# Effects of Two Mode of Multimedia Instructional Strategies on Secondary School Biology Students' Academic Achievement in Ecology in the Abeokuta Metropolis, Nigeria

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## Certification

This is to certify that Motunrayo Idowu ADEOSUN with Matriculation Number LCU/PG/000547 carried out this research work titled "Effects of Two Mode of Multimedia Instructional Strategies on Secondary School Biology Students' Academic Achievement in Ecology, Abeokuta Metropolis, Nigeria" in the Department of Science Education, Faculty of Education, Lead City University, Ibadan, Oyo State, for the award of Doctor of Philosophy Degree ( PhD) in Biology Education and that this has not been previously submitted to any institution for the award of any degree or certificate.

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**Dedication**

This research work is dedicated to God Almighty, who is worthy of all my praises.

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Even though the above-mentioned institutions and persons have assisted in the process of this research work, I alone stand responsible for the errors, if any, found in the work.

**Abstract**

The fluctuating academic performance of students in science is worrisome. Particularly achievement in Ecology has been a pointer to students' achievement in Biology and of great concern to educationists as reported by the chief examiners report of West African Examination Council over the years. Previous works investigated factors such as teachers' quality, Laboratory facilities, teachers' attitude, teaching methods among others in different parts of the country but not many had combined some of these factors in a single study. This study investigated the Effects of two mode of Multimedia Instructional Strategies on Senior Secondary School Biology students' achievement in Ecology in the Abeokuta Metropolis, Nigeria. Quasi-experimental research design was used. 202 SS2 Biology students out of 5870 were selected through multistage sampling procedure participated in the study across three local government areas. A purposive sampling technique was used to select three (3) public schools. Instruments for data collection were: Ecology Achievement Test (EAT)(r=0.72), Ecology Situational Interest Scale (ESIS)(r=0.85). Data were analysed using frequency, percentage, mean and Analysis of Covariance (ANCOVA) at 0.05 level of significance. The results revealed that there was a significant main effect of treatment on students' achievement in Ecology aspect of Biology ($F_{(2,189)} = 40.510$, $p < 0.05$). There was a significant main effect of Interactive Video Variation on student academic achievement in Ecology ($F_{(1,108)} = 36.504$, $p < 0.05$). There was a significant main effect of Virtual Field Trips strategy on students' achievement in the Ecology aspect of Biology ($F_{(1, 157)} = 62.511$, $p < 0.05$). There was a significant main effect of situational interest on students' achievement in Ecology in Biology ($F_{(1,189)} = 4.859$, $p < 0.05$). There was no significant main effect of gender on students achievement in Ecology. There was no significant interaction effects of treatments and gender on students' achievement in Ecology in Biology ($F_{(1,189)} = 0.232$, $p > 0.05$); there was no significant interaction effects of treatment and level of situational interest on students' achievement in Ecology ($F_{(1,189)} = 0.502$, $p > 0.05$); there was no significant interaction effects of Gender and level of situational interest on students' achievement in the Ecology ($F_{(1,189)} = 1.996$, $p > 0.05$); there was no significant interaction effects of treatment, gender and situational interest on students' achievement in Ecology($F_{(2, 189)} = 1.383$, $p > 0.05$). The study concluded that Interactive Video Variations and Virtual Field Trips are more effective strategies for teaching Ecology. It was recommended among others that teachers should use Interactive Video Variation and Virtual Field Trips regularly so as to enhance students' understanding and retention of ecological concepts.

**Keywords:** Interactive Video Variation, Virtual Field Trips, Ecology, Gender, Situational Interest

**Word Count**: 427

## Table of Contents

**Content**

## List of Tables

## List of Figures

# Chapter One

# Introduction

## 1.1 Background to the Study

Biology is the systematic study of life and its improvement. It studies living things and their origins, structures, morphology, physiology, behaviour and distribution. Its fundamental coverage is integrated into other scientific fields like Biochemistry which deals with different molecules, Biophysics, and Mathematics and collaborate using theoretical models to explain Biology methods through mathematics methods and instruments[1]. It is a core science subject offered by senior secondary school student across Nigeria. Biology is one of the core subjects that formed Science, Technology, Engineering and Mathematics (STEM) upon which the technological growth and development of the nation depends. It is a way of passing biological ideas to the incoming generation through its teaching in schools[2]. There are many branches of Biology such as Botany, Ecology, zoology, genetics, anatomy, morphology, microBiology, entomology, molecularBiology, biotechnology and so on[3,4,5,].

The aim of teaching Biology in schools is to train scientists who can think analytically, critically, and creatively, judge arguments and make decisions in the scientific field, enable learners to develop an inquisitive mind and curiosity, develop skills that can be used in solving daily life challenges for their further development such skill includes problem-solving skill, ability to generalize based on different facts gathered, observation, experimentation, drawing and manipulative skills[6,7]. Improving learners' ability to carry out investigations, evaluate proof to conclude from the facts obtained, to appreciate the merits and demerits of science and its application in technological advancement. The

knowledge of Biology helps learners to understand the nature of science, respect and protect it, understand the world, scientific concepts and the interdependence of science,

technology and society. To inculcate a scientific attitude and values of honesty and respect for learners and other students as they interact with themselves[6]. To acquire knowledge, to develop a sense of aesthetic, and mental curiosity, imbibe values such as moral, utilitarian, disciplinary and cultural values[8,9,10].

The importance of Biology is evident with the great achievements recorded in the fields of Ecology, genetics, and Biochemistry in finding solutions to man's challenges such as disease, health, family life, and hygiene management to name a few. The advancement of biotechnology a career in Biology helps to improve human lives through its products in food science and agriculture which include the domestication of animals, cultivation of crops, and production of quality products through genetic modifications. It study finds answers to reasons for the occurrence of things scientifically, it has broad areas of application from where we get numerous biological products for survival like the production of raw materials, it is useful in genetic engineering for the production of perfumes, probiotics that aid the gut system during sleeps[5,11,12]. It prompts new scientific research, provides solutions to important issues, and accounts for transportation that takes place in the human body. Biology is a subject which serves as a prerequisite for further study in higher institutions for any science courses such as medicine, nursing, engineering, pharmacy, zoology, and botanist to name a few[13,] . It is an inevitable tool for accomplishing success in any professional field in life[14]. With this, it is obvious that the study of Biology is crucial for national development and important in obtaining good academic achievement in Biology. Biology curriculum in secondary schools has been organized in such a way that different aspect of it will be studied by learners at different level and classes, that is from senior secondary school one to three ( SS1- 3). Ecology is

one important branch and aspect of Biology that students start learning about its concepts right from senior secondary school one and two for its importance in the subject Biology and the numerous benefits it offers life.

The importance attached to Ecology makes it to occupy a key part in senior secondary school examination like West African Examination Council (WAEC) curriculum from where a good percent of questions emanates on yearly basis. Ecology is a branch of Biology which studies living organisms and how they relate or interact with themselves and their environment. It is a field of study that deals with educating individual learners about the living organism and their interaction with their environment. It is complex and full of abstract concepts. Ecology is the scientific study of processes affecting the dispersal and quantity of organisms, the interaction among the organisms and the transformation of energy and matter, a field of study that focuses on the interrelationship of living things and their immediate environment[15]. It gives the basis for the conservation of natural resources, prediction of ecological effects of pollution and climatic change, gives clear insight on how to use nature-endowed resources without depleting its riches and protecting the endangered species [16]. Unfortunately, students find it challenging to comprehend the concepts of this aspect of Biology and from personal observation of the researcher as a teacher Ecology is complex, full of abstract concepts and cannot be taught effectively alone in the classroom without taking students to the real site of occurrence for exploration to concretize its teaching and permit hand on activities. Since the present curriculum in education system advocates that teaching should be student centre, from known to unknown, simple to complex, concrete to abstract, general to specific so that student can actively learn and participate effectively in teaching learning process for attainment of good academic achievement[17].

Academic achievement is the attainment of an individual in a subject. It indicates the strength and weakness of a learner in a particular subject. It is the most valid indicator that reveals how far a goal has beeing achieved by an individual or organization especially in school[13,] . Measurement of success or otherwise accomplished by a student, the remarkable change in the student performance attained due to their exposure to a particular program of instruction[18]. It is simply the aggregate of information a learner learns within a particular period of time[19]. It is the estimate of comprehension, skills acquired and transformation obtained by learners in their subjects in relation to the objectives of such subject[20]. It is a key factor that can be used to determine how successiful an individual is [21].

Despite the importance of Biology to the national development mentioned above, the chief examiners report of West Africa Examination Council (WAEC) reported that of all the branches of Biology listed above, students are not doing well in Ecology an important aspect of Biology. It was stated that student find it challenging or difficult to answer questions that has to do with Ecology. This reflects in the choice of question that student answers or are unable to answer during their external examination as Ecology was listed as one of the aspect in Biology that student have not being doing well in during the noble examination[22]. This assertion can be supported with the report of chief examiners report of WAEC 2018-2022[22]. Student seem to be failing as most learners find Ecology boring hence lack curiosity and interest to learn it and this has affected their performances in the concept. Previous researches reported that student academic achievement in Biology over the years is not encouraging and also studies conducted on students' academic performance in science showed low performance over the years [13,18,20,23, 24,25]. It then behoves teachers of this subject in secondary schools and other stakeholders, researchers

especially, to seek ways of keeping the percentages of failure in Biology under constant check.

This inability of students to perform well in questions relating to Ecology as well as low academic achievement of students in the subject as stated by previous studies may be attributed to many factors such as teachers' instructional strategies, the broad curriculum, laboratory facilities, school-related factors, teachers related factors and students' attitudes among many others. From the researcher's experience as a teacher who has been teaching the subject for years, students find the concepts of Ecology difficult to comprehend and pass, especially during the terminal Secondary School Certificate Examination (SSCE). Furthermore, from a study recently carried out during the researchers' master program Biology teachers in the study location majorly use chalk-talk (Lecture) and demonstration methods. In contrast, the least method used by Biology teachers in the study location was the field trip method which is suppose to permit construction of knowledge, active learning and fosters the teaching of Ecology. The chalk talk method used by teachers may not effectively impact the deep knowledge of biological concepts especially Ecology in learners[13]. Furthermore, Biology teaching in Nigeria is also faced with many challenges such as lack of fund and support by school administrators, inability to embark on field trips and excursion to visit ecological site of importance due to high cost of transportation, risk of accident, kidnapping which is now the order of the day and many more. The above challenges prevent teachers from adopting innovative teaching strategies which can impact knowledge effectively in learners as advocated for by the present educational curriculum used in schools, thereby limiting teachers to adopt chalk –talk ( Lecture) method which is not good for teaching Ecology and achieve good academic achievement in Ecology. It is against this background that this present study focused on the effects of Interactive Video Variations and Virtual Field Trips Strategies on Senior Secondary

School Biology Students' Achievement in Ecology in the Abeokuta metropolis, since the use of proper teaching strategy makes a good teaching-learning of subjects in schools and since the traditional teaching (Lecture or chalk- talk method) method popularly used by teachers limits the mind of learners, does not enhance changes nor impact learning and may not effectively enhance students deep understanding of concepts of Ecology[24,26]. The need for constant upgrading becomes imperative more so, that the achievement of students in the subject is always a source of concern to all stakeholders in education. Hence there is need for teachers to adopt innovative and suitable teaching strategies to bring out desirable outcome in students since teaching strategy is crucial for the achievement of success in science. Teaching strategies are instructional methods used by teachers to present teaching material to students in such a way that enable students to get the best from the lesson, enhance the knowledge of the concept taught, practice various skills and actively participate in teaching learning process. There are numerous teaching strategies such as problem solving, project-based learning, inquiry-based learning, blended learning, flipped classroom, cooperative learning, analogy, the use of multimedia instructional strategies among many others. The present study in attempt to proffer solution to the fore going problem focused on the use of multimedia strategies of teaching.

The inclusion of multimedia visual aids into teaching is therefore necessary at this junction. The use of visual aids in teaching-learning of science subjects especially Biology enhance the learning of the subject interestingly with the use of various technological tools such as digital video, computer simulation, projectors, display screens, cameras, smart boards, smart phones, animation and cartoon, virtual learning, world wild web to name a view[27,28]. Interactive Video Variation teaching strategy involves utilizing interactive video content to engage learners and enhance their understanding of a subject matter. Teaching by Video based instruction provides unique experience to students.

Video based instruction can provide a consistent form of teaching and can communicate certain concepts in a visual and realistic manner. Interactive Video Variation (IVV) is a teaching strategy that allows students to actively participate and have a deep understanding of Ecology. Interactive video involves the use of different educative video packages or video clips such as teacher made video, YouTube video or video already recorded which are available on different educative channel to deliver and transfer knowledge about specific concepts to students. Develop interactive videos that simulate real-world scenarios or virtual laboratories where learners can experiment and apply theoretical knowledge in a practical setting. This hands-on approach enhances retention and understanding[27,28]. It involves the incorporation of technology in disseminating educational information in teaching-learning process, not just a mere product but a process to enhancincing the effectiveness of science teaching through multimedia via sound, visuals and video with specific instruction and text learners[24,30]. This, according to the same source became necessary if Biology students in secondary schools must catch up with other developing countries at a very reasonable pace. The interactive nature of this video allows students to create, explore relationships, make conjectures about their properties, and test those conjectures in Ecology[23,29]. Hence, there is a need to expose Biology students to, a variety of educative interactive videos on concepts of Ecology, to explore the vast benefit of technology in dealing with the abstractness of a concept like Ecology using Interactive Video Variation(IVV) learning teaching strategy.

Another approach used in this study is the Virtual Field Trip (VFT) Strategy. The concept of Virtual Field Trip (VFT) in learning Ecology offers a unique opportunity for students to explore and understand ecological concepts in a digital environment. Some topics in Biology like ecological succession, pollution and many more cannot be taught effectively without taking learners on a trip to the site for proper observation[30]. A field trip is a

teaching strategy in which learning activities are done outside the classroom situation by the teacher and students for important observation of the environment which is filled with different real-life experiences. It is an excursion to the site of real-world events which is beyond the classroom setting to get firsthand information which enhance transfer of knowledge to learners through observation[31]. The challenges faced by teachers nowadays discourage them from embarking on field trips such as kidnapping, high cost of transportation, inadequate or lack of financial support by school authority, fear of accident among others[32,33]. The challenges stated above should not restrict teachers from exposing student to field trips which is important for inculcating knowledge of Ecology. Virtual Field Trips (VFTs) should be adopted despite the challenges stated above to allow students to virtually visit a wide range of ecosystems and biomes, from tropical rainforests to coral reefs to Arctic tundras. This access to diverse environments helps students understand the intricacies of different ecosystems and the unique flora and fauna they support[33]. Virtual field trip is necessary for effective teaching-learning of Ecology and as it is commonly said "what I see, I remember, what I hear, I forget".

Through high-quality multimedia content such as 360-degree videos, virtual reality (VR), and augmented reality (AR), students can immerse themselves in realistic simulations of natural habitats. This immersive experience enhances engagement and fosters a deeper connection with nature. Many researchers both within and outside the country utilize the opportunities of technology to transfer knowledge to students via online teaching. For instance, during the COVID-19 era, many schools implored the use of virtual classes for the teaching-learning process and great success was recorded even to date virtual learning has become a force to reckon with in the education industry. People can travel to important places of interest despite the travelling restrictions this is possible through virtual visitation to such places[34]. In like manner, VFT is a teaching strategy which

involves the use of technology to achieve field trips as a replacement for the real field trip which helps to eliminate problems hindering the organization of traditional field trips as stated above. It is a way of impacting students' learning experiences in the universe which enables learners to understand the importance of what has been learned while boosting their knowledge and motivating them to learn[33, 35]. VFTs incorporate interactive elements such as quizzes, games, and simulations to actively engage students in the learning process. For example, students can collect virtual samples, analyze data, and make predictions about ecological patterns and processes [34,35,36]. Appropriate and effective use of VFT will not only improve students' achievement but also help them to have good retention of what they have in the conventional classroom. VFTs were designed and commonly used for teaching science subjects, hence the need to establish empirical facts on its effectiveness in other areas especially in Ecology an integral part of Biology. Incorporating Virtual Field Trips into Ecology education enhances student engagement, fosters a deeper understanding of ecological concepts, and promotes environmental stewardship among future generations of learners[32,33].

From the foregoing, it is envisaged that these two approaches (IVV and VFT) which appear not to have been combined in a single study, will produce a better result than what is being obtained from the more prevailing conventional teaching approach. This is because, unlike the other two approaches adopted in this study, the conventional method of teaching recognizes the teacher as the alpha and omega of the class. In this environment, the teacher does more of the talking while students only participate in the form of response(s) to the teacher's question(s). On the other hand, the students play a more passive role. This may not give room for students to personally develop their understanding and thinking which the constructivist approach epitomizes.

In addressing students' performance in Ecology, the influence of students' gender cannot be ruled out. Gender inequality, particularly in developing countries is not a new phenomenon. From the available literature, gender issues have been linked with the performance of students in Biology in several studies but without any definite conclusion. In order to achieving gender equality in education it means an equal opportunity must be given to both males and females in the course of learning in the school[37].

The issue of gender and academic achievement has for a long time remained a controversial one. For instance, while some studies found a significant effect of gender on students' academic achievement, some did not [38] . Some researchers, therefore, concluded that male and female students would perform equally the same if they are exposed to the same type of instructions [37,38]. Many previous researches show variations in the performance of male and female students across many discipline[39, 40, 41]. Hence, while Gender has been linked with the performance of students in several studies, but with no definite conclusion, this study aims to add to the body of literature in the area, and also find out if Interactive Video Variation (IVV) and Virtual Field Trip (VTF) instructional packages could help enhance gender equality in the academic achievement of students in Biology.

Apart from gender, another moderator variable in this study is situational interest. Situational Interest (SI), this is a kind of curiosity develops in a student from the classroom condition or learning situation that enable learner to give rapt attention to teaching-learning process during the course of teaching. Situational interest emanates from the classroom condition or the learning environment that propel, stimulate or motivate a learner to get the best from the concept taught in the class or otherwise. Situational interest is characterized by Biology students' spontaneous response to the learning environment which could immediately attract their attention, involve them in the

process, and provide instant and positive feelings about their learning activities using IVV and VFT. Interest is a key factor that influences student academic achievement[42]. Situational interest among Biology students refers to a temporary and context-dependent interest that arises from specific situations, activities, or stimuli within the domain of Biology education. Interest is a fundamental factor that is necessary for effective science education. Interest is seen as quality that arouses concern or curiosity that holds one's attention. Interest is a condition of wanting to know or learn about something or somebody [43,44]. Situational interest can simply be refers to as an emotional condition of a learner that is prompted by eagerness of the learning atmosphere and it is partially under the teachers' control[45]. Situational interest can be sparked by various factors and plays a crucial role in enhancing student engagement, motivation, and learning outcomes. Students' interest in Ecology aspect of Biology has been observed to be generally low at the beginning of their study. However, as they progress in their study, particularly when they are in their penultimate year, the students tend to develop a spontaneous interest that propels them to forge ahead and consequently succeed in their study. By leveraging situational interest among Biology students, Biology teachers can create dynamic and engaging learning environments that foster curiosity, motivation, and a deep understanding of biological concepts. This approach not only enhances student learning outcomes but also cultivates lifelong interest in the field of Biology.

It has been observed that gender and situational interest could significantly influence students' academic achievement in the Ecology aspect of Biology. However, studies on their mediating roles are yet to be considered. In addition, scholars have not been able to ascertain the interaction among consequential variables, such as gender and situational interest, especially among Biology students in the study area. Therefore, this study seeks to provide information on how gender and situational interest could moderate the effect of

Interactive Video Variation (IVV) and Virtual Field Trips (VFTs) strategies on Biology students' academic achievement in Ecology in particular. It is evident from the above points that the use of the appropriate virtual multimedia aids (IVV and VFTs for specific purposes especially in science teaching with the right context can be an effective instrument in enhancing the teaching and learning of any subject[45]. To this end, the present study seeks to look at the effects of video variation and virtual field trips on Biology student academic achievement in Ecology among secondary schools in Abeokuta, Ogun State Nigeria.

