114	28	60
2	Male	31	50	102	32	50
3	Male	32	58	100	32	64
4	Male	35	46	111	34	56
5	Male	38	49	110	32	50
6	Male	30	51	108	16	52
7	Male	30	44	108	18	50
8	Male	29	46	102	28	60
9	Male	30	60	112	26	54
10	Male	32	52	104	30	48
11	Male	34	50	90	26	52
12	Male	34	48	88	28	48
13	Male	36	54	104	24	52
14	Male	29	46	104	38	54
15	Male	27	58	104	44	52
16	Male	30	60	102	38	48
17	Male	32	56	98	40	70
18	Male	39	82	100	36	60
19	Male	30	62	102	32	62
20	Male	32	68	106	34	60
21	Male	35	60	88	38	56
22	Male	32	58	98	32	52
23	Male	36	58	108	28	58
24	Male	24	54	100	32	56
25	Male	22	56	88	28	48
26	Male	35	58	80	16	46
27	Male	28	70	98	28	62
28	Male	24	76	104	26	54
29	Male	28	70	105	18	68
30	Male	22	78	100	32	48
31	Male	30	76	102	34	60
32	Male	32	74	118	30	64
33	Male	36	70	112	32	52
34	Male	32	58	114	30	62
35	Male	30	68	108	32	60
36	Male	28	68	120	28	52
37	Male	22	78	114	24	68
38	Male	34	70	118	22	58
39	Male	32	80	100	28	60
40	Male	26	76	106	26	54

APPENDIX J

LESSON PLAN FOR EXPERIMENTAL GROUP

Week 1:

Subject: Biology

Topic: Habitat (fresh water- pond)

Class: SSII

Time: 40 Minutes

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

i. Observe and record the characteristics of ponds habitat,

ii. Identify and name the adaptation of the plants and animals in the pond habitat.

iii. Identify and arrange (order) the food chain in the pond habitat

iv. Observe, identify and name animals and plants that can be found in pond habitat

Previous Knowledge: The students already know the meaning of Ecology, biotic and abiotic components

Introduction: The teacher introduces the lesson by asking question on the previous knowledge e.g. what is ecology?

Presentation Step 1: The teacher takes the students to the pond and requires them to bring and use the guided sheet. Also tell them to record what they observed in their K WL chart.

Step II: The teacher defines and explains pond while the students are looking at the pond e.g pond is a small body of shallow water having no or feeble current. Ponds vary in size depending upon age and location.

Step III: The teacher ask the students to identify and arrange/construct (order)food chain of the biotic component observed e.g Insect ⟶ Tree frog ⟶ Water snake.

Step IV: The teacher asks students to observe the pattern of distribution of the biotic components of the pond and their adaptive features. He then takes students to identify and take sample where possible of (plants and Animals) component in the pond habitat e.g tad pole, water lettuce, tree frog, water lily, waterSnake, arrow head e.t.c

Step VI: The teacher guide students to take reading of temperature, relative humidity and estimate light intensity of the pond.

Evaluation: The teacher evaluates the lesson by asking questions based on the lesson presented e.g

1. What are the characteristic of pond habitat?
2. What are the examples of plants and animals that can be found in pond habitat?
3. Observe, identify and construct a food chain of the biotic components observed

Conclusion: The teacher concludes lesson by summarizing a topic learnt e.g define pond, some characteristics of pond habitat, naming some of plants and animals that can be found in pond habitat.

Students Activities: The student would use the possible sample collected and what they have observed and write report.

Week2: Experimental Group

Subject - Biology

Topic - Hill (Terrestrial Habitat)

Class - SS II

Time - 1½ hours

Behavioral objectives: It is expected that at the end of the lesson, students should be able to:

I. Observe and name the characteristics of Hill habitat

II. Classify the adaptation of plants and Animals in the Hill habitat.

III. Identify the food chain in the hill habitat.

IV. Identify and name some biotic component in the hill.

Previous knowledge: The students observe pond, characteristics and the types of plants and animals found in the pond habitats.

Introduction: The teacher introduces the lesson by questions on the previous knowledge e.g. what is pond? What are the characteristics of pond what are the biotic component found in the pond habitat. What is aquatic habitat?

Presentation

STEP I: The teacher take the students to Kono Hill and requires them to bring and use the guided sheet and also advise them to record what they would observe in their KWL chart.