**1.2 Statement of the Problem**

The student have not being doing well in Ecology aspect of Biology, the chief examiners report of West Africa Examination Council attested to it in the Chief examiners report for 2020, 2021, 2022, 2023. Previous studies also reported that academic performance in science is not encouraging[13,23,24]. From personal experience of researcher, students find it uneasy to comprehend the concepts of Ecology and pass at the level of Senior Secondary School Examinations (SSCE) conducted by the West Africa Examination Council, unfortunately many questions emanate from this aspect of Biology during this annual certificate examination. Studies have been carried out on Ecology by various researchers to ameliorate students' outcomes in Biology examinations where Ecology is part. Previous researches known to the researchers have worked on the use of video instructional packages, Cartoon Strategy, Virtual Laboratory, Virtual Field Trips, simulations in relation to the study of Ecology at the senior secondary school levels within and outside Nigeria but no identified single study combined the use of Interactive Video Variations and Virtual Field Trips as interventions on the teaching and learning of Ecology. This study therefore applied proactive measures as interventions to drive home

better outcomes from the teaching and learning of Ecology at the senior secondary school level. Hence, this study on effects of two mode of multimedia instructional strategies on senior secondary school students' achievement in Ecology, in the Abeokuta metropolis Ogun State, Nigeria

**1.3 Aim and Objectives of the Study**

This study determined effects of two modes of multimedia instructional strategies on Biology student achievement in Ecology in the Abeokuta metropolis, Ogun State, Nigeria. The specific objectives were to:

i. Determine the main effect of treatment (Interactive Video Variation and Virtual Field Trips) on Biology students' achievement in Ecology.
ii. examine the main effect of Students' gender on student achievement in Ecology;
iii. examine the main effect of Students' Situational Interest on student achievement in Ecology;
iv. determine the interaction effect of the treatment (IVV, VFT) and gender on student achievement in Ecology;
v. examine the interaction effect of the treatment (IVV, VFT) and situational interest on student achievement in Ecology;
vi. examine the interaction effect of the student's gender and situational interest on student achievement in Ecology and
vii. Interest on student achievement in Ecology.

**1.4 Hypotheses**

The following null hypotheses will be tested in this study at 0.05 levels of significance:

$H_o1$. There will be no significant main effect of treatment on students' academic achievement in Ecology.

$H_o$2. There will be no significant main effect of gender on students' achievement in Ecology.

$H_o$3. There will be no significant main effect of Situational Interest on students' achievement in Ecology

$H_o$4. There will be no significant interaction effect of treatment and gender on students' academic achievement in Ecology

$H_o$5. There will be no significant interaction effect of treatment and Situational Interest on students' academic achievement in Ecology'

$H_o$6. There will be no significant interaction effect of gender and Situational Interest on students' academic achievement in Ecology.

$H_o$7. There will be no three-way interaction effect of treatment, gender, and situational interest on student academic achievement in Ecology.

**1.5 Significance of the Study**

This study is expected to expose Biology teachers and stakeholders to more advantage embedded in virtual multimedia aids and the need to maximize the numerous benefits to improve on the teaching and learning of Biology especially, Ecology. The findings from this study could help the practicing Biology teachers to see the need to diversify their instructional approach or otherwise. The Biology teacher may benefit from the study as it will provide them with a better understanding of using Interactive Video Variation and Virtual Field Trip Strategies for teaching Ecology and other difficult topics in Biology. It will be of help to make the complex and abstract nature of Ecology simple and easy to understand by students.

Specifically, the study will help to provide practical and useful guidance to students; they could have the opportunity to develop the skill of observation and the ability to identify

the different organisms in the environment. Therefore, this will enhance the situational interest and performance of what they learn.

Curriculum developers may also dwell on the outcome of this study to determine the worth of the inclusion of activities-based learning strategies in the teaching of Ecology through the use of Interactive Video Variation and Virtual Field Trips. The outcome of this study will also expose the need or otherwise to embrace training and workshop for the practicing teachers to make them to be more dynamic in their teaching approach.

Lastly, the finding from this study is expected to provide empirical evidences which will serve as literature for further research.

## 1.6 Scope of the Study

The study covered the Senior Secondary Schools II students with-in the three Local Government Areas in the Abeokuta metropolis. This include all the Senior Sedondary School owned by Ogun State Government (Public Secondary Schools). The study covered the effects of Interactive Video Variation and Virtual Field Trips Strategies on Biology students' academic achievements in Ecology was established. The study covered Ecology aspect of Biology only.

## 1.7 Limitation of the Study

This research work was faced by a lot of challenges during the field work, which included interruption by school calendar. Every school has a workable school calendar which must be followed for each term. The field work was carried out in the period when most school were preparing for inter house sport.

## 1.8 Operational Definition of Terms

**Interactive Video Variation Strategy**: involves delineating the specific methods and techniques used to create engaging and dynamic video content that fosters active learning and enhances comprehension of Ecology. It involves different kind of video clips from YouTube on the topic concern with this research work.

**Virtual Field Trips Strategy**: electronic use of field trips documentaries from YouTube, it is an outdoor visitation to places of interest which enables students to get first-hand information and experience the concept of Ecology without leaving the classroom.

**Academic Achievement in Ecology**: These are scores obtained in Biology test given to students in the course of study as measured by Student Achievement Test (SAT)

**Situational Interest:** This refers to the kind of interest that emerges from and is supported by the context of learning.

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## Chapter Two

## Literature Review

This chapter contains the review of literature related to the study. It contains the conceptual review, theoretical frame work and empirical review related to the important aspect of the study. This chapter is organized under the following concepts:

### 2.1 Conceptual Review

2.1.1 Biology

2.1.2 Academic Achievement

2.1.3 Interactive Video Variations

2.1.4 Virtual Field Trips

2.1.5 Gender Issues in Science Education.

## 2.1 Conceptual Review

### 2.1.1 Biology

Biology is simply defined as the systematic study of life. It uses step by step approach to study living organisms and their improvement. It is a branch of science that is concern with the study of living matter. Living matter here is referring to all living things (any living things that has weight and occupy space.) in all forms including man, other animals of different kind vertebrate and invertebrate animals, microscopic organisms, plants and their surrounding environment. This study of life attempt to study the organisms' features, behavior, physiology, structure, reproduction, anatomy, how an organism function and all live processes about an organism. Biology is the study of living individual organisms and their important processes that is concerns with the physiochemical area of life[1]. It is the methodological study of living things; it determines facts that can be confirmed through

experimental procedures on living organism using scientific approach[2]. Which means Biology does not only deal with the organism alone but also studies all normal physical and chemical processes that are important for maintenance of the regulation of the internal environment of such organisms. For instance, regulation of salt and water in the body, formation of urine and many reactions going on internally within the body are covered by this definition of Biology. It is an important branch of science that mainly deals with structure, function, growth and evolution of organisms, field of knowledge that is concern with living matters and their vital processes[3].

As earlier said from the definitions above, Biology is seen as a branch of science. This implies that science has many branches of which Biology is one. What then is science? Science is a body of knowledge organized about the whole universe. It is an ordered body of knowledge, a search for explanation to natural object and phenomena, a method of investigating and a way of thinking in pursuit and understanding of nature[8]. It involves observation, identification description and other step wise process of finding solution to natural phenomena[4]. This means there are basic principles for carrying out an investigation in science which require a step-by-step approach. It is a field of knowledge which helps individuals to learn how to research about the existence of an occurrence with the aim of arriving at a reasonable conclusion as a result of the evidence of the findings[5]. Researchers attempt to define science from different point of view: Science is the study of nature and behavior of natural things and knowledge gotten from them. It is the study of the nature around us and within us, natural occurrences and solutions to problems[6]. It is a rigorous, systematic endeavor which builds and organizes knowledge in a testable and predictive form about the universe[7] Science is any system of knowledge that deal with physical world and its occurrences that contains unbiased observations and systematic investigation. In other word it contains discovery of knowledge that is based

on truth or fundamental laws[8]. There are many branches of science on the basis of subject of study. Physical science: this branch of science deals with the study of inorganic world, which include the following discipline; Astronomy, Physics, chemistry, and the earth sciences. The Biological sciences such as Biology and Medicine: study the organic world of life and its processes. Social sciences: deal with the study of social and cultural areas of human behavior. It includes anthropology and economics[8]. It is a broad career field with numerous specialized and field of study. Another scholar also classified science into three broad branches such as: physical science, earth science and life science. Physical science has to do with inorganic substances; they are nonliving matters. This includes many fields of study that is concern with new discoveries on how matter works and other phenomena in the world. It includes the field of physicist, quantum physicist, chemist, Astronomer, Cosmologist, Computer scientist and so on. Earth science is concern with earth materials and the atmosphere. It includes careers like Meteorologist, land planner, oceanograher, geologist, paleontologist, environmental scientist and many others.

Life science which is the branch of science that deals with organic matter study or study of living matters. This branch of science enables us to know what happens to plants, animals and the world at large. It covers a wide range of fields of endeavor such as Biology, agriculture, pharmacology, forensic scientist medicine, among many more[9]. Another scientist classified it into: Natural science such as physics, chemistry, Biology, agricultural science and so on.

Social science: which include fields of economics, psychology, sociology, and so on. Formal sciences like logic, mathematics, computer science among others. Applied science with the following disciplines which uses scientific knowledge for practical purposes: engineering field, medicine to name a few[7]. The divisions of science above reveal that Biology belongs to the life science or what others called natural science. It is obvious that

science has great impact on everything in this world and covers nearly every aspect of life. The life science as a broad branch of science gave rise to Biology which is also refers to as biological science. It is the systematic study of living beings or study of nature. Teaching of life Science basically deals with providing information about the latest developments in the field of Biological science all over the world. It covers the minute workings of chemical substances present in living cells, to the broad scale concepts of ecosystems and global environmental changes. It also deals with the physical features and behaviors of organisms living in the world today and those in existence in the time past, how they came into existence, and what relationship they have with one another and their environments. It is the close study of details of the human brain, the genetic makeup, and even how our reproductive system functions are included in biological science.

In other word Biology is interchangeably refers to as life science as well as biological science. It covers different fields with many branches such as Botany, Zoology, Genetics, Medicine, Ecology, Molecular Biology, Physiology, Histology, MicroBiology, Anatomy, Morphology, Entomology, Biochemistry, Biotechnology, pathology, mycology, toxicology, chronology, astroBiology, epidemiology, evolution and many more branches[3,4,5,,10,11].

**2.1.1.1 History of Biology**

The word Biology originates from Greek language. Biology as a word is derived from two Greek word 'bio' means life and 'logos' means study of. It is the study of life8. In the late 17th century Pierre-Antoine de Monet and Jean-Baptiste de Lamarck coined the term Biology. Earlier study of living things was restricted to the pure Science like Botany and Zoology that together comprise the Biology. But as the time passed new branches evolved, new technologies developed in pure subjects as well as in applied fields, which gave rise to a very broad science called Biological Sciences[3]. Different scientist

contributed to various aspect of Biology. such as Aristotle, the ancient Greek philosopher and a biologist in the 4th century (384-322BC) was refers to as father of Biology and the first to discover the relationship between living things. He tried to organized several hundreds of plants and animals. In 18th century Carolus Linnaeus, a Swedish Naturalist of taxonomy (1707-1778) worked on two kingdom system of classification of living things which was in used for very long period of time before it was found to be inadequate as many living organisms are not captured by this two-kingdom system of classification, they don't belong to any of the group. And living organisms were later classified into five kingdoms as proposed by Whittaker in 1969 where all the subdivisions of the old two kingdoms were redistributed into five. Carl Linnaeus gave every living organism two names which is called the binomial nomenclature which is still in use till date. Galen (129-161 AD) early medical experimentation with some notable work on differences between artery and veins, pathology, and so on. Antonie van Leeuwenhoek (1632-1723) a microbiologist contributed to microscope and how it is applicable to the field of Biology, which led to the discovery of microscopic organism like bacteria. Charles Darwin (1809-1882) a popular naturalist was the father of evolution. He postulated the theory of evolution and contributed greatly to Biology and the society. He was able to establish that all specie of organism has the same origin through the theory of natural selection[21,22]. Gregor Mendel (1822-1884) an Austria monk, was the founder of genetics and known as the father of genetics. other scientists later work on genetics and were also refers to as pioneer of genetics along side with Mendel are: the Danish botanist, Johannsen (1909) he expressed Mendel's character as genes, Thomas Morgan (1912) an American genetics revealed that genes were contained on chromosomes[3,12,13,14]. Robert Hooke a great scientist that first discover cell, Matthias Schleiden a German botanist (1838) worked on plant cell and detected that plants contained different types of cells,

Theodore Schwann (1839) a British zoologist discovered animal cells, he also discovered that animals have different kinds of cells. These two scientists came up with the cell theory in 1839 which is in use till date[3,12,13,14]. Barbara Mc Clintock (1902-1992) jumping genes American genetics who made of different kinds of cells. made it possible through her work to map human genomes. She discovers how gene can turn on and off their physical features. Watson Francis (1928) Crick (1916-2004) contributed immensely to DNA structure which gave detail knowledge of disease diagnosis and treatment. Jane Goodall (1934) the UK female ethologist contributed great to Biology and discovery increased human knowledge on wildlife conservation through her work on how to understand chimpanzees. Wilmut (1944) and Keith Campbell (1954-2012) worked on cloning of mammals[1,14,15,16]. There are other scientists with great and notable work in Biology that are not mentioned under this study but are well appreciated.

Biology as scientific study of life gives room for building student capability to solve daily life's problems with the application of principles, theories, laws and concepts of science[17]. It is a force to reckon with in the field of science. It is a science subject offered by students at the senior secondary schools' level across the nation Nigeria and other west African countries and even in other nations outside African continents it their high schools. This means Biology is a subject offered globally in senior secondary schools or high schools as the case may be. It is one of the subjects that form Science, Technology, Engineering and Mathematics (STEM) upon which the national development of the nation depends[18]. Biology is a science subject that is stage at central and special position for its uniqueness in the school curriculum. Biology deals with other field in life that provides support and sustains life generally, such as environmental science, medicine, genetics, food production, anatomy, and Ecology to mention a few[18]. Of all the branches

of Biology listed above this present study takes a look at Ecology a branch of Biology in relation to learners' achievement.

### 2.1.1.2 Ecology

Ecology is one of the branches of Biology. It is an importance aspect of Biology that deals with the study of living organisms in relation to their environment where they live. The organism environments consist of various components which include physical factors like temperature, climate, soil etc. It is divided two main branches which are: AutEcology and SynEcology. AutEcology is the study of individual organism or the study of one single species of organism and its environment. SynEcology on the other hand is the branch of Ecology that deals with the study of inter-relationships between groups of organisms or species of individuals living together in an area. The component of Ecology includes the following concept: habitat, ecosystem, population, community, environment, biomes, biosphere, atmosphere, lithosphere, niche to name a few [3,12]. It is a field of study that deals with educating individual learners about living organism and their interaction with their environment. It is complex in nature and full of abstract concepts. The study of Ecology brings about change in behavior of learners as it gives them new knowledge through the study of its concepts. It is a field of study that focuses on the interrelationship of living things and their immediate environment[19]. It gives clear knowledge about the present and future state of its system, improves the world and it is important for human health and sustainability. It gives understanding of relationship between man and nature which is important for production of food, purification of the environment and maintenance of climatic change[20]. This branch of Biology consists of human science, population, habitat, community, ecosystem, biosphere, biomes, soil, and a lot more[21]. The study of Ecology is not only relevant to student in understanding the relationship between organisms and their environment but a crucial field of study in science curriculum

Biology in particular. The knowledge of Ecology is useful in familiarization of learners with the international nature of science and it application in technological development, in problem solving, rise in awareness of ecosystem, and development of intellectual curiositys[22]. The importance of Ecology to mankind is numerous with the success recorded in solving human problem in purification of water and air, pollution, population, detoxification and decomposition of wastes, conservation of natural resources, regulation of climate, regeneration of soil fertility, production and maintenance of biodiversity from which vital elements in today agricultural, pharmaceutical and industrial businesses are obtained[23]. This study focuses on the following aspects of Ecology; Habitats, plants adaptation and Ecology of population that is the concept of succession.

Ecology is an important aspect of Biology, a key fortress in the subject Biology which is useful in managing and resolving many of the world's human problems today. This means without Biology the study of Ecology is not possible in secondary schools. Biology is a force to reckon with in the field of science. It is a core science subject offered by students in senior secondary school across Nigeria. The importance of Biology to national development cannot be over emphasized.

**2.1.1.3 The Importance of Biology**

Biology is of great benefit to the student, society, nation, even to the entire world. The importance of Biology is evident with the great achievement recorded in the field of Ecology, Genetics, Physiology, Bio-chemistry in solving human problem such as pollution, population, radiation, disease, health, family life, hygiene management and natural resources conservation[3]. The advancement of biotechnology a career in Biology help to improves human lives through its products in food science and agriculture which includes domestication of animals, cultivation of crops, productions of quality product

through genetic modifications. Its study finds answers to reasons for the occurrence of things scientifically, it has broad areas of application from where we get numerous biological products for survival like production of raw materials, it is useful in genetic engineering for production of perfumes, probiotic that aid the gut system during sleeps[23,24,25]. It prompts new scientific researches, provides solution to important issues, account for transportation that takes place in the human body.

Biology is an inevitable tool in accomplishing success in any professional field in life[26]. The study of Biology enables us to have the comprehensive knowledge of the world we live in and the proper functioning of the diverse species in it. Progress witness in the field of medicine, agriculture and others aspects of Biology help to increase quality of life tremendously. Biology through the field of evolution helps to educate human kind about occurrences of the past which can help to shape the future. The knowledge gain in conservation an aspect of Biology allow man to have an accurate information on how best this planet earth can be well protected and preserved. Provision of job for Biology graduate from various fields of endeavor such as: agriculture, health care, education, environmental conservation, research, forensic science, policy, science communication and many others[1].

It serves as prerequisite for further study in higher institution for any science course such as Medicine, Nursing, Engineering, Pharmacy, Zoology, Botany, Human Kinetic, Agriculture, Technology, Geography, biochemistry and so on[38]. This means that Biology is one of the important subjects that a student must pass at credit level before such student can be given admission into higher institution to study any of the courses listed above.

Purification of the environment is possible with the help of green plants which utilize carbon dioxide during photosynthesis and produce oxygen as bi- product of

photosynthesis which help to reduce the amount of carbon dioxide around us there by purifying human environment. Production of bio-fuel used in biogas for cooking as alternative to kerosene and cooking gas is gotten from biological sources[18]. Development of biological objects like bio-fuel from domestic waste, agricultural product, wood straw, domestic refuse, plant waste and other organic waste from living things are good sources of heat and energy which provides solution to one of the greatest needs of man in various homes especially in this era when cooking gas and fuel are very expensive. The biodegradable element in bio-fuel especially biodiesel makes it attractive and non-toxic to human health on like the use of diesel thereby enhances the quality of environment and public health. The use of biodiesel in like manner reduces the national dependence of man on imported oil, boost national security, aids agricultural and economic development in the rural area, promotes lubricity of petro-diesel fuel as well as preservation of fossil fuels[27].

Biology also plays an important role globally with the great advancement witness in the field of genetics in crime detention. The knowledge of genetics is utilized to detect an offender who committed a crime through the finger print on any item find at the site of such incident most especially in this era when kidnapping and robbery is now order of the day. The knowledge of Biology enables learners to; think scientifically, have respect for nature and protect it. It enables learner to understand the world and scientific concepts, appreciate every living organism; function in diverse capabilities; have hygiene education and healthy living and; develop interest in their natural environments[23]. It gives deep scientific knowledge of the interaction between living and nonliving organisms. Also, in relevance of Biology to agriculture skill in planting crops, environmental protection, animal husbandry and production of raw materials for industry are acquired[18]. The importance of Biology can provide solution to major world problems, offers solutions

to environmental issues. It provides solution to food shortage in a nation. For instance, when a nation is having food shortages like what our nation is presently witnessing, the knowledge acquired in Biology can be used to develop effective methods in producing more food and adopt a better way of preserving such food to sustain life instead of selling it all in it raw form[22]. The relevance of Biology to agricultural skill in planting crops, environmental protection, animal husbandry and production of raw materials for industry are obvious[18]. It adds greatly to technological advancement, a tool that helped to shape the technological growth of and progress of any country[28].