STEP II: The teacher defines Hills e.g. Hills are regarded as small high land areas exposed out due to agent of denudation.

STEP Ill: The teacher, name and explain characteristics of Hill e.g hill is social mass of intrusive Igneous rock which are undergoing modification due to weathering process in the area. Because of humid, climate condition of savanna (guinea savanna) both physical, chemical and biological weathering are active in the environment. Which consequently lead to fragmentation of rock materials to form soil at based and hill top.

STEP IV: The teacher explains and asks students to observe pattern of distribution of biotic components of the Hills and their adaptive features.

STEP V: He then takes the students round to observe and sample where possible of the biotic component of the hill habitat e.g. Rat, insect, Birds, frogs, snake, chameleon, lizard, grasses, shrubs free etc.

STEP VI: The teacher ask students to construct food chain of the biotic component that can be found in Hill habitat. e.g Grasses Rat ⟶ Snake ⟶

STEP VII: The teacher guides students to take reading of temperature, relative humidity and estimate light intensity of the Hill.

Evaluation: The teacher evaluates the lesson by asking question base on the lesson presented e.g.

1. What is Hill?
2. What are the characteristics of hill habitat?
3. What are the biotic of components found in the hill habitat?

4. What are the adaptive features observed on the biotic component in the hill?

Conclusion: The teacher concludes the lesson by summarizing the lesson by defining Hill, list some characteristics of hill habitat and naming some of the biotic component found in the hill.

Students Activities: The students would use the possible Sample Collected and what they have observed and write report.

Week 3: Experimental Group

Subject - Biology

Topic - Abandoned farm land (terrestrial) habitat

Class - SSII

Time - 1½ hours

Behavioral objectives: It is expected that at the end of the lesson the students should be able to:

i. Observe, Identify and name the characteristics of abandoned farm land habitat

ii. Identify the adaptive feature of biotic component of the abandoned farm land habitat,

iii. Identify and name some of the biotic component found or observed in the abandoned farm land habitat.

Previous knowledge: The students know Hill habitat, they know the meaning of Hill, characteristics of hill, the adaptive features of Hill and biotic component of the hill.

Introduction: The teacher introduces the lesson by asking questions on the previous knowledge e.g what is Hill? What are the characteristics of Hill habitat? What are the adaptive features of the biotic component of the hill habitat? What are the biotic components found in the Hill habitat?

Presentation Step I: The teacher defines abandoned farm land while students are observing e.g this is the type of farm land that is left unfarmed or no crops planted for some years (2 and above years).

STEP I: The teacher name and explain while students are observing the characteristics of abandoned farm land e.g. in the abandoned farm land, the pioneers are weeds and underground stems, seeds of plant, eggs and Larvae of insect and worms. These pioneers derived their food from the left over nutrients of the old farm. Animal such as mice, rats and cane rats lizard are also found.

STEP III: He then takes the students round to observe and collect sample where possible of the biotic component of the abandoned farm land e.g. grasses, insect rat, lizard, trees etc.

STEP IV: The teacher explain food chain and guide to construct food chain of the biotic component observed in the abandoned farm land. E.g . Grass ⟶ Grasshopper ⟶ Snake

Evaluation: He evaluates the lesson base on what the student has been observed on the abandoned farm land habitat e.g.

1. What are characteristics of abandoned farm land?
2. What are the adaptive features of the biotic component that can be found in the abandoned farm land?
3. What are the biotin components found in the abandoned farm land habitat?

Student's activities: The students would use what they have observed and the possible sample collected to write report

Week 4: Experimental Group

Subject - Biology

Topic - Marshes Habitat

Class - SS II

Time - 1 ½ hours

Behavioral objectives: the students should be able to:

1. Classify the types of marshes
2. Observe and identify the adaptations of organisms in habitat.
3. Identify the plants and animals that live in marshes.

Previous Knowledge: - The students know the meaning of pound; the characteristics of pond, the adaptive features of plants and animals in the pond.

Introduction: - The teacher introduces the lesson by asking some questions on the previous knowledge e.g.

1. What are the adaptive features of plants in the pond?
2. What are the general characteristics of pond habitat?

Presentation;

Step I:- The teacher would take the students to the marsh habitat he then defines and explain marsh habitat while the students are observing e.g Marsh is a low, flat, land completely or partly covered by shallow water with silt frequently, deposited. The water is about knee deep in most parts while is less in many other places.

Step II :- He then name and explains while students are observing the types of marshes: temporary marshes are seasonal occurring during the rainy season drying up in the dry season, while permanent marshes: contains water throughout the year. They are close to the rivers or seas which serve permanent water source.

Step III :- He identify and explains the characteristics of marsh habitat e.g low and habitat covered with water (if permanent) but dry up during the dry season (if temporary). Soils is soft making difficult for big animal vegetation is normally dominated by grasses, the contents of mineral salts is high and dissolved oxygen content is low.

Step IV :- The teacher also classify and show adaptive features of plants and animals e.g animals; warm, crabs and bivalves burrow into the soft mud to avoid high temperature and drying up, insect larvae, beetles and frogs come near the surface to gulp atmospheric air to survive the low oxygen content in the water. Plants. The grasses grow large branches or tussocks to avoid being washed away by water movement. Their leaves are long narrow and held high above water for atmospheric gaseous exchange to compensate for poor aeration of the logged soil.

Step V :- He also name and show plants and animals that lives in marsh habitat. Plants: vossia cuspidate, duckweed, water lily, water lettuce, salvina, azolla algae etc. animals: water snake, tad pole, frogs, larvae, insects'e.t.c.

Step VI :- The teacher explains how to take reading of temperature, relative humidity and estimate light intensity the marsh.

Evaluations:- The teacher evaluation by asking questions on lesson presented e.g. what are the plants and animals found in marsh habitat?

Conclusion: The teacher concludes the lesson by summarizing the whole lesson e.g by defining marsh. Naming the characteristic of marsh adaptive features e.t.c.

Week 5: Experimental Group

Subject: Biology

Topic: Community

Class: SSII

Time: 40 Minutes

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

Observe and record the number of flowers found on pride of Barbados plant growing in two different sites, **A** and **B**.

Site **A** Sunny and dry	Site **B** Shady and damp
Number of flowers 7 12 9 5 9 7 18 7 8 3 7 11 4 15 11 9 7 6 9 5 6 8 13 4 8 7 18 15 9 7 8 18 13 9 9	Number of flowers 3 0 11 7 4 3 6 5 4 2 4 3 5 5 8 4 3 1 6 2 4 5 9 4 5 4 7 3 11 3 8 4 7 3 5

1. Complete the table below to show how the plant in the different sites flowered.

Number of flowers

Site	0-3	4-7	8-11	12-15	16-18
A B					

2. Identify and name the adaptation of the plants and animals in the pond habitat.

3. Identify and arrange (order) the food chain in the pond habitat

4. Observe, identify and name animals and plants that can be found in pond habitat

Previous Knowledge: The students already know the meaning of Ecology, biotic and abiotic components

Introduction: The teacher introduces the lesson by asking question on the previous knowledge e.g. what is ecology?

Presentation Step 1: The teacher takes the students to the field and direct them on how to fill table.

Site	0-3	4-7	8-11	12-15	16-18

A	1	13	13	6	3
B	11	18	5	0	0

Step II: The teacher defines and explains pond while the students are looking at the pond e.g pond is a small body of shallow water having no or feeble current. Ponds vary in size depending upon age and location.

Step III: The teacher ask the students to identify and arrange/construct (order) food chain of the biotic component observed e.g Insect ⟶ Tree frog ⟶ Water snake.

Step IV: The teacher asks students to observe the pattern of distribution of the biotic components of the pond and their adaptive features. He then takes students to identify and take sample where possible of (plants and Animals) component in the pond habitat e.g tad pole, water lettuce, tree frog, water lily, water Snake, arrow head e.t.c

Step VI: The teacher guide students to take reading of temperature, relative humidity and estimate light intensity of the pond.

Evaluation: The teacher evaluates the lesson by asking questions based on the lesson presented e.g

1. What are the characteristic of pond habitat?
2. What are the examples of plants and animals that can be found in pond habitat?
3. Observe, identify and construct a food chain of the biotic components observed

Conclusion: The teacher concludes lesson by summarizing a topic learnt e.g define pond, some characteristics of pond habitat, naming some of plants and animals that can be found in pond habitat.

Students Activities: The student would use the possible sample collected and what they have

Observed and write report.