The Importance of Biology to daily life includes the following:

**1. Agriculture:** this is the source of food we eat. All types of foods, including fruits, vegetables, legumes, grains, oils, honey, sugar, spices, tea, and coffee, are derived from plants. Humans and animals all depend on agriculture for food and survival. Biology is used in agriculture to improve crop yields, reduce pests and weeds, and develop new farming techniques. Farmers use biological principles to select and breed the best crops and to manage the soil and other natural resources. Flowers, sprouts, and seeds are obtained through pollination by insects and bird**s.**

**2. Medicine:** Biology plays a vital role in the development of new medicines and treatments. Medical professionals use biological knowledge to diagnose and treat illnesses and diseases, ultimately improving our overall health and well-being. The intricate nature of disease-causing microorganisms, including their existence, reproduction, and life cycle, has been studied by researchers. With the help of this study, they develop efficient disease-preventive medicines.

**3. Food and Beverages:** Food is the key to our survival. Life would not be possible without it. Both plants and animals provide us with food, all thanks to Biology. Cheese,

yoghurt, and other dairy products like curd are created with the assistance of microbes. The same procedure is used to make wine from grapes. Knowledge of Biology is used to improve the safety and quality of food products. Food scientists use biological knowledge to understand how food is processed, stored, and distributed to develop new food products that are safe, healthy, as well as appealing. Even for plants, the soil's microorganisms act as a decomposing agent to produce compost that serves as a helpful nutrient for plant growth[25].

**4. Environment:** Biology helps us understand the nature of interactions between organisms and the environment. Human interaction with the environment is diverse, and Biology is used to study and understand the natural environment, plants, animals, and ecosystems. Environmental scientists use this knowledge to develop ways to protect and preserve the environment while trying to manage the impact of human activities on the planet.

**5. Clothes:** Clothes of different types are meant to cover our nakedness and protect our skin. Clothes and fabric dyes are obtained from plants, and polyester is from fossils. All these manufacturing processes involve Biology.

**6. Biotechnology:** Biology is the foundation of biotechnology, which uses living organisms or biological systems to produce new products and technologies. Biotechnology is used in fields such as pharmaceuticals, agriculture, and environmental science, to develop new drugs, crops, and environmental solutions.

**7. Fuels:** Even though we are trying to switch to renewable energy sources, the world is still running on fossil fuels, especially coal and oil. Fossil fuels have biological origins since they are derived from living creatures only. Natural gas and petroleum are obtained from dead and decomposing biological matter.

**8. Investigation and Justice:** Biology helps us to investigate crime scenes for evidence like hair follicles, fingerprints, skin cells or blood. Police or investigation bureaus investigate them using genetic information to confirm whether a person was present at the crime site and to catch the culprit[25].

Biology plays a vital role in our daily lives, and its impact will only continue to grow in the future. Whether it's improving our health, feeding the world, or protecting the environment, Biology provides us with the tools and knowledge we need to make the world a better place.

### 2.1.1.4 Objective of Teaching Biology

The aim of teaching Biology in schools is to:

Breed scientists who will be able to contribute meaningfully to the society using the scientific knowledge acquired. Develop the mental capability of learners in science field. Enhance the career prospect of science student if they are found in career that need more than science knowledge. Apply knowledge of science in solving problems. Familiarize learner with the international nature of science and its application in technological development. To apply the knowledge of Biology in problem solving especially, in the areas of health[18]. To help learners understand the basic concepts of Biology, which includes the cell, genetics, evolution, and ecosystems; Develop students' scientific literacy skills, including critical thinking, problem solving, and, scientific inquiry. Encourage students to be curious and inquisitive about the natural world[31]. To provide practical knowledge of the content, providing advanced information. To develop various skills such as remembering, understanding, interests, appreciation, application and analysis through the teaching of life science. It stimulates the spirit of investigation and invention in learners. To improves the power of observation, experimentation and

problem-solving capacities. Understand the utility of biological science to the modem life. To inculcates the ideals like truthfulness, open-mindedness and reflective thinking in the learner. To inculcates the values of democracy, freedom, equality and fraternit[3]. To develops open-mindedness, objectivity, honesty and other scientific characteristics in learners. To respect others, view and opinion, to develop gender equity[3]. To promotes research in the field of science and technology. Science is practiced by people who are often sensitive to the needs and interests of the world around them. Vaccines for example are developed by scientists who are sensitive to the current needs of the society. Society supports science because of simple curiosity and because of the satisfaction that comes from knowledge of the world around us[3]. In addition to these objectives, teaching Biology in secondary school can also help students appreciate the importance of Biology in their everyday lives. For instance, students make informed choices about their own health and well-being with the knowledge of basic genetics acquired. Students understand the impact humans have on the environment and the importance of conserving natural resources with the lessons learnt about ecosystem in the course of teaching. Biology teaching in schools enables students to develop a greater understanding and appreciation for all forms of life in the universe[11]. It enhances development of intellectual curiosity, there is increase in awareness of ecosystem, acquiring of important skills required for professional advancement[3]



**2.1.1.5 General Goals of Teaching Sciences in the Senior Secondary Schools**

The goals of teaching sciences in Senior Secondary Schools are clearly stated by law maker in the nation's policy which is spelt out as follows:

To provide holders of senior secondary certificate examination with opportunity for higher education level regardless of gender, social status, religions, or ethnic background.

To offer diversified curriculum to cater for the differences in talents disposition, opportunities and future roles. To provides trained manpower in the applied sciences and technology. To provide entrepreneurial and technical job specific skills for self-reliance and agricultural and economic development[29]. To make relevant knowledge in science available to individual, develop scientific skill in an individual. To provide explanation to societal issues through scientific means that could only be answered through scientific knowledge. For creation of career awareness. To obtain the knowledge of science academic discipline. To acquire scientific methods and skills. To inspire student with desire for self-improvement and achievement of excellent. To raise morally upright and well-adjusted individuals who can think independently and scientifically[18,29].

**2.1.1.6 Goals of Teaching Biology**

Develop students' skills, knowledge, interests, and appreciation; as well as to apply scientific findings to their daily lives. As a result, the primary goal of teaching Biology in secondary schools is to provide students with advanced information, as well as to develop skills, knowledge, interests, and appreciation. Enable learners understand the fundamental biological principles where student obtain the knowledge of basic facts, terminology, concepts and theories in Biology. Have understanding of the diversity and complexity of the living world. Acquire the knowledge of continuous research and advancements made in different aspects of biological sciences. Nurture critical thinking and analytical abilities in learners, using scientific method. Here, students learn to carry out experiments with predictive hypotheses, analyze results of experiments. To apply knowledge of science to make healthy and ethical decisions, which enable student to understand the ethical code of conduct in scientific research. To acknowledge, understand and appreciate the ethical and moral implications of investigation in Biology. To enables students to communicate scientific information effectively in the society, which gives bountiful opportunities to

learners to develop efficient writing and oral communication skills. To develop in learner familiarization and utilization of various laboratory techniques where students learn to work with tools and demonstrate good knowledge of handing laboratory equipment both in the laboratory and field[18]. It gives deep scientific knowledge of the interaction between living and nonliving organisms.

### 2.1.1.7 Goals of Teaching Biology in Senior Secondary Schools

To provide an extensive education in Biology which emphasize scientific thinking and problem solving in every aspect of Biology. To build learners for various post. To provide comprehensive training in the field of technology, statistics, laboratory skills and communication. To produce learners who can conduct biological research successfully. To present learners who are capable of explaining principles and mechanisms behind organic evolution. To produce learners with ability to explains the essential of Biology diversity globally. To present learner who can explain various fundamental processes in Biology. To impacts the understanding of genetic counseling in learners. To enable learner's, develop scientific attitudes and power of observation[30]. To enhance learner's ability to collect data through experimentation. To promote student's ability to explain occurrences with the use of models where applicable. To apply the scientific process to address biological questions and problems. Find critical evaluation and communication information on biological research and its societal inpact. Make observations, identify problems, formulate hypotheses, carry out experiments so as to solve the problem at hand[30].

### 2.1.1.8 Justification for the inclusion of Biology in Nigeria Senior Secondary School Curriculum

The points below justify the inclusion of Biology in secondary school curriculum:

To provide learners with mastery of the structures, functions of living organisms and appreciation of nature. Acquire vital laboratory and field skills needed for Biology investigation and project. Obtain suitable knowledge required for future and further studies in biological science. Gain scientific attitudes needed for problem solving[31]. To present learner who can use the knowledge acquire in genetics and interpretation of genotype result to select marriage partners in future. Ability to apply biological principles in solving daily life problem such as personal, social, environmental, community health and economic problems[31].

#### 2.1.1.9 The Aims and Goals of Teaching Biology in the Nigeria Secondary Schools

To produce trained students who possess the following attributes:

i. Knowledge of structures and functions of living things.
ii. Cherish the nature and the needs to preserve it.
iii. Acquire appropriate laboratory and field skills required of Biology practical and projects.
iv. Ability to observe, collate and interpret data.
v. Acquisition of useful knowledge require in choosing and enhancing career prospects of Biology students.
vi. Acquiring of scientific attitudes for solving problems[32].

In schools, Biology curriculum is divided into two parts: theory and practical aspects. For any student to record great success in the nations' external examination, such student must have been taught thoroughly in both aspects with different strategies of teaching such as experimentation, field trips, the use of multimedia, discovery, demonstration, cooperative, constructivism, concept mapping among many others. Research conducted in the study area revealed that expository method (Field trip and excursion) of teaching

was the least method used by Biology teachers[18]. This may also be one of the factors contributing to student in ability to answer questions pertaining to Ecology in the nations' external examination as reported by the chief examiners report. Since the challenge of this era of technology advancement needs individuals who can turn the theoretical knowledge gain into practical situation to solve real life problems and make abstract concept real to student as the use of multimedia in science teaching can be an effective instrument in enhancing teaching-learning of any subject[33]. It is on this that the present study seeks to find solution to complex, abstract nature of Ecology by trying to see if Interactive Video Variation and Virtual Field Trips will have positive influence on Biology student academic achievement in Ecology in Abeokuta.

### 2.1.2 Academic Achievement

It is commonly express that a nation's growth and development depend on the level of education of its citizens. Success is simply defined as the achievement of a high result or a goal that one aims to achieve. Academic achievement can be defined as the level of performance of a student in a particular area of study. Higher scores connote better academic achievement. It refers to as participants' examination grades at the end of a given period which could be term, semester, or session or program[34]. Academic achievement is the score obtained by a student after he or she has been exposed to a set of instruction during teaching and learning. It is the mark an individual gets when he was tested to know much such he has learnt in the course of teaching. It is the attainment of a person in a particular subject in an assessment or examination. It is the degree to which a learner, institution or organization was able to achieve a set of goals. It is the magnitude to which an individual learner, tutor, or institution has reached their educational goals[35]. It refers to result obtained in a subject which showcase how far an individual has achieved a particular goal. It can also be called the quantity of educational content a

learner masters within a particular period of time. It means a set of goals has been accomplished by a learner within a time frame in an academic environment. It is measured with test and assessment[35]. It represents the degree of success and achievements obtained by learners in their academic pursuits. It includes a range of results such as educational awards, scores of tests, grades, taking parts in extracurricular activities and so on. It entails many concepts and not just performance of test. It deals with ability to build critical thinking, problem solving skills, creativity skill, emotional uprightness and so on[36]. Academic achievement shows how strong or weak an institution is, it influences the socioeconomic progress of a country, it serves as an instrument for measuring the rate of success of an organization. Academic achievement is an inevitable tool for measuring educational success in education set up. Another scholar defined academic achievement as the measurement of success accomplished by a student, remarkable change in the student performance in school in the course of learning[37].

#### 2.1.2.1 Academic Achievement Examples

Academic achievement for undergraduate student may include:

1. School grades at the end of a semester examination or session such as GP or A-levels may bring a student to the light in such institution.
2. Winning a Scholarship: Winning a scholarship, which might be as simple as one that helped a student pay for his books or school fees during an undergraduate degree, is a revealer of good academic achievement.
3. Receiving an Academic Award or Prize. An academic prize or award is something you receive as recognition for your academic achievements or excellences as a student. For example, you might receive an award or prize that shows that you were toward the top of your class, or that you were picked

as a promising student. Academic awards and prizes can be given to a student for entering contests, such as essay writing contests or even a science fair. Winning an academic award can absolutely add to the persons profile and open up more opportunities for elevation

4. Leadership Role in an Academic Club or Society - Occupying a leadership role in an academic capacity or society shows a student's commitment to extracurricular learning and their ability to lead others. This might include roles as simple as President of a debate team, editor of a university journal, or chairperson of a student-led seminar series and so on. These roles need skills in team management, problem-solving, and communication, which are very important in a professional setting.
5. Partaking in a Study Program Abroad - Been selected to participate in a study program abroad is a demonstration of ones outstanding performance in student academics. It is also an indication that such a student is willing to step out of his comfort zone and an ability to adapt to new environments. This experience can also indicate language skills and a global perspective, both of which add value in many professional settings. In addition, study abroad programs often involve navigating complex logistics, which can demonstrate problem-solving and organizational skills which are all desirable for future employers.
6. Completion of an Internship or Co-op Position - Completing an internship, industrial attachment or co-op position during undergraduate studies is a significant achievement that can help fill the gap between academic studies and the professional world. The experiences gained during this provide students with an opportunity to apply their academic experience in a real-world setting and develop technical skills. In addition, having this experience

during a job interview can make a candidate more attractive to potential employers, as it is an indication that they have practical experience in their field of study.

7. Certifications**:** Certificate received at the completion of school certificate, national diploma (ND), Nigeria Certificate in Education (NCE) and so on. Or any certificate obtained for participation and completion of an academic program or event is an academic achievement.

### 2.1.2.2 Importance of Academic Achievement

Studies revealed that learners who perform well in school may end up having good and successful careers, earn high income, live a healthy life style and less anxiety and at the long run[38,39,40].

1. Academic achievement is a crucial aspect of a student's educational journey as it not only reflects their level of knowledge and understanding but also plays a significant role in shaping their future whether it is through standardized tests examinations, or assessments, academic achievement provides a measure of a student's progress and potential. In this section, we will explore the importance of academic achievement and delve into the various factors that contribute to its importance.

2. Academic achievement serves as a yardstick for assessing a student's performance and growth throughout their academic years. It helps stakeholders like tutors and parents to identify areas of weakness where a learner needs help. For instance, a student with high academic achievements scores in mathematics all the time but he or she is struggling with English language, it is an indication that such student need assistance in communication skills to bring about improve in such area of weakness. By focusing on academic

achievement, tutors can channel their teaching methods and resources to address specific areas of weakness thereby improving overall learning outcomes of students.

3. Furthermore, academic achievement plays a central role in college admissions and scholarship opportunities. Colleges and universities often consider a student's academic record, including their grades, test scores, and overall academic performance, when making admission decisions. A strong, consistent academic record can absolutely boost the chances of getting admission to a choice educational institution or acquiring scholarships that can relieve the financial burden of higher education. Academic achievement provides access for student to gain admission to higher institution of learning as well as provides opportunities for students to pursue their dreams and aspirations in life.

4. Academic achievement also fosters a sense of accomplishment and self-confidence in students. When students witness that their hard work and dedication yield into positive results, it increases their self-esteem and encourages them to aspire for greater achievements. This sense of accomplishment can go beyond the classroom and may have positive influence in other areas of a student's life, such as choice of career, extracurricular activities, personal goals, and so and so forth. Academic achievement enables learners to develop a mind set to grow, stimulates students to accept challenges, take risks, and stand firm in the face of barriers.

5. It is a great tool for building effective study habits in learners as they try to maintain a good academic stand and strategies. Time management, organization, and goal-setting skill are important in sustaining consistent academic performance. For example, setting specific, achievable goals at the beginning of each academic session can help students to be focused and encouraged.

6. Academic achievement serves as stepping stone for a brighter future and a way to success. Case studies have shown the positive influence of academic achievement on an individual's life. Many success stories of people who have overcome challenging situations through academic success serve as motivation to students throughout the world. These stories reveal the transformational power of education and the doors it can open, regardless of the background of such a person. Destiny can be changed, life styles of an individual can be transformed from rags to riches, and night can be turn to day through academic achievement of such people. It is a tool for measuring growth and development of a learner. Enhance the development of strong work ability[40,41].

### 2.1.1.3. Factors Affecting Students' Academic Achievement

Many factors can influence student academic achievement positively or negatively. Some of which are; student and peer factors, Teachers' factors, School factors, Parental factors, cultural factors, economic factors, political factors and so on[42,43].

**Student and peer related factors:** is concern with everything around the students' that may influence his or academics life. Learners' time management, self-motivation, engagement, behavior, and attitudes, frequent absenteeism from school, laziness are some of the important factors controlling their academic achievement[44,45]. Other student-related factors that influence Biology achievement also include science background at primary school, learners interest in Biology, practical skills, ambition, attitudes, students' perceptions of the teaching-learning environment, approaches to learning, organized studying, peer support, and self-regulation skills also impact academic achievement in Biology . Motivational factors such as self-determination, career motivation among many others. The student who aimed to succeed in his or her academic must give priority to his or her education, make judicious use of his or her time, has a straightforward schedule,

and spends most of his or her time in the classroom, library, and other places reading and doing his or her assignment and vice versa. Peer influence is another student related factor that affects students' academic achievement positively or negatively. This is more in secondary school than primary school because of the student maturity level. For instance, negative peer influence occurs when students encourage one another to perpetrate evil such as drink alcohol, smoking, drug intake, cultism, sneaking out of school to attend parties, absenting themselves in class activities among many others can have negative influence on student academic achievement[46]. On the other hand, peer influence also has positive effect on student academic achievement for instance where students motivate their friends to read, challenge one another to aim at high grade through health competition, creative thinking. Students social, psychological, intellectual influences on one another tend to boost learners' performance in various subjects in school. In a nutshell, peer influence plays a pivot role on secondary school student academic performance and learning as whole[46].

**Teachers' related factors:** this includes teachers' method of teaching, teachers' character, qualification, personality, teachers job performance, teachers experience, teachers' attitude, time management, among many others have great influence on student academic achievement negatively or positively. Research_revealed that an effective teacher can drastically affect students' academic achievement and economic outcomes[47]. On the other hand, if the teacher lacks the essential training, teaching ethic and teaching experience, knowledge of effective teaching methods, the students may be faced with many academic challenges. There are a lot of issues relating to teaching that may influence the learning of students, such as whether teachers teach students conscientiously, whether they are well-prepared for lessons, and whether they comment on students' assignments carefully[48,49].

**School related factors** include school environment, class size, school location, inadequate funding, school management, laboratory facilities and so on. How conducive is the learning environment, classroom situation, school location among others. An ideal environment for learning should be secured, neat, conducive peaceful, free from noise and welcoming to student and teachers to enable learning to take place. The classroom should contain moderate size of student such that the teacher can effectively cater for or control. School location is another school factor which may have positive and negative influence on learners. The place where a school is sited can determine the level of performance of student and teacher. A school situated in a quiet serene environment will enhance student academic performance. While school situated in a noisy and polluted area such as near airport, factories, market places, religious centre will disturb school activities as well as act as source of distraction to learners[50,51]. School management can also affect student academic achievement either directly or indirectly. Good leaders will have positive influence on learners and vice versa[44].

**Cultural related Factors**

Cultural related factors include cultural values, practices, language among others. Cultures have a great influence on schooling as it decides how we see the things and our perception about the world. Our understanding, belief system and behavior socially and academically are greatly influenced by culture. In some culture female academic is belief to be useless as it ends in the kitchen. As a result, culture has a large influence on both learning and teaching styles. Most African cultures are stiff, and students are expected to be extremely humble while learning. Such socio-cultural behavior may affect a student's academic success. On the other hand, memorization-based examinations are bad practice in which students cram lessons, which causes them to fail to apply what they have learnt to society and solve rely life social problems[43].

**Economic Factors**

Students' educational choices depend on the financial ability of the parent; this often determine the student choice of course in most cases[43].

**Political Factors**

Politics has a great effect on education. For instance, a country in which the government's budget for education is lower than 7% this will greatly affect student academic achievement as there is little or no provision for educational needs. Studies reveal that degrading standard of education is attributed to inadequate support from government on education matter as well as the poor quality of teachers. Inappropriate management of schools, lack of facilities, poor or unstable governmental policies, curriculum content are all influenced by polities directly or indirectly[43]. All these in turn will greatly affect student academic achievement in many ways.

Other factors affecting student academic achievement especially in science subjects includes: Language of instruction, insufficient laboratory equipment and teaching materials, inappropriate teaching method or teaching strategies, inadequate time and content allocation, lack of parental involvement, poverty, explosion of knowledge, challenges to the scientific method, the urgency of short-term solutions, the shift to more applied studies, and the specialization of Biology disciplines. Student-related factors that influence Biology achievement include primary school science background, interest in Biology, exposure to practical skills, ambition, attitudes.' perceptions of the teaching-learning environment, approaches to learning, study habit peer support, time management, and self-regulation skills also impact academic achievement in Biology. Motivational factors such as self-determination, career motivation, intrinsic motivation, and personal relevance play a role in Biology lesson motivation among many others[51].

Academic achievement in Biology has been observed not stable in O level Senior Secondary School Certificate Examination (SSCE) in West African Examination Council (WAEC). This could be as a result of various factors stated above. Previous researches also reported that student academic achievement in Biology over the year is not encouraging[18,27,28.42,43,44]. Previous studies conducted on students' academic performance in sciences showed low performance over the years[18,28,53,54]. It then behoves teachers of this subject in secondary schools and other stakeholders, researchers especially, to seek ways of keeping the percentages of failure in Biology under constant check. It is against this background that this present study takes a look at effect of interactive video variation and virtual field trips on Biology student academic achievement in Ecology in Abeokuta since the use of proper teaching strategy makes a good teaching-learning of subjects in school and traditional teaching method popularly used by teachers limits the mind of learners, does not enhance changes nor impact learning and may not effectively enhance students deep understanding of ecological concepts if used alone[18]. The need for constant upgrading becomes imperative more so, that the achievement of students in the subject is always a source of concern to all stakeholders in education. The inclusion of multimedia visual aids into teaching is therefore necessary at this junction. It is against this background that this study wants to see how interactive video variation and virtual field trips strategies can enhance Biology academic achievement in Ecology concept.



### 2.1.3 Strategies of Teaching

These are systematic methods that teachers use so as to achieve specific learning objectives. They can be called plan of action or procedure employ by teachers during sessions of teaching to achieve specific teaching goal. There are numerous examples of

teaching strategies such as problem solving, gamification, project-based learning, inquiry-based learning, problem-based learning, reciprocal teaching, active learning, differentiated instruction, personalized learning, response to intervention, classroom technology base teaching, multimedia, cooperative learning, flipped classrooms, blended learning, effective lecturing, team-based learning, effective classroom discussion, visualization, virtual laboratory, analogy, concept mapping, digital field trips ( Virtual Field Trips), use of video / multimedia lesson and presentation, integration of social media, use of podcasts, constructivism, game and simulation, focus group discussion, cartoon and animation and so on[37,55,56]. Interactive Video Variation and Virtual Field Trips only are the focus of this present study.

### 2.1.4 Interactive Video Variation Strategy

Interactive Video Variation strategy involves the use of various video clips, teacher self-recorded video, the use of YouTube videos in presenting lesson to learners. It is the use of technology to enhance biological concept teaching in a way that student will get the best from such lesson. Interactive video variation is referred to as the use of multimedia to provide, promote, deliver and aids learning in any location so as to give learners opportunity to take part in manipulating and studying at close range until learning takes place[37,55,56]. It involve integration of technology in teaching learning process, not just an ordinary product but a process to aid science teaching in acquiring educative information through sound, visuals and video with specific instruction, text and for the right set of learners[54,57]. It is described as a system of passing information that involves different forms of communication which include text, video, audio, still photographs, sound, animation, image and interactive content. It is the combination of any of the above mentioned that is done with the aid of computer, laptop, projector and so on. It is an effective teaching strategy that enables students to participate actively and give deep

understanding of concept to student. Interactive video involves the use of different educative video packages or clips to deliver and transfer knowledge about specific concept to student. It is an integral part of modern-day technology in education sector and it refers to as new model that adds to transformational changes of convectional education in various levels of educational system[55]. The difference between the old and new generation or dispensation is technology. Traditional method commonly used for teaching science has failed to enhance problem-solving skills, curiosity and critical and logical thinking among the science students hence there is a great demand to shift to technology incorporations strategies as a new way of teaching[59]. Incorporation of technology to education sector brings about paradigm shift to teaching learning process since teaching majorly involves delivery of information through communication. Incorporation of information communication technology is necessary in education system. It is a force to reckon with which has transformed lots of things in education system. Information communication technology consists of all forms of technology which is used to create, store, and exchange information (such as video, audio, still images, text, pictures and so on) with high - speed communication links that contain data, sound and video. When more than one of these is utilized in communication process, it is regarded to as Multimedia[57]. Multimedia elements are of great value in teaching of science it provides opportunities for students to learn both theory and practical aspect of Biology. It makes learners to eradicate the hindrances of learning in real-life situations thereby making the abstract concept easy to understand. It leads to development of complex skills in learners[59]. It increases retention of knowledge gain and affords learners the opportunities to explore their environment. It increases learners' readiness to learn more and enhance good retention, thus improving academic achievement[60].

Interactive Video Variation (IVV) involve the use of educative video clips to teach, explain and disseminate information regarding any concept in Biology in an interesting way to make biological concept real to learners. It may involve a pre- recorded video of the teacher combined with the display of diverse kind of pictures or real phenomena in natural form or educative video of interest down loaded from YouTube or other website that offers such an ample opportunity. It is the combination of visual, audio sound and documentation of concept with text by Biology teacher or video clip record that is borne on disc player and play with the aid of a digital video display (DVD) to present concept in a meaningful way to student to make teaching clearer and easy to understand by learners. It refers to as the use of different kind of video clips to present biological concept to student to enhance teaching and learning of such concept. For instance, while teaching the concept of ecological succession the teacher can make use of different types of videos on succession in different habitat such as succession in a pond, succession on abandon farm land, succession in the forest, succession on the rock can be used to enhance this concept where learner see event unfolding by themselves to get better understanding of such concept. IVV is a way of passing verbal and visual information to learner with the use of computer, laptop, projector and other electronic gadget that can be displayed on the screen for effective teaching in Biology. It reduces classroom pressure thereby promotes learners' interest in their academics. In other words, it leads to development of a positive attitude towards learning. Interactive video is a medium that creates a safe atmosphere for learning through audio-visual teaching aid which permits students to observe event as they are in their natural environments without any hindrance. Through the use of video during teaching, students can watch and learn the occurrences of phenomena that are considered risky and complex. Interactive videos variation gives opportunities for individualize and self-regulated learning[59]. Interactive Video Variation enhances and

stimulates the real environment as it's providing connection between theory and practical situation. Its flexibility in taking care of individual needs makes it a useful tool in education system as it permits individual learning, increases quality of cognitive, creativity and innovative thinking in among learners[61]. Incorporation of video in Biology teaching is arranged in such a way that many tasks can take place simultaneously in the teaching sessions[28]. Appropriate video clips that present the issue at hand in such a way that it provides solutions to some problem is used in the course of teaching. With IVV the teacher becomes brave and able to face challenges encounter with different learning methods and increase how the student understands, digest and use educational information. Video can be classified as audio visual aids. Audio visual aids are instructional materials which involve the combination of audio sound and visual aids. In other word, it is a type of instructional material which appeals to sense of hearing and vision at the same time.

#### 2.1.4.1. Role of audio-visual Instructional Materials

i. It promotes better teaching and learning, arouse students' interest
ii. It makes learners active participant rather passive listeners in the course of learning
iii. It enhances the formation of right image in learner since seeing is believing
iv. It aids the presentation of facts to learners
v. It makes presentation of teaching more practical and not just mere theory[63].

Video can also be classified as educational media, which are channel of passing information in which effectual teaching and learning can be obtained. Educational media may be projected and non-projected, hardware and software, printed and non-printed. Hardware media are non- consumable items known as machines. Examples are video set,

projector and tape recorder and so on. Software are consumable materials that contain information. Examples are disc, filmstrips, cassettes, slides and so on. Both hardware and software educative media work hand in hand for effective teaching learning to occur[63]. They are useful instruments used by teachers to make lesson interesting and lively to students. They play key roles in teaching process; they can be used to reinforce and support oral communication. Media functions well when combined with other teaching aids.

### 2.1.4.2 Importance of Media in Teaching Learning process

i. It leads to retention of knowledge
ii. It promotes learners' interest as they see what they are learning about rather than learning in abstract.
iii. Teachers get positive result in his teaching compare to convectional method of teaching.
iv. It saves time and effort.
v. It makes discharge of lesson clearer and better
vi. It enables learners to have good learning experience.
vii. It stimulates a sense of observation in students
viii. It enriches the learning environment thereby leading to the achievement of learning objective[63].

### 2.1.4.3 Criteria for Media Selection

The following must be considered before selecting media for use so that better teaching and learning can be promoted.

i. Content: content of media to be selected must be considered before selection, the content must be up to date, correct, it must be familiar and comprehensive enough. It must contain relevant information which is in line with the curriculum.

ii. Purpose: selection of media must be with specific purpose. It must be able to perform the function for which it is selected to perform. For instance, the use of video in teaching learning system is to present complex and abstract concept in Biology in simple way to student. Media such as computer, laptop, disc player selected must be able to perform such purpose.

iii. Appropriateness: one must consider student maturity level before selecting any media to enhance teaching learning process. Type of educational media selected must meet the needs of the different categories of student such as the gifted, the average and below average learners. Student learning styles must be considered before selection of medium.

iv. Cost, Time and Effort: It must not be expensive, it must be economical when considering time and effort use.

v. Manual: It must contain clear manure with detailed instruction on how to use it. This is to ensure proper and functional operation and maintenance of it.

vi. Technical quality: this deals with how durable it is in terms of color, repair, manufacturer sound, ease operation and editing so as to avoid technical fault.

vii. Instructional format: the category of learners that the tool is meant for whether small or large groups must be considered before opting for it[63].

#### 2.1.4.4 Principles Guiding Media (Video) Selection and Use

a. Clarity of content: it must be clear, up to date, relevance to the concept to be studied and logically arranged.

b. It must meet be useful for all categories of learners since individual differences occur among learners. It must be equal to the level of learners in term of difficulty.
c. It must not be too lengthy and time consuming.
d. It must be free of ambiguity.
e. It must be objective specific, clear and definite.
f. It must be appropriate for mode of instruction.
g. Selection must be based on objectivity rather than personal.
h. It must be effective for targeted audience be it large, small group or individual[63].

Interactive video offers students opportunity to participate, control and, study at their own pace until learning take place. It also makes the teaching of difficult concepts easier for both student and teacher. Instructional video-based package, when used as a teaching material in the sciences makes the practical aspect of Biology to be easy since students are familiar with the topic as they participate and control the videos, they watch[37]. It can also be used to bring home the practical topics of biological science on the close observational aspect, making the teaching and learning of Biology to be more of student-centered. IVV strategy help to improve the student sense of vision and hearing as well as that of the teacher. It is an electronic based technology generally used as teaching material which comprises of video that can be controlled by both teachers and learners at will for effective learning. It includes drill and practice, tutorials, simulations, instructional management and exercises which leads the students to high level of achievement[37].

It involves utilizing interactive video content to engage learners and enhance their understanding of a subject matter. Teaching by Video based instruction provides unique experience to students. Video based instruction can provide a consistent form of teaching and can communicate certain concepts in a visual and realistic manner. Interactive Video Variation (IVV) is a teaching strategy that allows students to actively participate and have

a deep understanding of Ecology. Interactive Video involves the use of different educative video packages or clips to deliver and transfer knowledge about specific concepts to students. Develop interactive videos that simulate real-world scenarios or virtual labs where learners can experiment and apply theoretical knowledge in a practical setting. This hands-on approach enhances retention and understanding[55,56]. The interactive nature of this video allows students to create, explore relationships, make conjectures about their properties, and test those conjectures in Ecology. With the above usefulness of interactive video stated above it is obvious that there is need to expose Biology students to, a variety of educative interactive videos on concepts of Ecology, to explore the vast benefit of technology in dealing with the abstractness of a concept like Ecology using Interactive Video Variation (IVV) learning teaching strategy will enhance Biology student academic achievement tremendously. It is against this background that this study takes a look at effect of Interactive Video Variation and Virtual Field Trips on Biology student academic achievement in Ecology in Abeokuta metropolis.

**2.1.5 Virtual Field Trips Strategy.**

Field Trip is a teaching strategy in which learning activity is done outside the classroom setting by teacher and students for important observation in the environment which is fill with various real-life experiences. It is an excursion to site of real-world events which is beyond the classroom setting with the aim of getting firsthand information through observation. It is a journey made by group of people to a place of interest outside the usual environment for education or leisure purpose within or outside the country[64]. It is a visitation to outside part of the classroom environment by learners and teacher to various places to get direct information or firsthand experience through observation[65,66]. It refers to as school tour in places like UK, New Zealand and Philippines. Field trip is a well acceptable method of teaching use to introduce a concept, experience and idea that cannot

be gotten within the classroom environment. It simply refers to as short term teaching learning activities which enable student chance to relate with their environment for purpose of exploration of the environment to enhance learning of particular concept or topic. It is a school outing which is gear towards educating learner from the riches of the God in the environment. It includes visitation to botanical garden, to zoo, museum, visitation to different habitat and various historical places to or site of occurrence for better understanding of biological concept[18,66]. It is a trip to a specific place so as to fulfill the objective of learning which can't be received through another means[67]. It led to development of power of observation; it facilitates better understanding as objects can be viewed in both physical and visual forms. It provides opportunities to explore concepts; it's a way of bringing classroom lesson to real life. It permits useful learning opportunity in environment, create long lasting effect that surpass mere learning of facts. It links knowledge gain in the classroom to the real live event; it provides an avenue for permanent learning experience and make teaching easy for teachers. It makes learning interesting, effectual, meaningful and clearer for learners[67]. It provides an avenue to observe and learning about living organism in their natural occurring habitat, it promotes skill acquisition in sciences [65,68].

Despite the importance of Field Trips to Ecology education stated above, nowadays teachers no longer organize field Trip to enhance teaching of ecological concepts. This lack of interest in organization of field trips has been attributed to a lot of administrative procedure in planning field trips and many challenge encountered by teachers of Biology. The challenges faced by teachers nowadays discourage them from embarking on field trips such as kidnapping, high cost of transportation, inadequate or lack of financial support by school authority, fear of accident on parent part among others[69,70]. The challenges stated above should not restrict teachers from exposing student to field trips

which is important for inculcating knowledge of Ecology. Therefore, integration of technology at this junction is inevitable. Introduction of virtual field trips can become alternative or replacement for real field trip at this junction.

Virtual Field Trip (VFT) is a teaching strategy which involves the use of technology to achieve field trips as alternative for the real field trip which helps to remove problems hindering the organization of traditional field trips as stated above. It is a way of impacting students' learning experiences in the universe which enables learners to understand the importance of what has been learned while boosting their knowledge and motivating them to learn[70,71]. VFTs incorporate interactive elements such as quizzes, games, and simulations to actively engage students in the learning process. For instance, students can take virtual samples, analyze data, and make predictions about ecological patterns and processes [72,73].

Proper and effectual use of VFT will enhance students' achievement and aid good retention of what they have gained in the classroom. VFTs were made and used for teaching science subjects. Incorporation of Virtual Field Trips into Ecology education enhances student paticipatory, nurtures a deeper understanding of ecological concepts, and promotes love for the environment among future generations of learners. The most thrilling things in the traditional education system are field trips. Virtual Field Trips are a great way of engaging students in learning experiences in the real world. They help students identify the importance of what they have learnt. Furthermore, VFT boost learners understanding and tap into new ways of learning while engaging and encouraging learners. Technological improvements, interactive learning, and online resources have opened doors to offer real-time experiences to students despite the challenges associated with traditional field trips. Virtual Field Trips, specifically offer opportunities to have real-world experiences at students' fingertips[70].

Virtual Field Trips (VFTs) allow students to virtually visit a wide range of ecosystems and biomes, from tropical rainforests to coral reefs to Arctic tundras without living the class. This access to diverse environments helps students understand the intricacies of different ecosystems and the unique flora and fauna they support. VFT is crucial for effective teaching-learning of Ecology and as it is commonly said "what I see, I remember, what I hear, I forget".

Through high-quality multimedia content such as 360-degree videos, virtual reality (VR), and augmented reality (AR), students can immerse themselves in realistic simulations of natural habitats. This immersive experience enhances engagement and fosters a deeper connection with nature. Many researchers both within and outside the country utilize the opportunities of technology to transfer knowledge to students via online teaching. For instance, during the COVID-19 era, many schools implored the use of virtual classes for the teaching-learning process and great success was recorded even to date virtual learning has become a force to reckon with in the education industry. People can travel to important places of interest despite the travelling restrictions this is possible through virtual visitation to such places[70]. A Virtual Field Trip is a guided exploration through the internet into places and experiences that are pre-organized and sectionally based to provide a structured learning experience. Virtual Field Trips are an Interactive and special kind of learning that is readily available, making access no longer a concern. With virtual field trips, students can study subjects and explore places to learn in real-time. They are also very cheap and less prone to risks associated with traditional field trips. It helps students make real-life connections by allowing them to go beyond book knowledge[70].



#### 2.1.5.2 Benefits of Virtual Field Trips

Virtual Field Trips are the intelligent way to bring the world to students without the barrier of planning a field trip, since student may not have opportunity of going for field trips throughout their stay in schools due to challenges facing organization of field trips. Virtual Field Trips can provide opportunities and real-life experiences that can enhance ecological teaching and learning. Below are some of the benefits of Virtual Field Trips:

1. Virtual Field Trips increase learners' knowledge as they go through the process themselves. VFT have a lot of learning potentials and make learning more meaningful to learners. Despite that learners are not physically present at the site of phenomena yet they can get hand knowledge of the concept through hand on activities.

2. Virtual Field Trips are Helpful in education system: VFT can be of help in teaching student across all levels of education from primary to tertiary levels. Students learn better with VFT. It enhanced skill-based learning, ability to remember and comprehend concepts[74].

3. VFT enhance student participatory in teaching learning process.

4. Safety: Learner's safety is a major challenge in field trip, Virtual Field Trip ensure student safety, it is free from kidnapping, accident among others [75]. It can be directed to meet the objective of teaching and as well provide unique curriculum.

5. It occupy Student's Senses More VFT enables learner see, hear and interact with virtual element on their own as they control the computer or multimedia involve[76].

6. It leads to development of healthy relationship between teacher and students.

7. Accessibility Benefits of Virtual Field Trips: VFT eliminates barriers that prevents teacher from organizing field trips. It enables students with mobility restrictions to take part in field trips virtually.

8. Students who are immune compromised are able to take part in such trip. For students whose bodies have a hard time fighting off illnesses, virtual trips are safer and easier than physical ones. You can avoid risking your differently able students getting exposed to germs or catching something by traveling[70,76].

9. It is easy to access from different location provided there is technological device to use.

10. Expanding Geographically: Virtual Field Trips permit exploration and connection to various places of interest within and outside the country without living the classroom.

11. Financial Benefits of Virtual Field Trips: it is cheap to use compare with the traditional field trip. A lot of money that should have been spent on transportation and other expensive on real field trips can be saved[70,74,75,76].

12. It reduces teachers' workload: A lot of effort goes into planning, organizing, and executing traditional field trips by teachers coupled with a lot of risk that comes with real trip. Instead of going through all this stress teachers can simply save a lot of time and reduce their workload through Virtual Field Trips[70,76].

**2.1.5.3 Scope of Learning through Virtual Field Trips**

Virtual Field Trips are very crucial to the requirements of present-day classroom. They can be used to teaching all subjects depending on the abilities and performance of different students. The scope of learning from Virtual Field Trips shall be discussed as follows:

**Range of Subjects**: Virtual Field Trips can be of great benefit to various subject most especially science, geography, and history. Students can learn different concepts from their various subjects and get the best from it with VFT. For instance, the outer space,

nature, forest, habitat, historical places, micro-organisms and so on can be explore through the documented significant events in the past.

**Levels of Grades**: Virtual Field Trips can be used for all students across all levels of education putting into consideration their age, class, group and individual differences.

**Various Student Abilities:** Traditional field trips might pose difficulties for students with physical and mental disabilities. This can make such students might not to partake in such important field trips, thereby depriving them the opportunity to learn from real life experience that field trips offer. VFT provide opportunities for learners with different learning abilities to take part in it regardless of their financial capability[70,76].

Virtual trips help to enrich learning as it offers free access to student to obtain real-life experiences. With the advancement of technology, incorporating virtual field trips into education can give a new, captivating life to lessons learned by students[70,74,75,76]. Virtual Field Trip is not gendering bias, it can be accessed by male and female individuals.