Week 6: Experimental Group

Subject - Biology

Topic - Hill (Terrestrial Habitat)

Class - SS II

Time - 1½ hours

Behavioral objectives: It is expected that at the end of the lesson, students should be able to:

Snail is a mollusk. Johnson collected 50 snails and measured the length of their shells. The results are shown below.

1. Observe carefully

16 18 25 19 20 15 25 20 19 17 23 30 12 25

22 10 18 14 24 14 23 17 24 11 15 17 24 31

22 23 22 18 28 23 26 13 26 27 20 8 10 23

29 23 16 21 11 13 19 20

Complete the table below to show the number of snails with different shell lengths.

Shell length	8-11 cm	12-15 cm	16-19 cm	20-23 cm	24-27 cm	28-31 cm
Number of snails						

2. Classify the adaptation of plants and Animals in the Hill habitat.
3. Identify the food chain in the hill habitat.
4. Identify and name some biotic component in the hill.

Previous knowledge: The students observe pond, characteristics and the types of plants and animals found in the pond habitats.

Introduction: The teacher introduces the lesson by questions on the previous knowledge e.g. what is pond? What are the characteristics of pond what are the biotic component found in the pond habitat. What is aquatic habitat?

Presentation

STEP I: The teacher take the students to Kono Hill and requires them to bring and use the guided sheet and also advise them to record what they would observe as follow;

Shell length	8-11 cm	12-15 cm	16-19 cm	20-23 cm	24-27 cm	28-31 cm
Number of						

snails	5	7	11	14	9	4

STEP II: The teacher defines Hills e.g. Hills are regarded as small high land areas exposed out due to agent of denudation.

STEP Ill: The teacher, name and explain characteristics of Hill e.g hill is social mass of intrusive Igneous rock which are undergoing modification due to weathering process in the area. Because of humid, climate condition of savanna (guinea savanna) both physical, chemical and biological weathering are active in the environment. Which consequently lead to fragmentation of rock materials to form soil at based and hill top.

STEP IV: The teacher explains and asks students to observe pattern of distribution of biotic components of the Hills and their adaptive features.

STEP V: He then takes the students round to observe and sample where possible of the biotic component of the hill habitat e.g. Rat, insect, Birds, frogs, snake, chameleon, lizard, grasses, shrubs free etc.

STEP VI: The teacher ask students to construct food chain of the biotic component that can be found in Hill habitat. e.g Grasses $\longrightarrow$ Rat $\longrightarrow$ Snake

STEP VII: The teacher guides students to take reading of temperature, relative humidity and estimate light intensity of the Hill.

Evaluation: The teacher evaluates the lesson by asking question base on the lesson presented e.g.

1. What is Hill?

2. What are the characteristics of hill habitat?
3. What are the biotic of components found in the hill habitat?
4. What are the adaptive features observed on the biotic component in the hill?

Conclusion: The teacher concludes the lesson by summarizing the lesson by defining Hill, list some characteristics of hill habitat and naming some of the biotic component found in the hill.

Students Activities: The students would use the possible Sample Collected and what they have observed and write report.

APPENDIX K

LESSON PLAN FOR CONTROL GROUP

Week 1: Control Group

Subject: Biology

Topic: Habitat (fresh water- pond)

Class: SSII

Time: 40 Minutes

Behavioral objectives: It is expected that at the end of the lesson, students should be able to:

i. Observe and defines a ponds habitat.

ii. Observe and name the adaptation of the plants and animals in pond habitat.

iii. Identify and name animals and plants that can be found pond habitat

iv. Identify and construct a food chain found in the pond habitat

Previous Knowledge: The students known the meaning of Ecology biotic and a biotic components

Introduction: The teacher introduces the lesson by asking question(s) based on the previous knowledge e.g what is ecology?

Presentation

Step 1: The teacher defines and explains pond e.g pond is a small body of shallow water having no or feeble current Ponds vary in size depending upon age and location.

Step Il: The teacher then list and explain the characteristics of pond habitat. E.g the water is stagnant it, has little or no salt in them, lack waves and tides etc.

Step III: The teacher explains plants and animals adaptive feature to pond: Plants: Well developed numerous fibrous roots system for firm anchorage into the soft mud, Numerous root hairs for absorption of nutrient from the soil, there are numerous spines on the long petioles. These spines are protective in function Animals: the body is long and flexible which help to locomotion, protective coloration, and the scales are smooth and water repellent for easy locomotion in water.