### 2.1.6. Gender Issues in Science Education

Gender is another important factor in education which affects student achievement in various subjects and career choices. In addressing students' achievement in Ecology, the influence of students' gender cannot be ruled out. Gender inequality, particularly in developing countries is not a new phenomenon. From the available literature, gender issues have been linked with the performance of students in Biology in several studies but without any definite conclusion. Previous studies have it that gender equality in education means giving equal opportunity to both males and females during learning process[107]. Gender deals with the social, psychological, cultural and behavioral part of an individual[78.] Gender in different context may mean the social role and expression of male or female[79,80]. Gender may be grouped into two bases on the sex of an individual into

male and female. It is a general feature of social organization or characteristics of boys, girls, men and women with the same social norm[83]. It deals with the culture, behaviour and role of male, female, boys and girls and their relationship with one another. Gender differs from one culture to another and changes with time base on social make up[83]. Existence of levels among gender brings about inequalities that cut across factors like social and economic inequalities. Gender inequality and discrimination affects the female in many areas such as health, decision making, education and literacy level, among many others[83]. Gender inequalities is a situation where by the right and honor of an individual is determines by his or her gender which can be seen in their unequal accessibility to their rights and bias social and cultural roles. Gender inequality has a great effect on the prestige of a person in all sphere of life, be it in the open or secret in terms of social, economical, political, even in family life. The female genders are at the receiving end of effect of gender inequalities especially in Nigeria where there is limit to what females can do, position the female gender can occupy but with high responsibility of house chores in the family and with the belief that female education end in the kitchen[84]. In many cultural sets up in Nigeria females are seen as being inferior to their male counterpart, this reflects in their role right from the family. In Nigeria different ethnic group attached importance to the gender of a child, which reflect in the role they perform from one family to another. For instance, the male child refers to as the heir of the family, pillar of the family the one that will uphold the family name and any family that is yet to have one is seen as not yet fulfill. On the other hand, the female in the family is seen as someone that will be sold out to another man and as a result not much importance is attached to the birth of female child. With this importance attached to the birth of male child some parent only sends their male children to school while the girl child may not have opportunity to go to school with the societal belief that the female education ends in the kitchen as a result denying

the girl child access to education. Gender disparity is seen in the role performed by individual in various families. Female child is known for plate washing, cooking, sweeping, and many other households work while washing of car, dealing with electronic, climbing ladder to fix things at home are male stereotype. In like manner the society also reveal gender stereotype in some field such as mechanical engineering, farmers, architecture, surveyor, bricklaying, welding, blacksmithing, carpentry, pilot, to name a few. While some fields of profession are domesticated to female such as nursing, hairdressing, catering, dying and bleaching of cloth, teaching among many others[84,85,86].

Gender inequality in education, is not complete without taking a look at the barriers to schooling for girls and young women. Research revealed that 75% of children across the globe who may never attend any school for various reasons are girls compare to 25% boys [116]. Apart from schooling, gender inequalities are seen in other parts of education, like learning or school guidance. Two types of barriers are identified. Difficulties relating to educational offer, which deals with education systems, policies, or schools and those that have to do with the demand for education (inherited hindrances) seen in families, children, and society. They include social norm, economic situation and poverty, under representation of female teachers, accepting pregnant girl and young mothers in schools, gender bias teaching and textbook. These effects may be connected and have great influence on one another[87]. Boys are also faced with barriers that make them to drop out of school some of these barriers such as struggle for generation of income to support their parent, food shortage among others.

Globally, there has been a continuous likelihood for girls' underachievement and under representation in science at different stages of schooling, especially from the secondary school level[88,89,90]. This inequality at lower levels of education is more feasible in science related courses in higher education and in science related fields in the students' further

occupations, in favor of more males than females[91]. Gender inequality must be eradicated to have an unbiased relationship across the gender. Hence there is need to promote gender equality where male and female have equal right and to their basic needs and requirements in life in all sphere of life such as socially, legally, politically, academically and so on[92].

#### 2.1.6.1. Gender Equality in Education

Gender-equitable education systems give equal right to male and female, empower girls and boys and promote the development of skills such as self-management, communication, negotiation and critical thinking that is require for a successful life.

Gender-equitable education systems help to reduce school-related gender-based violence and harmful practices child marriage and female genital mutilation[93].

Gender equality in education is concern with social justice, rights, opportunities and freedoms. Gender equality in education is important for maintainable development, for societies free from trouble and health of an individual. Gender equality in education remains paramount for organizations, society even for government both locally and globally. Gender equality ensures that there is equal education opportunity is giving to both male and female, keep them in school and lead to development of prosperous nation. Gender-responsive education enhances gender equality at schools and can be attained by addressing students' gender issues through gender responsiveness[88,92].

Elimination or decrease in gender inequality in science education can promote the economy through increased employment and productivity among women and reduce job-related segregation[94].

The issue of gender and academic achievement has for a long time remained a controversial one. For instance, while some studies found a significant effect of gender on students' academic achievement, some did not [95]. Some researchers, therefore, concluded that male and female students would perform equally the same if they are exposed to the same type of instructions [96]. Many previous researches show variations in the performance of male and female students across many discipline[97, 98,99] . It was recorded that male students performed better than female student in mathematics and that boys generally preformed better than girls in sciences[89].

Hence, while Gender has been linked with the performance of students in several studies, but with no definite conclusion, this study aims to add to the body of literature in this area, and also find out if interactive video variation (IVV) and Virtual Field Trip (VTF) instructional packages could help enhance gender equality in the academic achievement of students in Biology.

Apart from gender, another moderator variable in this study is situational interest.

**2.1.7. Situational Interest** (SI). Situational interest among Biology students refers to a temporary and context-dependent interest that arises from specific situations, activities, or stimuli within the domain of Biology education. Interest is a fundamental factor that is necessary for effective science education. Interest is seen as quality that arouses concern or curiosity that holds one's attention. Interest is a condition of wanting to know or learn about something or somebody[110]. Interest controls our feeling and emotion toward what we do. It is a key factor that enhances learning[83]. Situational interest can be sparked by various factors and plays a crucial role in enhancing student engagement, motivation, and learning outcomes. Teachers' method of teaching, Provision of important learning materials increases learners' interest in their studies thereby increasing student

performance in such subject or course [70,71]. Learners' interest in science subject is the opposed by a lot of problems among which are: Many factors are responsible for low student interest in science subject particularly in secondary schools which also serve as hindrance that have greatly reduced students' interest in various science subject invariably account for low academic achievement in such subject these problems include; lack of in depth knowledge and understanding of science, Lack of a well equipped laboratory that can arouse learners' in science concept, inadequate provision of funds for field trips, excursion which can enhance science learning, inappropriate teaching strategies, Lack of educational materials needed for professional growth to name a view[18]. Studies reveal that gender has significant effect on interest[83]. Motivation occupies a central position when it comes to student interest in a particular subject. Motivation influence student interest especially in the classroom. Teachers, parent and student themselves should work hand in hand to encourage student to develop high interest toward learning especially biological concepts[46, 101].

Interest can also be described as the feeling that stimulates an individual to perform a task without any external force. The amount of interest an individual has on a particular activity determines the level of success in such task. Interest powerfully influences our academic and professional choices[68]. The importance of interest in learning does not only mean that someone has an interest in learning about something. It also means that when a person is interested in a thing, it becomes easy and even enjoyable to learn about such topic. Students' interests do not rise authentically at all times. Therefore, without teacher's scientific and effective instruction, students will not have interest in certain concept. Many factors are responsible for low interest in science by students' chief of which is the method adopted for teaching and learning science. An important aspect of Biology teaching is to create a comfortable environment that allows the students to find

and develop their interest through participation. This makes learners to perceive the learning of Biology from a positive angle. Students draw conclusion as they actively engage in teaching learning process and explore the environment. This makes them to derive pleasure in what they are learning which lead to success. The joy derives in achievement of success further enhance their interest in Biology. When a person is interested in what he or she is doing, he will pay a closer attention, and process the information more efficiently, thereby employ more effective learning strategies, such as engaging in critical thinking, making connections between old and new knowledge, and attending to deep structure instead of surface features[68]. One effective way of determining career choices of young people is by promoting the interest of such young individual learners in their academics[71].

## 2.2 Theoretical Framework

Many theories have been formulated on effect of video and virtual Field Trips strategies on students' Academic Achievement. This present study will be based on theory of constructivism and cognitive theory of multimedia learning.

### 2.2.1 Brunner Constructivist Theory

The concepts of learning with Interactive Video Variation and Virtual Field Trips involve theory of constructivism which was postulated in 1960 by Bruner in which the active nature of learning was described. The constructivist believes that the road to learning is under construction. The philosophy of constructivist teaching is based on the following: learning occurs as students are actively involved in a process of learning and knowledge construction as opposed to passive receiving information, teaching and learning are student centered and learners are the makers of meaning and knowledge construction is based on their previous knowledge[102,103]. The constructivism is a view of learning based

on the belief that knowledge is not a thing that can just be given by teacher at the front of the classroom to learners in their desks. Rather, knowledge is constructed by learners through an active, mental process of development, learners are the builders and creators of meaning and knowledge. Constructivism draws on developmental work of Piaget and Kelly. The theory was based on four important principles: learning in an important way depends on what we already know (previous knowledge); new ideas occurs as we adapt and change our old ideas; learning involves inventing ideas rather than mechanical accumulation of facts; meaningful learning takes place through rethinking old and coming to new conclusions about new ideas which conflict with our old ideas[95]. In a constructivism classroom Students are active involved, the environment is democratic, activities are interactive and student centered, and the teacher facilitates a process of learning in which students are encouraged to be responsible and autonomous. In the process of active learning, learners are referring to as active individuals in constructing knowledge in the sense that they are actively involved in what they are learning. Interaction with the environment help learner to construct learning. This learning theory enhances critical thinking and produces motivated and independent learners. With the use of Interactive Video Variations and Virtual Field Trips strategies elements of constructivism are made which include building communication columns in which students are able to explore and interact with the real-life environment through the useful links provided by the teacher for student to discover concepts deeply from the rich of nature and making use of their previous knowledge. These strategies enhance a good response from learners via reactive elements like video to create thought, develop curiosity and permit deeper investigation[104]. Previous knowledge plays a pivot role in constructivism class and in education system generally. Previous knowledge is important for further learning in any academic situation. Research revealed that this arrangement of

curriculum assists learners to have mastery of knowledge as they revisit the same basic ideas of knowledge over and over in different manners of learning base on learners' readiness to learn[77]. The present educational curriculum both in Biology and other subject was designed in such a way that enable learning to occur form simple to complex, known to unknown, general to specific and concrete to abstract to allow student to always learn the important concepts in any subject as they ascend from lower class to higher classes in schools[105]. This will enhance the mastery of some basic skills and knowledge in learners. The occurrence of these basic skills and knowledge from know to unknown provides connection between each lesson as learners move up to higher classes in their studies. The introduction of new concepts during lesson will strengthens the previously learnt concept, relating it to information previously gained. This brings about meaningful learning since the new materials have been well linked and related with the old knowledge gained. This theory advocated that for meaningful and effectual learning to take place the relevant previous knowledge of student must be drawn upon while teaching new concepts, teaching should be done in sequence (from simple to complex, known to unknown, concrete to abstract and so on.), learners should go to classroom with relevant previous knowledge while teachers should provides connection to enable learners identify its relevance[105,106]. Virtual Field Trips and Interactive Video Variation provides learners with the opportunity to explore and relate with the real-world environment where students can learn from the riches of nature, relate what they have learnt previously to the present concept to provide link between the ecological concepts learnt in SS1 to that of SS2. VFT and IVV strategies enhances a good response from learners via reactive elements like video, documentaries either developed personally or adopted from platforms where such has already been developed to create thought, develop curiosity and permit deeper investigation. This theory is relevant to this study in that it help the researcher to arrange

the materials in a logical way from simple to complex, known to unknown to remove abstract concept in Ecology through the application of constructivist based learning will improve effectual teaching and learning and enhance learners performance in senior secondary school Biology both in their internal and external examination as the study builds on learners previous knowledge of learner for meaningful learning to take place.

### 2.2.2 Cognitive Theory of Multimedia Learning

The second theory examines by this study was the Cognitive Theory of Multimedia Learning. This theory was formulated by Mayer in 2002. Base on some previous theories, he defines cognitive theory as three assumptions based on theories of how people learn from words and pictures. These are: Dual channel assumptions: it states that visual and auditory channels for processing information. Limited Capacity Assumption states that a limited capacity is seen by each channel. And the last one is that of active processing assumption which states that learning is an active process of selecting, organizing, incorporating and integrating information based on the prior knowledge. In the cognitive processes of word processing, learner will pay undivided attention to some of the words that make some construction of sound in working memory. In the process of the cognitive selection of images, students pay attention to many aspects of the construction of some of the pictures producing images in working memory. Verbal reasoning deals with the process of choosing words and phrases and incorporating these into the knowledge base. The cognitive theory of multimedia learning states that meaningful learning takes place when learners are involved in verbal reasoning and visual space processing. Thus, interactive Video variation installs many multimedia elements as text, graphics, video and audio in discharging complex and abstract concepts more easily[28]. In 2009 Mayer defined multimedia as a blend of words and visual information during demonstration or illustration in cognitive theory of multimedia education (CTML). Multimedia technology

employs not just current and high-level IT developments such as advanced digital apparatus, also items that we use daily such as small video clips, text, PowerPoint presentations, graphics, and more[144]. Additionally, Microsoft Encarta and Wikipedia are paramount references that can be easily evaluated for enhanced understanding [145]. Furthermore, content in class could be understood better by students using video clips and pictures. Subsequently, with integration of digital technologies in the educational sector teachers can use different digital resources and multimedia. There are several technologies for teaching and learning such as power point, you tube, recorded video clips[109]. Although recorded video does not involve student but could be very impacting, hence the need for students to actively engage themselves while watching such video[109]. Teachers can also involve student by stopping the video halfway, put questions and further instruction to allow student active participation. Based on the above, this study makes use of Interactive Video Variation and Virtual Field Trips already developed on YouTube that incorporates the use of technology for learners to understand the concepts of Habitats, Plants adaptation, and Succession. Topics that deal with the concept of Ecology will be selected from SS2 Biology curriculum and use for interactive video and virtual field trips strategies to achieve the objective of teaching learning of the selected topics[106]. on the proposed learning activities and teaching of the Biology Syllabus in SS2, through field studies in order to achieve the learning objectives[28,104]. IVV and VFT are important in enhancing student academic achievement in Biology particularly in ecological concepts both in internal and external examination. This study will provide learning opportunities that are both interactive and effective in promoting different skills and achievement in students. It is a medium of teaching and learning in a multimedia form which assists the students to understand and have mastery of the concepts and other components of learning, with greater clarity and deep understanding there by eliminating

the need for an actual field study where the selected topics can be learnt. It is against this background that this study aims to examine effect of Interactive Video Variations and Virtual Field Trips on Biology student academic achievement in Ecology.

## 2.3 Review of Empirical Studies

Recently many researches were carried out in different parts of the country and other nations in relation to the variables of this present research work to identify causes of low or under achievement of student in different subject and particularly in Biology, some of it shall be considered here.

### 2.3.1. Interactive Video Variation and Students' Academic Achievement.

Effect of video instructional package (VIP) on secondary school students' academic achievement in Biology in Makurdi metropolis, Benue state Nigeria was examined by a group of scholars. A quasi-experimental design of non-equivalent control group design was used in the study. The population of the study was 2100 senior secondary school II (SSII) students in Makurdi metropolis. The sample consists of 138 SSII students. A multi stage sampling procedure was used to select sample for the study. Intact classes were randomly assigned to VIP and Lecture method. Instrument for data collection was Biology Achievement Test (BAT). Data were analyzed with descriptive statistics of mean and standard deviation was used to answer research question and analysis of covariance (ANCOVA). Two hypotheses were formulated and tested at 0.05 level of significant. The findings revealed that there was a significance difference in the achievement of students taught Biology VIP and those taught with lecture method. No significant difference was found in the achievement of male and female students taught with VIP. It was recommended that textbook writer and publishers should make use of the advantage of

the use of VIP and incorporate it into their textbooks for secondary schools so enable student benefit from it[62].

Another study was carried out on the use of video and cartoon concepts in the teaching and learning of secondary school Biology. This study investigated the use of video and cartoon concepts in the teaching and learning of secondary school Biology. A pretest, posttest non-equivalent group quasi-experimental research design was adopted for the study. The sample comprised one hundred and fifty-one (151) Senior Secondary School Three (SSS III) students from intact classes in four schools in Epe Local Government Area of Lagos State. Results show that achievement of students exposed to video concepts increased significantly from 7.17±2.62 before to 8.75±4.07 after exposure (df64, P=0.09) while the academic achievement of Biology students exposed to cartoon concepts increased significantly from 5.43±2.52 before to 8.63±3.58 after exposure (df85, P=0.000). Analysis of Covariance (ANCOVA) shows that teaching methods is significantly associated with students' academic achievement in Biology (p0.05). Therefore, it was concluded that Biology teachers should continuously build the capacity to effectively use video or cartoon concepts to enhance the teaching and learning of complex ideas in Biology[28].

Another study examined effects of video based instructional package on achievement of secondary school Biology students in Suleja, Niger state, Nigeria the effectiveness of video based instructional package on Biology students' achievement in mammalian skeletal, osmosis and diffusion. The influence of gender was also examined and Quasi-experimental design was utilized for the study, specifically the pretest, posttest, non-equivalent control group design was used. Purposive sampling technique was used in selecting co-educational secondary schools where intact class of' SS II Biology students was sampled. A total of 169 students sampled were assigned to experimental group and

control group. The control group was taught using lecture method while the experimental group was taught using video instructional package. The experimental group comprised of 86 students (male and female) and the control group comprised of 83 students (male and female). Biology Achievement Test (BAT) was used to collect data. Two research questions were answered using mean and standard deviation while Analysis of Covariance (ANCOVA) was used to test the two hypotheses formulated at 0.05 level of significant. The findings of the study revealed that video based instructional package improved students' achievement in Biology. It was recommended that video instructional package should be used to teach Biology in secondary schools[37].

A study investigated the Effect of Video Instructional strategy on Biology Students' academic performance in Port Harcourt, Rivers State. The study adopted pretest, post-test, control group quasi–experimental design. Two Intact classes were taught using video instructional strategy as experimental group and another two classes taught using Instructional Diagrams as control group. The population of the study therefore comprises of all SS 3 Biology students in the two Local government areas with the total number of 7,963 students. From the schools which constituted the population of the study, two schools were randomly selected from each local government. Two schools were taken to be the experimental group, one school from Port Harcourt local government and the other from Obio/Akpor, while the other two schools were used as the control group in the same order. Sample consists of 240 students from the four selected schools (60 from each school). The instrument for data collection was Biology Performance Test on Genetics (BPTG) made up of standard objective questions on Genetics. It was made up of 25 multiple choice items and each has four options (A – D) with only one correct option and reliability coefficient value of 0.76 was obtained. Data generated from the study were analyzed at 0.05 level of significance using mean and standard deviation to answer

research questions and Analysis of Covariance (ANCOVA) was used to test the hypotheses. Two research questions and two hypotheses were formulated to guide the study. Instrument used for collection of data was Biology Performance Test on Genetics (BPTG) with 25 Objective with reliability coefficient of 0.76. The data were analyzed using mean and standard deviation to answer the research questions while ANCOVA was used to test the hypotheses at 0.05 levels of significance. The result revealed that the experimental group obtained higher mean performance score and no significant difference existed between location and academic performance. It was then recommended that teachers should use video instructional strategy in the teaching and learning of sciences as it promotes internalization of abstract concepts[110].