Step IV: He also list the plants and Animals that can found in pond habitat e.g plants: Water lettuces, water fern, Duck weed, water lily. Animals: Tree frog, dragon flies, Bird e.t.c

Step V: The teacher explains the possible food chain found in pond environment e.g insect tree frog water snake

Evaluation: The teacher evaluates the lesson by asking questions base on the lesson presented e.g what are the characteristics habitat? What are the examples of plants and animals that can be found in pond habitat?

Conclusion: The teacher concludes the lesson by summarizing the lesson e.g defining pond, some characteristics of pond habitat. Naming some of plants and animals that can be found in pond habitat.

Week 2: Control Group

Subject - Biology

Topic - Hill (Terrestrial Habitat)

Class - SS II

Time - 1 ½ hours

Behavioral objectives: It is expected that at the end of the lesson, student should be able to:

i. Observe, identify and name the characteristics of hill habitat.

ii. Identify and name the adaptation of the plants and Animals in the hill habitat.

iii. Identify and name some biotic component in the hill

iv. Construct (order) a food chain of the organisms found in Hill habitat.

Previous knowledge: The students know pond characteristics and the types of plants and animals found in the pond habitats.

Introduction: The teacher introduces the lesson by asking questions on the previous knowledge e.g what is pond? What are the characteristics of pond? What arc biotic components found in the pond habitat? What is aquatic habitat?

Presentation:

STEP I: The teacher defines hills e.g. hills are regarded as small high land areas exposed out due to agent of denudation.

STEP II: The teacher, name and explain the characteristics of hill i.e. it's characterized as social mass of intrusive igneous winch we undergoing modification due to weathering process in the area, Because of humid, climate condition of savanna (guinea savanna) physical, Chemical and biological weathering are active in the environment. Which consequently lead to fragmentation of rock materials to form soil at base and hill top.

STEP III: The teacher explains the pattern of distribution of biotic components of the Hills and their adaptive features.

STEP IV: He then name the biotic component of the Hill habitat e.g. Rat, insect, Birds, frogs, snake chameleon, frogs, lizard, grasses, shrubs free etc.

STEP V: The teacher construct food chain of the biotic component that can be found in Hill habitat. e.g Grasses $\longrightarrow$ Rat $\longrightarrow$ snake.

STEP VI: The teacher explains to the students how to take reading of temperature, relative humidity and estimate light intensity ofthe Hill.

Evaluation: The teacher evaluates the lesson by asking questions base on the lesson presented e.g. what is hill? What are the characteristics of hill habitat? What are the biotic components found in the hill habitat? What are the adaptive features observed on the biotic component in the hill?

Conclusion: The teacher concludes the lesson summarizing the lesson by defining Hill, list some characteristics of hill habitat and naming some of the biotic component found in hill.

Students Activities: The students will copy note in their exercise books.

Week 3: Control Group

Subject - Biology

Topic - Abandoned farm land (terrestrial) habitat

Class - SS II

Time - 1½ hours

Behavioral objectives: it is expected that at the end of the lesson the student should be able to:

1. Observe, identify and name the characteristics of abandoned farm land habitat
2. Identify the adaptive features of the biotic component of the abandoned farm land habitat.
3. Identify, and name some of the biotic component found or observed in the abandoned farm land. Habitat.

Previous knowledge: The students know hill, they know the meaning of Hill, characteristics of hill, the adaptive features of Hill and biotic component of the Hill.

Introduction: The teacher introduces the lesson by asking questions on the previous knowledge e.g. what is Hill? What are the characteristics of Hill habitat? What are the adaptive features of the biotic component of the hill habitat? What are biotic components found in the Hill habitat?

Presentation;

STEP I: The teacher defines abandoned farm land e.g. this is the type of farm land that is left unfarmed or no crops planted for some years (2 and above years).

STEP II: The teacher explains and names the characteristics of abandoned farm land, E.g. in the abandoned farm land, the pioneers are weeds and underground stems, seeds of plant, eggs and larvae of insect and worms. These pioneers derived their food from the left over nutrients of the old farm. Animal such as mice, rats, and cane rats, lizard are also found.