Another study examined effect of animated and interactive video variations on learners' motivation in distance Education One of the objectives of this research is to develop and validate the Instructional Material Motivation Scale for Single-Use (IMMS-SU) instrument in the Turkish context. The IMMS-SU was developed and validated in a two-phased process on a sample of 1654 students. The Exploratory Factor Analysis revealed that IMMSSU included 14 items ($\chi 2$=332.59; sd=74; p0.1 indicated that the scale did not have an acceptable level of consistency. The Cronbach-Alpha value for the internal consistency of the overall scale was calculated as 0.989, with total item correlations ranging between 0.78–0.92. In examining the scale's goodness to ft conditions, the unacceptable intervals revealed by the RMSEA value indicated that the scale did not possess consistency and could not be confirmed. Inspection of the structural modeling and path coefficients performed as part of CFA showed Item 5 to interfere with the other two items of the scale. The scale was reviewed by three subject-matter experts and a measurement evaluation expert, and it was determined that Item 5 was not sufficiently differentiated in terms of meaning. The decision was made to resume the data-collection

process after revising this item to make it sufficiently clear and differentiated. On the recommendation of experts, the "Instructional Material Motivation Scale" was revised by rewriting the item in question, and a second scale development procedure was commenced. The revised on-line data-collection tool was implemented with participants who were attending open and distance education, and the data set was prepared for analysis (n=1221; nFemale=660, 54.1%; mean Age=29.25 years; df=8.99). In order to determine the factorial structure of the scale items CFA was conducted with the sub-sample (n=610), after which EFA was conducted for cross validation (n=611). In order to conduct EFA with the sub-sample for scale development, assumptions were examined, and outlying values were discarded in order to secure multivariate normality (n=594; nFemale=333, 56.1%; mean Age=28.89 years; df=8.64). The sample was found to be suitable for analysis based on dual correlation values that did not exceed 0.90, a meaningful outcome of Bartlett's Sphericity Test ($\chi 2$=6880.93; df=91; p1 and using Catell's screeplot graphic method, a single-factor structure with an Eigenvalue of>1 and 14 items were identified. The analysis was repeated for the single-factor structure and showed the 14-items accounted for 61.58 percent of variance. Examination of the loading of the 14-item factor shown in Table 1 shows a factor loading of>0.63, indicating it meets the requirement of>0.30 mentioned in the literature (Pallant, 2001). Cronbach's Alpha coefcient of reliability was calculated as 0.96. The single-factor, 14-item model obtained from EFA was subjected to Confrmatory Factor Analysis for sub-sampling cross-validation. Prior to performing CFA, assumptions were examined, and multivariate outliers were excluded (n=594; n Female=305, 51.3%; mean Age=29.65 years; df=9.27). The split data sets were examined to determine whether they met the requirements for CFA analysis. According to the results of Bartlett's Sphericity ($\chi 2$=6292.07; df=91; p0.05; d=0.12; power=0.55). When the cognitive load scores for both material types were

examined, the interactive video group score was significantly higher than that of the animated video group score (t(931)=-2.15[111].

Research carried out recently examined effectiveness of Edpuzzle Learning Videos in class 9 Biology and it impact on academic performance. The study employed quasi-experimental design and purposive sampling technic was used consisting of 30 students in grade 9. The research participants consist of two groups, namely control (Lecture method) and experimental (Edpuzzle) consisting of 15 students in each group. To collect data pre-test and post-test were administered. Data collected were analysed with descriptive statistics. A normality test determined the distribution of data. Further, test score analysis for pre-test indicated that students in the control group (M=7.0667) and experimental group (M = 6.4667) had a similar level of knowledge. However, analysis of post-test revealed that there were substantial differences between control group (M = 8.2667, SD = 1.94447) and experimental group (M = 12.6000, SD = 1.24212). The finding of the study revealed that employing educational technology such as Edpuzzle Learning Videos proved effective in learning Biology for Middle Secondary School. Moreover, academic score increased on the post-test as a result of the student's active participation and engagement in their studies. Additionally, students were involved in learning at their own pace resulting in enhancing cognitive skills. This study recommended that Science teachers to use educational technology such as Edpuzzle Learning Videos as an alternative to conventional methods[109].

Recent research conducted on the effectiveness of multimedia learning packages in enhancing secondary school student s' attitudes toward Biology in Ile-Ife Osun state, Nigeria, employed a quantitative and qualitative research approach. The population for the study consisted of all students offering Biology as a subject in the senior secondary schools in Ibadan North Local Government Area of Nigeria, from where a sample of 80

students was randomly selected from three secondary schools and assigned to three groups (one control and two experimental groups). The instrument used for the study consist of two multimedia instructional learning packages (MILP) designed for the study. The topic treated was Cell Division, and the study lasted for six weeks. The packages and all instruments used were validated for content and construct validity, and reliability test was also done. Data were analyzed with descriptive statistics of mean, standard deviation, frequencies and percentages. The results revealed that multimedia instructional packages used in teaching and learning Biology in secondary schools enhanced better students' engagements and positive attitudes toward learning. It was concluded that students developed positive attitudes toward learning Biology after using the packages and that multimedia instructional packages are an interesting and creative method of teaching, learning, and enhancing positive attitudes towards learning among secondary school students[20].

Another study carried out investigated the effectiveness of interactive video in the achievement of Geography for sixth grades in Madaba Government schools used a quasi-experimental research design of pretest and posttest. Population of the study contained the sixth basic of 38 schools. Purposive sampling technique was used to select 60 students of the sixth grade from Ibntaima school in Mdaba governate second semester in the Univesity in 2019/2020. Instrument used was achievement test which consist of 20 multiple choice questions. Result was analyzed with analysis of variance (ANCOVA). Result of the study showed that there were significant differences at the 0.05 level of significant between the experimental and control group for the benefit of experimental group in the post-test, which were taught with interactive video. The study detected the effectiveness of interactive video in increasing academic achievement in geography[78].

Likewise, research conducted by a group of scholars on the effect of interactive video on social studies learning motivation for fifth grade at SDN Kiliwungu 2 Jombang used experimental research design with pre-experimental method and one group pre-test post-test design. Population for the study was all fifth grades students. The results of the study can be seen from the t-test (pair t test) obtained t-count (4.0376) greater than t-table (2.0930). The result concluded that there was the influence of the use of interactive video media on social studies learning motivation for class V SDN Kaliwungu2[112].

### 2.3.2. Virtual Field Trips (VFT) and Student Academic Achievement

A recent study was conducted on exploring the impacts of contextualized outdoor science education on learning on primary school students learning about ecosystem relationships in Canada. The study used interviewed method for the study. Population of the study consisted of all grades five and six students in two French speaking Schools in the inner city of Montreal (Urban area), Quebec province, Canada. Sample comprised of 63 grades five and six students in four classes from both schools. Data were collected with semi-structured interview with each of the students. Inductive categorical content analysis was used to analyse the data. Result revealed that contextual outdoor have positive impacts on science teaching and learning. It was also recorded that this strategy enhances student conceptual understanding about living organisms in the ecosystem, help to develop learnes ability to carry out scientific investigation and connection to nature[113].

Recent research examined the effectiveness of Virtual Field Trips regarding Academic Achievement in respect to teaching forest resources and to find out the level of motivation among students in relation to Virtual Field Trips use of virtual reality technologies for rich multi-media presentations of the field sites thus becomes a practical alternative. Quasi-Experimental Method was followed and Two-group, Pretest Post-test design was selected.

There are two types of method of teaching such as Conventional Method of Teaching and Virtual Field Trip method of Teaching. The treatment is Virtual Field Trip method of Teaching. Population consisted of all class XI students. The sample consisted of 100 Geography students of class XI from the four schools belonged to rural and urban categories. Instrument for data collection was an achievement test and a five-point rating scale tools. A non-interactive one-hour Virtual Field Trip (VFT) module based on Equatorial Rain Forests was used. The Virtual Field Trip mode of teaching was found to be more effective than the conventional method of teaching for academic achievement of students because the mean score of achievement test of the VFT exceeds the mean score achievement test of the conventional method. Rural students performed better than the urban students in both method of teaching. But in VFT, the urban students scored higher than the rural students under the conventional method. No interaction is found. Hence, the VFT method of teaching is an overall effective method of teaching for better academic achievement irrespective of locale. VFT method of teaching is more effective than conventional method of teaching to arouse motivation in learning among students. There is an interaction effect of methods of teaching and the levels of locale. However, the VFT method of teaching is more effective in arousing motivation irrespective of levels of locale[114].

A recent study examined the effect of field trip instructional strategy on students' interest and achievement in Ecology in Nasarawa State, Nigeria. Quasi-experimental, non-equivalent pretest and post-test control group design was employed for the study. Two research questions and two null hypotheses guided the study. The population of the study comprised 5,207 SS1 students in public coeducational schools in West Senatorial District, Nasarawa State, Nigeria. The sample of the study comprised 71 SS 1 students from two intact classes randomly selected from public coeducational secondary schools in West

Senatorial District, Nasarawa State, Nigeria. Ecology Interest Rating Scale (EIRS) and Ecology Achievement Test (EAT) were used as instruments for data collection. The reliability of EIRS was determined using Cronbach Alpha and the coefficient obtained was 0.77 and the reliability of EAT was determined using Kuder-Richardson formula 20 (KR20) and this yielded a reliability coefficient of 0.79. Mean and Standard Deviation were used to analyze the research questions while Analysis of Covariance (ANCOVA) was used to test the research hypotheses at 0.05 alpha level of significance. The findings of this study revealed that a significant difference existed in the interest and achievement of students taught Ecology concept using field trip instructional strategy and conventional method. Based on the findings of this study, it was recommended that teachers should be encouraged to use field trip instructional strategy in the teaching of Ecological concepts[68].

Recent a group of scholars carried out their research on Virtual Field Trips utilizing virtual outcrop: construction, delivery and implications for the future. And their finding was presented below. The advent of photorealistic, 3D computer models of cliff sections (virtual outcrops) has improved the immersive nature of virtual geological field trips. As the COVID-19 pandemic led to widespread national and international travel restrictions, Virtual Field Trips (VFTs) became practical and essential substitutes for traditional Field Trips and accelerated the development of VFTs based on virtual outcrop data. This contribution explores two such VFTs delivered to a master's level Integrated Petroleum Geoscience course at the University of Aberdeen. These VFTs are based on traditional field trips that are normally run to the Spanish Pyrenees and Utah (USA). The paper summarizes the delivery mechanism for VFTs based on virtual outcrops and examines student perception, gauged primarily through questionnaires and learning outcomes. The VFTs were run in LIME, a soft-ware specifically designed for the interpretation of 3D models and the delivery of VFTs. Overall, the student perception was very positive and

comparable to satisfaction with the conventional trips. Staff feedback and student assessments suggest that the learning outcomes were satisfied and highlight the value of this method of teaching for students who are unable to attend the field trip and as an addition for those who can[115].

A study about impact of Virtual Field Trip programs on elementary students' interest in sciences domain and STEM fields reported that the number of sciences, technology, engineering, and mathematics (STEM) jobs available in the United States will soon outnumber those qualified to fill them, and there is a decrease in the number of students pursuing STEM careers. Promoting students' interest is an effective way to influence career choices. Field trips offer students' handsome, experiential learning opportunities that have an impact on students' interest levels. Yet, not every teacher can take field trips due to logistical, financial, and geographical constraints. Standards-based virtual field trips are a promising strategy to support student interest in science, STEM fields, and meet the educational needs of teachers and students. The purpose of this action research was to determine the impact that Virtual Field Trip programs have on elementary students' interest in specific science domains and STEM fields. This convergent parallel mixed method was used. Throughout the study, participants attended four standards based Virtual Field Trip programs related to Chemistry, Geology, Meteorology and Astronomy. Quantitative data was collected through Likert-type pre- and post- surveys and qualitative data was collected from focus-group interviews and open-ended surveys vi to evaluate participants' interest. Findings from this study, though not statistically significant, suggest that participants' interest had a modest increase following Virtual Field Trip programs in all science domains and STEM. Qualitative findings also revealed that participants with an initial interest in a science domain expressed an increased interest in the science domain following the Virtual Field Trip. Findings regarding activities indicated that

participants enjoyed working with professionals, hands-on, active lessons, and taking a role in the scenario. This research has implications for the impact that Virtual Field Trips have on participants' interest. Recommendations are provided for Virtual Field Trip design and for future research[76].

### 2.3.3. Gender and Academic Achievement

Research carried out by a group of scholars examined the effect of gender on Basic science students' academic achievement in secondary schools. The study employed a quasi-experimental design of pre-test and post-test non-equivalent control design. Four research questions and four hypotheses were formulated to guide the study. Three research questions and three hypotheses were formulated to guide the study. Population of the study comprised of all the JSS 2 students in Enugu Education Zone of Enugu State, Nigeria. Two intact classes of seventy-two (72) JSS 2 students (30 males and 42 females) were randomly selected from public secondary schools for the study State Nigeria. The selected classes were randomly assigned to experimental and control groups. A 25-item Basic Science Achievement Test (BSAT) was designed by the researchers and used for data collection. The instrument was subjected to face and content validity by experts in Basic Science and Measurement and Evaluation. Kuder-Richardson reliability formula 20 (K-R 20) was used to determine the reliability coefficient index of 0.81 for the instrument, which indicates that the instrument was very good to be used for the study. Means, Standard Deviation was used to answer the research questions while Analysis of covariance (ANCOVA) was used to test the null hypotheses at 0.05 levels of significance. Result revealed that gender (male/female) had no significant effect on students' achievement in Basic Science and finally, result showed that there was significant interaction effect of treatment and gender on students' academic performance

in Basic Science. Based on the findings of the study, conclusion and some recommendations were made[115].

The research carried out by a group of scholars examining academic performance across gender differently: measurement invariance and latent mean differences using bias corrected bootstrap confidence intervals contained threefold aim: First, examined the dimensionality of the construct of General Academic Ability (GAA) at the subscale level providing additional insights over and above on the conceptualization of the construct. The second explored different degrees of measurement invariance of the GAA across gender using more recent advancements in the examination of Measurement Invariance (Bias-Corrected bootstrap Confidence Intervals). The third examined gender differences across the different facets of the GAA at the latent mean levels. The sample consisted of 1,800 high school graduates who applied for higher education in Saudi Arabia. The results from the analysis indicated that the hierarchical model with one higher-order factor (general academic ability) and four lower-order cognitive factors (i.e., verbal ability, quantitative ability, scholastic aptitude, and GPA) exhibited an excellent fit to the data. In terms of the measurement invariance hypothesis, it was found that the hierarchical model exhibits full configural and metric invariance and partial scalar invariance. Finally, using the Latent Mean Difference procedure, the results showed gender differences in the Verbal and GPA domains. Although significant differences were also found in the Scholastic aptitude domain, this finding is not stable due to several non-invariant items within the domain. In both cases, females scored higher than males. Finally, regarding the higher-order factor (GAA), the results showed that females scored higher than males. There were no significant differences in the Quantitative domain[97].

A study looked at the influence of gender and school location on Science and Mathematics students' achievement in Nassarawa western senatorial district in Nigeria, descriptive research design was used, population of the studywas all senior secondary school students in Nassarawa state. 198 students formed the study sample and simple roundom sampling technique was used for sample selection. Questionnaire and achievement test were used to collect data. The data collected were analyzed with frequency count and t-test method of analysis. Result of the study revealed that there existed significant differences between the academic achievement of male and female students in science and mathemetics[116]. Another study conducted on gender differences in the utilisation of information and communication technology (ICT) among undergraduate students employed a descriptive research design formulated one research question and one hypothsis for the study. 100 students male and female in the Faculty of Education University of Nigeria Nsukka formed the sample. Questionnaire was used to ontained data while mean score and t-test were used to analyzed the data. Result of the study revealed that male and female student utilize ICT in different way and that male students used ICT more than female students. Significant different was seen in the mean scores of male and female students, result revealed that male student utilized ICT more than female student for their academic pursuit[117].



### 2.3.4 Situational Interest and Academic Student Achievement

A study examined the effect of Field Trip Instructional Strategy on students' interest and achievement in Ecology in Nasarawa State, Nigeria. Quasi-experimental, non-equivalent pretest and post-test control group design was employed for the study. Two research questions and two null hypotheses guided the study. The population of the study

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A study about impact of Virtual Field Trip programs on elementary students' interest in sciences domain and STEM fields reported that the number of sciences, technology, engineering, and mathematics (STEM) jobs available in the United States will soon outnumber those qualified to fill them, and there is a decrease in the number of students pursuing STEM careers. Promoting students' interest is an effective way to influence career choices. Field trips offer students hands on, experiential learning opportunities that have an impact on students' interest levels. Yet, not every teacher can take field trips due to logistical, financial, and geographical constraints. Standards-based virtual field trips are a promising strategy to support student interest in science, STEM fields, and meet the educational needs of teachers and students. The purpose of this action research was to

determine the impact that Virtual Field Trip programs have on elementary students' interest in specific science domains and STEM fields. This convergent parallel mixed method was used. Throughout the study, participants attended four standards based Virtual Field Trip programs related to chemistry, geology, meteorology, and astronomy. Quantitative data was collected through Likert-type pre- and post- surveys and qualitative data was collected from focus-group interviews and open-ended surveys vi to evaluate participants' interest. Findings from this study, though not statistically significant, suggest that participants' interest had a modest increase following Virtual Field Trip programs in all science domains and STEM. Qualitative findings also revealed that participants with an initial interest in a science domain expressed an increased interest in the science domain following the virtual field trip. Findings regarding activities indicated that participants enjoyed working with professionals, hands-on, active lessons, and taking a role in the scenario. This research has implications for the impact that virtual field trips have on participants' interest. Recommendations are provided for Virtual Field Trip design and for future research[71].

A recent study conducted on interest as predictor of academic achievement of secondary school students in physics examined the extent to which student interest can predict their academic achievement in physics amongst secondary school students in Anambra State Nigeria. The study used the correlational research design. Population of the study was all SSII students from the 254 public secondary schools across the six education zones in Anambra state. The sample consists of 300 participants (134 males and 166 females) SSII students drawn from the 254 public secondary schools across the six education zones in Anambra state. The instruments used to collect relevant data from the students were Physics Interest Scale (PIS) and terminal continuous assessment results. The instruments were subjected to validity and reliability and found to be reliable at Cronbach Alpha

coefficient of 0.87. Hierarchical regression technique was used to analysis data. The findings revealed that student interest predicts about 57% of academic achievement scores of secondary school students in physics. It was concluded that students with an improved interest in physics science is expected to gain higher academic achievement in physics[118].

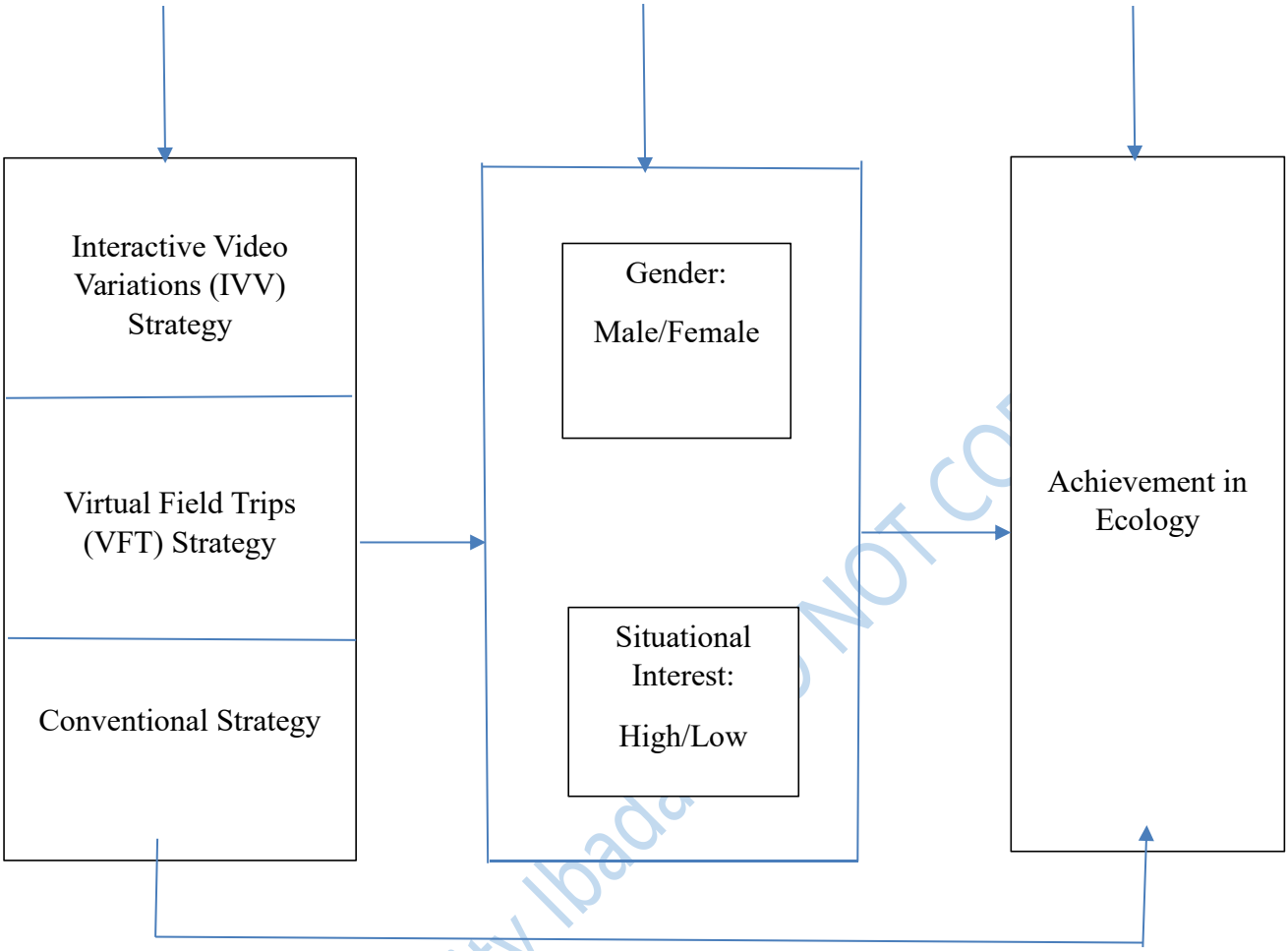
Academic interest determines the academic performance of undergraduate accounting students: Multinomial logit evidence was investigated by a group of researchers recently. It was revealed that academic performance is important for students as a result of educational experience in colleges to represent knowledge, skills, and attitudes. Academic performance is a key factor in determining students' success in their future careers. The research assessed student's academic interest, learning attitude, and learning quality as well as control variables for the academic performance improvement of undergraduate students in Indonesia. The study adopted a cross-section survey design to 872 samples gained by disproportionate random sampling. The research instruments were tested for their validity and reliability. The multinomial logit regression model was employed to analyze academic performance. The results of the research showed that academic interest was confirmed to determine significantly the academic performance. However, the learning attitude and learning quality did not contribute to the student's academic performance. High academic interest students possessed a bigger chance to have better academic performance. Meanwhile, learning attitude and learning quality indicated otherwise, decrease the students' academic performance. The results of this study contributed to the universities' management to manage innovative and learning activities to promote accounting students' academic interest in continuing better learning. The universities' leaders should fulfill the infrastructure and learning facilities needed by lecturers to maintain learning quality[100].

A study investigated academic interest as predictor of academic achievement of secondary school Physics students in Enugu Education Zone of Enugu State. The study adopted a correlational survey research design for the study. Purposive sampling procedure was used in selecting 244 Physics students comprising 105 males and 139 females from ten selected schools in the Zone. Academic Interest Scale (AIS) adapted from Wong and Wong (2019) and Students' Achievement Scores obtained from their promotion examination results from the schools used were used for data collection. The instruments (AIS) were validated by three experts and tested for reliability using Cronbach's alpha with the reliability index of 0.84. Data were analyzed using multiple regressions. The results revealed that academic interest relatively and significantly contributed 18% to the prediction of academic achievement of secondary school Physics. Based on these findings, it was recommended that teachers should adopt teaching strategies that would stimulate students' academic interest in teaching Physics[119].

A researcher carried out a study on student's interest on the academic performance in history in secondary schools in Ikom local government area. He investigated the influence of students' interest in History and their academic performance in the subject. 110 secondary school History students in Ikom Locaal Government Area of Cross River State formed the sample. The student responded to a survey instrument designed and administered by the researcher. Data collected were analysed using the independent T-test at a confidence level of 0.05. The result showed that students' interest in history significantly influenced their performance in the subject. Based on the findings, recommendations were made[120].

## 2.4 Conceptual Model

| Independent Variables | Moderator Variables | Dependent Variable |
|---|---|---|




Source: Field Work 2025

Figure 2.1



From the conceptual framework, Interactive Video Variation Strategy, Virtual Field Trip Strategy and Conventional Teaching Strategy are the independent variables of the study. The independent variable was manipulated by the researcher in order to examine its

effects on the dependent variable which was students' achievement in Ecology aspect of Biology. For the purpose of this study, the Biology students' situational interest and gender are the two intervening variables considered. The manipulation of the independent variable and the interactions with the moderating variables are expected to produce a consequent result on the students' performance in Ecology.

## 2.5 Summary of Literature Reviewed

The review of literature was done under the conceptual review, related literature on Interactive video variation, virtual field trips, gender and situational interest on Ecology were reviewed. The study reviewed two educational learning theories as guide for this study. They are Brunner constructivist theory which believe that learning should be constructive, student learn as they are actively involved in the process of learning, teaching and learning are student centered and learners are makers of meaning and knowledge is based on learners previous knowledge. The second learning theory that was reviewed in this study was the cognitive theory of multimedia learning by Mayer. Which was based on three assumptions based on theories of how people from words and pictures. The three assumptions are dual channel assumptions, limited capacity assumption and active processing assumptions. The study also reviewed some pass studies conducted on Interactive Video, Virtual Field Trips, student academic achievement, gender and interest as they affect student academic achievement both within and outside the country. It is based on this that this study investigates effect of Interactive Video Variation and Virtual Field Trips on Biology students' academic achievement in Abeokuta metropolis.



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# Chapter Three

# Methodology

This chapter examined the methodology that was used for the study. It includes: the research design, population of the study, Sample and Sample Techniques, Research Instrument, Validity of Research Instrument, Reliability of Research Instrument, Procedure for data collection and Method of data analysis.

## 3.1 Research Design

The study adopted the pre-test, post-test control group quasi-experimental design method. The outlay of the instructional strategies employed coupled with the pre-test and post-test notations are shown below: -

| | | | |
|---|---|---|---|
| $O_1$ | $X_1$ | $O_2$ | Experimental Group 1 (Interactive Video Variation Strategy) |
| $O_1$ | $X_2$ | $O_2$ | Experimental Group 2 (Virtual Field Trips Strategy) |
| $O_1$ | $C_3$ | $O_2$ | Control Group (Conventional Strategy) |

Where:

$O_1$ – represents the pre-test measure

$O_2$ – represent the post-test measure

$X_1$ – (Interactive Video Variation Strategy)

$X_2$ – (Virtual Field Trips Strategy)

$C_3$ – (Conventional Strategy)

Table 3.1: Factorial Matrix Design for the study 3x2x2

| Treatment | Situational Interest High/Low | Gender Male/Female |
|---|---|---|
| **$E_1$** | **High** | **Male** |
| | **Low** | **Female** |
| **$E_2$** | **High** | **Male** |
| | **Low** | **Female** |
| **C** | **High** | **Male** |
| | **Low** | **Female** |

$E_1$ = Experimental Group 1 – (Interactive Video Variation Strategy)

$E_2$ = Experimental Group 2 – (Virtual Field Trips Strategy)

C = Control - (Conventional Strategy)

**Variables of the study**

**Independent variable:**

Treatment at three levels

(a) Interactive Video Variation Strategy

(b) Virtual Field Trips Strategy

(c) Conventional Strategy

**Moderating Variables**

(a) Gender (Male and Female)

(b) Situational Interest (High and Low)

**Dependent Variable:** Student Academic Achievement in Ecology

### 3.2 Population of the Study

The population for this study comprised of all Senior Secondary School two Biology students (SSII) of 2023/2024 academic session in the 49 senior secondary schools own by Ogun state government in (public schools) Abeokuta metropolis which is about 5870 in number. (Source Abeokuta zonal offices of teaching service commission). This includes schools in Abeokuta south, Abeokuta North and Odeda local government area within Abeokuta metropolis, Ogun state only. SSII students were used because the student must have possessed adequate knowledge of biological concepts the bulk of which is in SSII curriculum.

### 3.3 Sample and Sampling Technique

A multistage sampling procedure was used to draw 19 schools out of 49 schools across the three local government areas in Abeokuta metropolis. A purposive sampling technique was used to select three (3) public schools one from each local government from the 19 schools. The selected schools satisfied the following conditions which qualified them to per take in this study: They have functioning computer laboratories and personal computers. They are co-educational schools (Mixed schools). They are far from each other in terms of distance to avoid experimental treatment diffusion. They have been presenting candidates for the Senior Secondary Certificate Examination (SSCE) yearly for the past five years (Both NECO and WAEC). They have qualified and well experienced Biology teachers with a minimum of B. Sc (Ed) in Biology or its equivalent. The selected schools were randomly assigned to treatment using simple random sampling techniques. That is, one school was assigned to each of the groups (IVV, VFT and Control groups). Lastly, in each of the selected schools, simple random sampling technique was

adopted to select the arm of the SSII Biology class where an intact class was engaged in the study.

**Table 3.2: Multi-stage Sampling Procedure**

| Local Government Area | Number of schools | Schools with computer laboratory | Selected School | Number of Students in each local government | Selected students |
|---|---|---|---|---|---|
| **Abeokuta South** | **20** | **8** | **1** | **3238** | **81** |
| **Abeokuta North** | **18** | **7** | **1** | **1690** | **85** |
| **Odeda** | **11** | **4** | **1** | **891** | **36** |
| **Total** | **49** | **19** | **3** | **5819** | **202** |

Source[1]

**Table 3.3 Sample Distribution into Strategies**

| School | Male | Female | Total | Strategy Used |
|---|---|---|---|---|
| School 1 | 15 | 21 | 36 | Interactive Video Variation |
| School II | 49 | 36 | 85 | Virtual Field Trip |
| School III | 42 | 39 | 81 | Conventional Method |
| Total | 106 | 96 | 202 | |

Source: Field survey 2025

### 3.4: Description of the Research Instruments

The following instruments were used for this study

(a) Ecology Achievement Test (EAT)

(b) Ecology Situational Interest Scale (ESIS)

(c) Instructional Guide for Interactive Video Variation Strategy (IGIVVS)

(d) Instructional Guide for Virtual Field Trips Strategy (IGVFTS)

(e) Instructional Guide for Conventional Strategy (IGCS)

#### 3.4.1: Ecology Achievement Test (EAT)

EAT was partly constructed by the researcher and partly adopted from the West African Examination Council (WAEC) past question based on the content of the study. At the initial stage, sixty multiple-choice items with four options (A, B, C, D) were generated using the Senior Secondary Education Curriculum for Biology (SSII) by the Nigerian Education Research and Development Council (NERDC). The content validity of the EAT was ascertained by using a Test Blueprint covering the first three levels of Bloom's taxonomy of educational objectives (Knowledge, Comprehension, and Application). The generated items were given to Biology Experts as well as experienced secondary school Biology teachers for vetting. After the vetting with necessary amendments, suggestions, and corrections made, the items were pilot-tested on SSII students from co-educational schools similar to the target samples to establish both the difficulty indices and discriminating indices of each item. Difficulty indices and discriminating indices were further ensured for the final selection of items. Thirty items with difficulty indices between 0.40 and 0.60 and discriminating indices between .030 and above were finally selected for the study. The reliability of the items was established using the Kuder Richardson 20 Formula ($KR_{20}$) which yielded 0.72 indicating that the instrument is reliable.

**Table 3.4: Table of Specification for Ecology Achievement Test**

| S/N | Content | Knowledge 40% | Comprehension 36.7% | Application 23.3% | Total |
|---|---|---|---|---|---|
| 1 | Aquatic Habitat | 3 | 2 | 1 | 6 |
| 2 | Terrestrial Habitat | 3 | 3 | 3 | 9 |
| 3 | Plant Adaptation | 3 | 2 | 1 | 6 |
| 4 | Ecology succession | 3 | 4 | 2 | 9 |
| **Total** | | **12** | **11** | **7** | **30** |

Source: Field Survey 2025

### 3.4.1: Ecology Situational Interest Scale (ESIS)

The ESIS is a self-reporting instrument for Biology students, **adapted from Linnenbrink-Garcia, Durik, Conley, Barron, Tauer, Karabenick, and Harackiewicz (2010)** to measure their situational interest. It contained 20 items which included items on triggered-Situational Interest and items on maintained-Situational Interest which were rated on four Likert scales: 4 - Very True of Me; 3- True of Me; 2- True of Me, and 1- Very Untrue of Me. The content validity of the instrument was determined by experts in questionnaire construction. To establish the reliability index of the instrument, the questionnaire was administered to 50 Biology students who were not part of the main study and Cronbach Alpha was used to estimate the reliability coefficient which yielded 0.85.

### 3.4.2: Instructional Guide for Interactive Video Variation Strategy (IGIVVS)

**IGIVVS** was developed by the researcher and consisted teachers guide (Lesson note) and some educative interactive videos suitable for the different topics that were considered by this study which were adopted from YouTube to avoid time wastage. This served as a guide for research assistants in experimental group I (IGIVVS group). The researcher with the aid of the supervisor packaged the instructional guide (Interactive Video

Variation on the selected topics in Ecology) which was later given to experts in the field of evaluation as well as some experienced Biology teachers and Educational Technology lecturer for vetting.

**3.4.3: Instructional Guide for Virtual Field Trips Strategy (IGVFTS)**

IGVFTS was developed to serve as a guide to the research assistants in the Virtual Field Trips Strategy group (Experimental Group II). It consisted of lesson guides used to teach this group of students and Virtual Field Trip documentaries on selected topics in Ecology adopted from YouTube channels that are suitable for the topics under consideration. The instrument was subjected to scrutiny and criticism by given it to experts in the field of research as well as seasoned Biology teachers.

**3.4.4: Instructional Guide for Conventional Strategy (IGCS)**

IGCS was developed by the researcher with the assistance of the supervisor based on the prevailing methods of teaching in schools (especially Ecology topics). The instrument was given to experts in the field of evaluation as well as experienced Biology teachers for observation and correction.

**3.4.5: Treatment Package (TP)**

This refers to the training manual and the instructional guide for the research assistants (Biology teachers) who participated in the study. This was packaged by the researcher in line with the suggestion and contribution of experienced computer tutors and Biology teachers as well as experts in the field of research.

**3.4.6: Research Procedure**

The study was carried out in two phases: Pilot testing, and the main study. Pilot testing or pilot study was conducted in two co-educational schools similar to the targeted sampled schools which were not part of the study. The schools were used to test run the experiment by applying the treatment packages on the students. This helped the

researcher to identify the likely challenges to encounter during the real experiment, so necessary amendments and corrections were made. Other instruments were piloted on fifty (50) students to ensure valid psychometric properties of all the instruments which informed the researcher of the items to be dropped or re-framed. The main study consisted of pre-field and post-field activities. Pre-experimental activities, having followed the sampling procedure to select participating schools, the researcher obtained official letters of introduction from the head of the department. The letters were taken to the selected schools and there, the researcher took permission from the schools' principals through the head of department of sciences in each school to use the schools for the study having discussed the purpose and the modality for the study with them. Thereafter, the researcher met with the Biology teachers of the selected schools, created rapport with them, got them fully informed about the purpose and how to go about the research work. Both the researcher and the teachers agreed on the time and value for training for those who fall into experimental group 1(IVVS) and experimental group 2 (VFTS).

Before the training, the researcher visited and checked the computer laboratory for the experimental groups (IVVS and VFTS) to inspect, and install downloaded videos of the selected topics and Virtual Field Trips documentaries on all the computers in the laboratory. The researcher then carries out the training of the research assistants (Biology Teachers) based on the experimental group to which they belong. Three (3) research assistants were used for the study. The students of the selected schools were made to realize the purpose, the nature, and the advantages of the study. This was done to encourage them to participate in the study.

Pre-test, (EAT and ESIS) were administered to students in all groups in their respective schools. The researcher and research assistants monitored the procedure of the administration. Both their responses and the instruments (EAT and ESIS) were collected

immediately after the test. This was done a week before the treatment. Thereafter, the treatment commenced and lasted for five weeks.

Three teaching strategies were used for the experimental stage; IVVS, VFTS, and the conventional method. The experiment covered 5 weeks. (See the Appendix for the instructional guide)

**3.4.6.1 Experimental Group I (Interactive Video Variation Strategy (IVVS)**

After the researcher had sought permission from the school authorities to use their schools for the study, the researcher with the help of a research assistant installed an Interactive Video Variation Strategy containing topics on Ecology on all their computers some days before the commencement of the study. After which the Biology teachers of those schools who served as the research assistants, were trained on how to use the videos to teach Ecology following the objective of the lesson. After the training, there was Micro Teaching for the Biology teachers to ascertain the mastery of the use of the package. This activity lasted for one week. Before the commencement of the real teaching, students in this group were accustomed to learning in a technological-based environment by introducing them to the use of IVVS. Students in this group were taught Ecology topics such as habitats, plants adaptation, and Ecology of population: Ecological succession using IVVS.

**3.4.6.2: Instructional Guide for IVVS Group**

The teacher introduces the topic

The teacher guides students to recall their previous knowledge by asking questions on the previous topic.

The teacher explains the new concept to students using IVVS as an aid

The teacher guided students to watch the video package which showed static pictures depicting the explanations of the Ecology concepts along with concurrent audio narration.

This allowed them to have as much as possible understanding of the topics within the shortest time and to explore the dynamic nature of IVVS.

The teacher moves around to see what the students are doing and makes corrections where necessary.

The teacher gives class exercises to students.

The teacher goes around to checked the students' note books and made corrections together with them

The teacher gives them homework to do.

**Teacher's Activities**

1. Introduces the topic to students.

2. Guides students to recall the previous topic

3. Guides students to link their entry behavior with the present topic.

4. Guides students to use IVVS on topics in Ecology.

5. Guides students to practice some exercises as displayed in IVVS.

6. Evaluate the lesson by giving class exercises to students.

**Students' Activities**

1 Listen to the teacher's explanation

2. Recalling the previous knowledge through the guidance of the teacher.

3 Watch the IVVS on the selected topics in Ecology.

4. Summary of the lesson learned from IVVS

5. Ask questions.

6. Do class exercises.

### 3.4.6.3: Instructional Guide for Virtual Field Trips Strategy

**Engagement Stage**

The teacher introduces the topic

The teacher guides students to recall their previous knowledge by asking them questions

The teacher guides students to link their entry behaviour with the new topic

The teacher raised students' curiosity by asking some provoking questions.

Teachers take the students on Virtual Field Trips for instruction.

The teacher puts students in groups and allows them to have a leader who coordinates and takes recordings as if they are on a Field Trip.

Each student carried out his/her assignment using the Virtual Field Trip on the topic selected.

The teacher guides the groups to come up with observations and lessons learned based on the topic in the VFT. Each student explains what they observed to the whole class from VFT.

The teacher guides their explanation and corrects any misconception

**Evaluation State**

Students were given class exercises based on the objectives of the lesson

The teacher goes around to check their note books and done corrections where necessary

The teacher gave them homework to do

**Teacher's Activities**

1. Introduces the topic to students.

2. Guides students to recall the previous topic

3. Links the students' entry behaviour with the present topic.

4. Put students in groups for proper VFT

5. Guides students on the selected topics.

6. Guides students to understand each concept displayed in VFT.

7. Evaluates the lesson by given class exercise to students.

**Students' Activities**

1. Listen to teacher's explanation

2. Choose a leader who coordinates and takes recordings

3. Work with their group members

4. Recall the previous knowledge through the guidance of teacher.

5. Follow the teacher's instructions on each selected topic on VFT.

6. Explain what they observed from the topic on the VFT.

7. Form notes for a better understanding of the concepts on VFT.

8. Ask questions.

9. Do some class exercises.

**3.4.6.4 Control Group**

This consisted of only one school. No training was conducted for the Biology teacher in this group. The teacher used the conventional method (Lecture Method) to teach the same concepts as in the two experimental groups.

**3.4.6.5 Instructional Guide for Control Group**

The teacher introduces the topic

Teacher guide students to recall their previous knowledge

The teacher explains the new concept to students.

The teacher explains the concept of Ecology with examples to the students

The teacher gives the class exercises to do

Teacher moves around to check their notes and corrections was done where necessary

The teacher gives the homework

**Teacher's Activities**

1. Introduces the topic to students.

2. Explain the concepts

3. Guides students to practice some exercise.

4. Evaluate the lesson by giving class exercises to students.

**Students' Activities**

1 Listen to the teacher's explanation

2. Ask questions.

3. Do some class exercises.

**3.4.6.6: Activities for the Experimentation**

1st week: Visitation to Schools to meet with the Principal, Biology Teacher and students and Installation of IVVS & VFT.