STEP III: He then names the biotic component of the abandoned farm land e.g. grasses, insect rat, lizard, trees etc.

STEP IV: The teacher explain food chain and guide students to construct food chain of the biotic component observed in the abandoned farm land. e.g. Grass → Grasshopper → lizard → Snake

Evaluation: He evaluates the lesson base on what the lesson has been presented on the abandoned farm land habitat e.g. what are the characteristics of abandoned farm land? What are the adaptive features of the biotic component that can be found in the abandoned farm land? What is the biotic component found in the abandoned farm land habitat?

Student's activities: The students would copy note into their exercise books.

Week 4: Control Group

Subject - Biology

Topic - Marshes Habitat

Class - SS II

Time - 1½ hours

Instruction materials: - chart showing marshy areas.

Behavioral objectives: the students should be able to:

1. Classify the types of marshes
2. Observe and identify the adaptations of organisms in habitat.
3. Identify the plants and animals that live in marshes.

Previous Knowledge:- The students know the meaning of pond the characteristics of pond the adaptive features of plants and animals in the pond.

Introduction: - The teacher introduces the lesson by asking some questions on the previous knowledge e.g. what are the adaptive features of plants in the pond?, what arc the general characteristics of pond habitat.

Presentation: The teacher present the lesson in steps as follow;

STEP I :-The teacher define and explain marsh habitat e.g. Marsh is a low, flat land completely or partly covered by shallow water with silt frequently, deposited. The water is about knee deep in most parts while is less in many other places.

STEP II :- He then name and explains the types of marshes Temporary marshes are seasonal occurring during the rainy season drying up in the dry season while permanent marshes: contains water throughout the year, They are close to the rivers or seas which serve as permanent water source.

STEP III :- He also names, and explains the characteristic of marsh habitat e.g low and habitat covered with water (if permanent), but dry up during the dry season (if temporary) soils is soft making difficult for big animal to move, the vegetation s normally dominated by grasses, the contents of mineral salt is high and dissolved oxygen content is low.

STEP IV: The teacher also name adaptive features of plants and animals e.g Animals warm, crabs and bivalves burrow into the soft mud to avoid high temperature and drying up, insect larvae, beetles and frogs come near the surface to gulp atmospheric air to survive the low oxygen content in the water, Plants: the grasses grow in large branches or tussocks to avoid being washed away by water movement, their leaves are long narrow and held high above

water for atmospheric gaseous exchange to compensate for poor aeration of the water logged soil.

STEP V:- He also name plants and animals that lives in marsh habitat. Plants: vossia cuspidate, duckweed. water lily, water lettuce, salvina, Azolla, algae etc. Animals: water snake, tad pole, frogs, larvae, insect's e.t.c.

STEP VI :- The teacher tells students how take reading temperature, relative humidity and estimate light intensity of the marsh.

Evaluations: - The teacher evaluateby asking questions on lesson presented e.g what are the plants and animals found in marsh habitat?

Conclusion: The teacher concludes the lesson by summarizing the whole lesson e.g by defining marsh, naming the characteristics of marsh, adaptive feature of the marsh.

Week 5: Control Group

Subject: Biology

Topic: Habitat (fresh water- pond)

Class: SSII

Time: 40 Minutes

Behavioral objectives: It is expected that at the end of the lesson, students should be able to:

The teacher observe and record the number of flowers found on pride of Barbados plant growing in two different sites, **A** and **B**.

Site **A**	Site **B**
Sunny and dry	Shady and damp

Number of flowers	Number of flowers
7 12 9 5 9 7 18 7 8 3 7 11 4 15 11 9 7 6 9 5 6 8 13 4 8 7 18 15 9 7 8 18 13 9 9	3 0 11 7 4 3 6 5 4 2 4 3 5 5 8 4 3 1 6 2 4 5 9 4 5 4 7 3 12 3 8 4 7 3 5

1. The teacher complete the table below to show how the plant in the different sites flowered.

Number of flowers

Site	0-3	4-7	8-11	12-15	16-18
A B					

2. The teacher identify and name the adaptation of the plants and animals in the pond habitat.

3. The teacher identify and arrange (order) the food chain in the pond habitat

Previous Knowledge: The students known the meaning of Ecology biotic and a biotic components

Introduction: The teacher introduces the lesson by asking question(s) based on the previous knowledge e.g what is ecology?

Presentation — step 1: The teacher record what they have observe as follow;

Shell length	8-11 cm	12-15 cm	16-19 cm	20-23 cm	24-27 cm	28-31 cm
Number of snails	5	7	11	14	9	4

Step Il: The teacher then list and explain the characteristics of pond habitat. E.g the water is stagnant it, has little or no salt in them, lack waves and tides etc.

Step III: The teacher explains plants and animals adaptive feature to pond: Plants: Well developed numerous fibrous roots system for firm anchorage into the soft mud, Numerous root hairs for absorption of nutrient from the soil, there are numerous spines on the long petioles. These spines are protective in function Animals: the body is long and flexible which help to locomotion, protective coloration, and the scales are smooth and water repellent for easy locomotion in water.

Step IV: He also list the plants and Animals that can found in pond habitat e.g plants: Water lettuces, water fern, Duck weed, water lily. Animals: Tree frog, dragon flies, Bird e.t.c

Step V: The teacher explains the possible food chain found in pond environment e.g insect tree frog water snake

Evaluation: The teacher evaluates the lesson by asking questions base on the lesson presented e.g what are the characteristics habitat? What are the examples of plants and animals that can be found in pond habitat?

Conclusion: The teacher concludes the lesson by summarizing the lesson e.g defining pond, some characteristics of pond habitat. Naming some of the plants and animals that can be found in pond habitat.

Week 6: Control Group

Subject - Biology

Topic - Abandoned farm land (terrestrial) habitat

Class - SS II

Time - 1½ hours

Behavioral objectives: it is expected that at the end of the lesson the student should be able to:

Snail is a mollusk. Johnson collected 50 snails and measured the length of their shells. The results are shown below.

1. The teacher observe carefully

16 18 25 19 20 15 25 20 19 17 23 30 12 25

22 10 18 14 24 14 23 17 24 11 15 17 24 31

22 23 22 18 28 23 26 13 26 27 20 8 10 23

29 23 16 21 11 13 19 20

Complete the table below to show the number of snails with different shell lengths.

Shell length	8-11 cm	12-15 cm	16-19 cm	20-23 cm	24-27 cm	28-31 cm
Number of snails						

2. The teacher classify the adaptation of plants and Animals in the Hill habitat.
3. The teacher identify the food chain in the hill habitat.
4. The teacher identify and name some biotic component in the hill.

Previous knowledge: The students know hill, they know the meaning of Hill, characteristics of hill, the adaptive features of Hill and biotic component of the Hill.

Introduction: The teacher introduces the lesson by asking questions on the previous knowledge e.g. what is Hill? What are the characteristics of Hill habitat? What are the

adaptive features of the biotic component of the hill habitat? What are biotic components found in the Hill habitat?

Presentation;

STEP I: The teacher take the students to Kono Hill and record what he has observe while the student are watching at him;

Shell length	8-11 cm	12-15 cm	16-19 cm	20-23 cm	24-27 cm	28-31 cm
Number of snails	5	7	11	14	9	4

STEP II: The teacher defines Hills e.g. Hills are regarded as small high land areas exposed out due to agent of denudation.

STEP Ill: The teacher, name and explain characteristics of Hill e.g hill is social mass of intrusive Igneous rock which are undergoing modification due to weathering process in the area. Because of humid, climate condition of savanna (guinea savanna) both physical, chemical and biological weathering are active in the environment. Which consequently lead to fragmentation of rock materials to form soil at based and hill top.

STEP IV: The teacher explains and asks students to observe pattern of distribution of biotic components of the Hills and their adaptive features.

STEP V: He then takes the students round to observe and sample where possible of the biotic component of the hill habitat e.g. Rat, insect, Birds, frogs, snake, chameleon, lizard, grasses, shrubs free etc.

STEP VI: The teacher construct food chain of the biotic component that can be found in Hill habitat. e.g Grasses → Rat → Snake

STEP VII: The teacher take reading of temperature, relative humidity and estimate light intensity of the Hill.

Evaluation: He evaluates the lesson base on what he has presented on the abandoned farm land habitat e.g. what are the characteristics of abandoned farm land? What are the adaptive features of the biotic component that can be found in the abandoned farm land? What is the biotic component found in the abandoned farm land habitat?

Student's activities: The students copy note into their exercise books.