2nd week: Training of research assistants (Biology Teachers) and administration of pre-test (EAT and ESIS) on the participants

3rd - 7th week: Treatment (IVVS, VFT and Conventional Approach)

8th week: Administration of post-test (EAT and ESIS) on the experimental and control groups.

**Scoring of the Instruments**

The instruments were scored as follows;

Ecology Achievement Test (EAT), for every correct answer one (1) mark was awarded while every wrongly answered item was scored zero (0). This makes the total obtainable marks to be thirty (30) marks. The scoring of Ecology Situational Interest Scale (ESIS) was rated as follows; 4 - Very True of Me; 3- True of Me; 2-Untrue of Me, and 1- Very Untrue of Me. The highest score which a participant can get is 60 while the least is 15.

### 3.5: Validity of the Research Instrument

#### 3.5.1: Validity of Ecology Achievement Test (EAT)

EAT was validated by giving it to expert in the field of test and measurement to scrutinized. At the initial stage, sixty multiple-choice items with four options (A, B, C, D) were generated based on the content of the selected topics from SS11 scheme of work. The content validity of the EAT was ascertained by using a Test Blueprint covering the first three levels of Bloom's taxonomy of educational objectives (Knowledge, Comprehension and Application). The generated items were given to Biology experts and some lecturers in the faculty. After the vetting with necessary amendments, suggestions, the researcher took necessary corrections to ensure the validity of the instrument.

#### 3.5.2: Validity of Ecology Situational Interest Scale (ESIS)

ESIS contained 20 items which included items on triggered-SI and items on maintained-SI which were rated on four Likert scale: 4 - Very True of Me; 3- True of Me; 2-Untrue of Me, and 1- Very Untrue of Me. The content validity of the instrument was determined by giving it to experts (Lecturers) in field of test and measurement and lecturers in the faculty of education and to carry out the face validity in terms of clarity of language, ideas and application of finding.

### 3.6: Reliability of the Instrument

#### 3.6.1: Reliability of Ecology Achievement Test

The item was pilot-tested on SSII students from co-educational schools similar to the target samples to establish both the difficulty indices and discriminating indices of each item. Difficulty indices and discriminating indices were further ensured for the final selection of items. Thirty items with difficulty indices between 0.40 and 0.60 and discriminating indices between .030 and above were finally selected for the study. The reliability of the items was established using the Kuder Richardson 20 Formula ($KR_{20}$)

which yielded 0.72 indicating that the instrument is reliable. The field testing or pilot study was conducted in two co – co-educational schools similar to the targeted sampled schools which were not part of the study.

### 3.6.2 Reliability of Ecology Situational Interest Scale (ESIS)

To establish the reliability index of the instrument, the questionnaire was administered to 50 Biology students who were not part of the main study and Cronbach Alpha was used to obtain 0.85 reliability coefficient.

### 3.7 Administration of the Research Instrument

The research assistants were trained by the researcher and distributed to treatment. All Biology Students in the intact classes selected were exposed to Ecology Achievement Test and Ecology Situational Interest Scale at pre-test stage within the first week of the field work. Treatment was carried out for the next five weeks on the experimental and control group by the researcher and research assistants with the used of the lesson notes prepared for each group. The instrument was reshuffled and administered as post field at the eight weeks of the field work.

### 3.8 Method of Data Collection

A week before the commencement of the treatment, the following instruments; the Ecology Achievement Test (EAT) and Ecology Situational Interest Scale (ESIs) were administered to participants. Both the instruments and the participants' responses were collected immediately. This is because the same instruments were used as a post-test. After treatment, the treatment lasted for five weeks. EAT and ESIS were administered to the participants as a post-test. In the same way, the instruments were collected alongside the participants' responses.

### 3.9: Method of Data Analysis

Data collected were analyzed using frequency, percentage, and mean for the demographic data. Data generated were subjected to One Way Repeated Measure ANOVA and Analysis of Covariate (ANCOVA). The use of ANCOVA was to correct the initial differences in the dependent variable and other extraneous factors, using the pre-test scores as covariance. Sidak Post hoc test was further conducted to determine the source of the significant main effect at 0.05 levels of significance.

### 3.10 : Ethical Approval

The researcher obtained official letters of introduction from the head of the department. The letters were taken to the selected schools, after which the researcher took permission from the schools' principals through the head of department of science in each school to use the schools for the study having discussed the purpose and the modality for the study with them. Thereafter, the researcher met with the Biology teachers of the selected schools, created rapport with them, got them fully informed about the purpose and how to go about the research work. Both the researcher and the teachers agreed on the time and value for training for those who fall into experimental group 1(IVVS) and experimental group 2 (VFTS) as well as control group.

## Endnotes

1. Zonal Offices of Ogun State Teaching Service Commission, Abeokuta South, Abeokuta North and Odeda, Abeokuta Ogun State

# Chapter Four

## Results and Discussion of Findings

This chapter provided the results of data analyses and discussion of findings. The results and discussion of findings are presented based on the demographic characteristics of the participants. Seven null hypotheses were generated and tested on the dependent variable. Analysis of Covariance (ANCOVA) was adopted in this study for data analysis.

### 4.1 Demographic Data Analysis

**Table 4.1.1: Participants' Gender**

| Variable | Category | N = 202 | Frequency | Percentage |
|---|---|---|---|---|
| Gender | Male | | 106 | 52.5 |
| | Female | | 96 | 47.5 |

**Source:** Field Survey, 2025

Table 4.1 revealed the demographic variables of the respondents. From the table, it was observed that 106 of the respondents representing 52.5% were male while 96 representing 47.5% were female. This indicates that the majority of the students are male.

**Table 4.2: Participants' Age**

| Variable | Category | N = 202 | Frequency | Percentage |
|---|---|---|---|---|
| Age (Years) | 13-15yrs | | 113 | 55.9 |
| | 16-18 yrs. | | 83 | 41.1 |
| | 19yrs. & Above | | 6 | 3.0 |
| | Total | | 202 | 100.0 |

**Source:** Field Survey, 2025

Also, on the age bracket of the participants, it was observed that 113 representing 55.9% are within the age of 13-15 years, and 83 representing 41.1% are between the ages of 16-18 years. However, 6 representing 3% are 19 years and above. This implies that the majority of the students' age falls between the ages of 13-15 years.

### 4.2 Test of Hypotheses

**Hypothesis One:** There will be no significant main effect of treatment on students' academic achievement in Ecology.

**Table 4.2.1: Summary of Analysis of Covariance (ANCOVA) of Students Achievement in Ecology by Treatment (IVV, VFT, and Control), Gender and Situational Interest.**

Dependent Variable: Post-Test

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected Model | 2984.630[a] | 12 | 248.719 | 9.890 | 0.000 | 0.386 |
| Intercept | 2806.531 | 1 | 2806.531 | 111.596 | 0.000 | 0.371 |
| Pre-Test | 731.650 | 1 | 731.650 | 29.093 | 0.000 | 0.133 |
| Treatments | 2037.574 | 2 | 1018.787 | 40.510* | 0.000 | 0.300 |
| Gender | 41.627 | 1 | 41.627 | 1.655 | 0.200 | 0.009 |
| Situational Interest | 97.042 | 1 | 97.042 | 4.859* | 0.003 | 0.102 |
| Treatment Gender | 11.678 | 2 | 5.839 | 0.232 | 0.793 | 0.002 |
| Treatment Situational Interest | 25.239 | 2 | 12.619 | 0.502 | 0.606 | 0.005 |
| Gender Situational Interest | 50.197 | 1 | 50.197 | 1.996 | 0.159 | 0.010 |
| Treatment Gender Situational Interest | 69.554 | 2 | 34.777 | 1.383 | 0.253 | 0.014 |
| Error | 4753.157 | 189 | 25.149 | | | |
| Total | 84081.000 | 202 | | | | |
| Corrected Total | 7737.787 | 201 | | | | |

a. R Squared = 0.386 (Adjusted R Squared = 0.347) *=P< 0.05

Source: Field work 2025



Table 4.2.1 showed the summary of the Analysis of Covariance (ANCOVA) of students' post-test achievement scores in Ecology by treatment (IVV, VFT, and Control), Gender, and Situational Interest. The table reveals that after adjusting for the covariance, (pre-test score in EAT), the effect of treatment on students' achievement in Ecology was significant, $F_{(2,189)} = 40.510$, $p < 0.05$. Consequently, the null Hypothesis which states that there was no significant main effect of treatment on students' achievement in Ecology was therefore rejected. The table further showed that the Partial Eta Square was 0.300, which was considered to be a medium effect size. The simple implication of this is that 30% of the variance experienced in students' achievement in Ecology was accounted for

by the treatment. This means that the strategies are potent and effective in enhancing students' performance in the Ecology aspect of Biology in secondary schools.

To determine which group differs significantly among the three treatment groups, Sidak Post-hoc analysis was done. The results are presented in Tables 4.2 and 4.3.

**Table 4.2.2: Estimated Marginal Means of students' achievement in Ecology by treatments**

Dependent Variable: Post-Test

| Treatment Group | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| IVV Group | 22.992[a] | 1.003 | 21.015 | 24.970 |
| VFT Group | 22.346[a] | 0.620 | 21.123 | 23.568 |
| Control Group | 15.597[a] | 0.563 | 14.485 | 16.708 |

a. Covariates appearing in the model are evaluated at the following values: Pre-Test = 11.68.

**Table: 4.2.3: Pairwise Comparison of students' achievement in Ecology by treatment**

Dependent Variable: Post-Test

| (I) Treatment Group | (J) Treatment Group | Mean Difference (I-J) | Std. Error | Sig.[b] | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| IVV Group | VFT Group | 0.647 | 1.181 | 0.928 | -2.197 | 3.491 |
| | Control Group | 7.395* | 1.150 | 0.000 | 4.625 | 10.166 |
| VFT Group | IVV Group | -0.647 | 1.181 | 0.928 | -3.491 | 2.197 |
| | Control Group | 6.749* | 0.838 | 0.000 | 4.731 | 8.767 |
| Control Group | IVV Group | -7.395* | 1.150 | 0.000 | -10.166 | -4.625 |
| | VFT Group | -6.749* | 0.838 | 0.000 | -8.767 | -4.731 |

Based on estimated marginal means

*. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Sidak.

Table 4.2.2 further revealed that experimental Group I (IVV group) has the highest mean score of ($\overline{X}$= 22.99) followed by participants in experimental Group II (VFT group) with a mean score of ($\overline{X}$= 22.35). In contrast, the control group has the lowest mean score of ($X$= 15.59).

Table 4.2.3 confirmed that the difference between the two Experimental groups (IVV and VFT Group) and the Control Group was statistically significant. The estimated marginal mean scores are further shown in Figure 4.1 at the appendix section.

**Hypothesis Two:** There will be no significant main effect of gender on students' academic achievement in Ecology.

Table 4.2.1 shows that there is no significant main effect of Gender on students' Achievement in Ecology, $F_{(1,189)} = 1.655$, $p > 0.05$. Therefore, the stated null hypothesis that there is no significant main effect of Gender on students' Achievement in the Ecology aspect of Biology was not rejected. The estimated marginal means in figure 4.2 (see appendix xxv) show that female participants with high academic achievement in the Ecology aspect of Biology ($\overline{X}$= 20.88) than male participants with low achievement mean scores in the Ecology ($\overline{X}$= 19.75). The pairwise comparisons of the mean score in Table 4.6.show a mean difference of 1.128 between Male students and their female counterparts which was not statistically significant.



**Table: 4.2.4: Pairwise Comparisons of students' achievement in Ecology by gender**

Dependent Variable: Post-Test

| (I) Gender of the Participant | (J) Gender of the Participant | Mean Difference (I-J) | Std. Error | Sig.[a] | 95% Confidence Interval for Difference[a] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| Male | Female | -1.128 | 0.876 | 0.200 | -2.857 | 0.601 |
| Female | Male | 1.128 | 0.876 | 0.200 | -0.601 | 2.857 |

Based on estimated marginal means

a. Adjustment for multiple comparisons: Sidak.

**Hypothesis Three:** There will be no significant main effect of situational interest on students' academic achievement in Ecology

Table 4.2.1 showed that there was a significant main effect of situation interest on students' academic achievement in the Ecology aspect of Biology $F_{(1,189)} = 4.859$, $p < 0.05$.

As a result of this, the null hypothesis was rejected. The table further showed that the partial Eta square ($\eta^2$) was 0.150, though a low effect size but statistically significant. This implies that the students' situational interest accounted for 15% of the variance experienced in academic achievement in the Ecology aspect of Biology. The estimated marginal means in Figure 4.2 shows that students with low situational interest had higher performance in the Ecology aspect of Biology ($\overline{X}$ = 21.166) than students with high situational interest ($\overline{X}$= 19.457) performance in the Ecology aspect of Biology. The mean difference of 1.710 was observed between the two groups and it was statistically significant.

**Table: 4.2.5: Pairwise Comparisons of students' achievement in Ecology by Situational Interest**

Dependent Variable: Post-Test

| (I) SI | (J) SI | Mean Difference (I-J) | Std. Error | Sig.[a] | 95% Confidence Interval for Difference[a] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| Low | High | 1.710 | 0.870 | 0.003 | -0.007 | 3.426 |
| High | Low | -1.710 | 0.870 | 0.003 | -3.426 | 0.007 |

Based on estimated marginal means

a. Adjustment for multiple comparisons: Sidak

**Hypothesis Four:** There will be no significant interaction effect of treatment and gender on students' academic achievement in Ecology.

Table 4.2. shows that the interaction effect of treatment and gender on students' post–test academic achievement in Ecology was not statistically significant at $F_{(1, 189)}$ =0.232 p> 0.05. The null hypothesis which states that there will be no interaction effect of treatment and gender on academic achievement in Ecology was therefore accepted. The partial Eta square, ($\eta^2$) = 0.002, confirms that there was no effect size. Table 4.5 shows the Estimated Marginal Means of students' academic achievement in Ecology by treatment and Gender, with the highest mean of 23. 287 were recorded by female students in the

Experimental groups while male students in the Control group recorded the least mean of 15.028.

**Table 4.2.6: Estimated Marginal Means of Students' post-test academic achievement in Ecology by treatment and Gender**

Dependent Variable: Post-Test

| Treatment Group | Gender of the Participants | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| IVV Group | Male | 22.812[a] | 1.627 | 19.602 | 26.021 |
| | Female | 23.173[a] | 1.163 | 20.880 | 25.466 |
| VFT Group | Male | 21.404[a] | 0.779 | 19.867 | 22.940 |
| | Female | 23.287[a] | 0.969 | 21.375 | 25.200 |
| Control Group | Male | 15.028[a] | 0.791 | 13.467 | 16.588 |
| | Female | 16.166[a] | 0.808 | 14.572 | 17.760 |

a. Covariates appearing in the model are evaluated at the following values: Pre-Test = 11.68.

**Hypothesis Five:** There will be no significant interaction effect of treatment and situational interest on students' academic achievement in Ecology'

As shown in Table 4.2.1, there was no significant interaction effect of treatment and level of situational interest on students' achievement in Ecology in Biology in secondary schools in Abeokuta metropolis $F_{(1,189)} = 0.502$, $p > 0.05$. The null hypothesis was therefore accepted.

**Table 4. 2.7: Estimated Marginal Means of Students' post-test academic achievement in Ecology by treatment and Situational Interest**

Dependent Variable: Post-Test

| Treatment Group | Situational Interest | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| IVV Group | Low | 24.321[a] | 1.741 | 20.887 | 27.755 |
| | High | 21.664[a] | 0.987 | 19.716 | 23.611 |
| VFT Group | Low | 23.272[a] | 1.058 | 21.186 | 25.358 |
| | High | 21.419[a] | 0.650 | 20.137 | 22.701 |
| Control Group | Low | 15.906[a] | 0.818 | 14.292 | 17.520 |
| | High | 15.288[a] | 0.775 | 13.758 | 16.817 |

a. Covariates appearing in the model are evaluated at the following values: Pre-Test = 11.68.

**Hypothesis Six:** There will be no significant interaction effect of gender and situational interest on students' academic achievement in Ecology.

From table 4.2.1 revealed that there was no interaction effect of Gender and situational interest on students' academic achievement in Ecology ($F_{(1,189)} = 1.996$, $p > 0.05$, The null hypothesis was therefore accepted.

**Table 4.2.8: Estimated Marginal Means of Students' Achievement in Ecology by gender and Level of Situational Interest.**

Dependent Variable: Post-Test

| Gender of the Participants | Situational Interest | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| Male | Low | 19.989[a] | 1.138 | 17.745 | 22.234 |
| | High | 19.506[a] | 0.658 | 18.209 | 20.804 |
| Female | Low | 22.343[a] | 0.918 | 20.532 | 24.155 |
| | High | 19.407[a] | 0.682 | 18.062 | 20.753 |

a. Covariates appearing in the model are evaluated at the following values: Pre-Test = 11.68.

**Hypothesis Seven:** There will be no significant interaction of treatment, gender, and situational interest on student academic achievement in Ecology.

Table 4.2.1 showed that the interaction effect of treatment, gender and situational interest, on student academic achievement in Ecology was not significant $F_{(2, 189)} = 1.383$, $p > 0.05$. The null hypothesis was therefore accepted. The partial Eta square, $(\eta^{2)} = 0.014$ is an indication of low effect size.

### 4.3 Discussion of Findings

**Main Effect of Treatment (Interactive Video Variation (IVV), Virtual Field Trips Strategy and Control) on Students' Achievement in the Ecology aspect of Biology**

The current research findings revealed that after adjusting for the covariance (pre-test in EAT) the effect of treatment on IVV, VFT, and Control was statistically significant ($F_{(2,189)} = 40.510$, $p < 0.05$). The findings further revealed that experimental Group I (IVV group)

has the highest mean score of ($\overline{X}$ = 22.99) followed by participants in experimental Group II (VFT group) with a mean score of ($\overline{X}$= 22.35). In contrast, the control group has the lowest mean score of ($X$= 15.59). Therefore, confirming that the difference between the experimental groups and the control group was significant. The simple implication of this is that 30% of the variance experienced in students' achievement in Ecology was accounted for by the treatment. This means that the strategies are potent and effective in enhancing students' performance in the Ecology aspect of Biology in secondary schools. The substantial difference between the pre-test and post-test for an experimental group indicated that the students better comprehended the concepts. By assisting students in better understanding concepts being taught and allowing low achievers to learn at their own pace. The findings are in line with research that was conducted on Edpuzzle Learning Videos for Chemistry which helped students develop self-regulated learning abilities[1]. The features such as embedded questions in Edpuzzle Learning Videos were responsible for students' engagement with learning, thus it improves the students' engagement with content[2]. It is also in line with research on use of video and cartoon concepts in which the academic achievement the students that were exposed to the treatment increased significantly[3]. In addition, another research indicated a significant difference in the performance of Biology students taught the concept of Genetics using Video Instructional Strategy and those taught using Instructional charts and Diagrams. This significant difference is attributed to the fact that the use of video encouraged the students to learn at their own pace, especially the slow learners. Video Instructional Strategy as a self-learning technique helped the students to use the audio-visual property of the video to gain a deeper understanding of the concept which was considered to be abstract and difficult. The students in the experimental group were able to comprehend the concept of Genetics better than the students in the control group because they could

see it being played out in front of them. This implies that Video Instructional Strategy improves students' academic performance more than the use of Instructional Diagram [5.] While the experimental groups and the control group were the same at first, after implementation, there was a significant difference in favour of the experimental group. This further agree with research findings on effects video instructional package on secondary school students' achievement in Biology in Makurdi metropolis which findings recorded a significance difference in the achievement of student taught with video instructional package and those taught with lecture method[5]. The finding corroborated earlier findings on effectiveness of multimedia learning packages in secondary school Biology which reported that multimedia packages used in teaching and learning Biology enhanced better student engagement and positive attitudes toward learning[6].

More so, the findings of this study corroborated with the study that investigated the effectiveness of an interactive instructional film in improving academic performance in geography for sixth-grade students enrolled in schools located in Madaba Governorate. The results revealed that there were significant differences at a significance level of $\alpha \leq 0.05$ between the two groups, with the experimental group exhibiting better outcomes in the post-test[7]. The research findings provided evidence for the effectiveness of incorporating interactive films as a strategy to improve academic Performance [7].

The findings are in consonant with another research on the Effects of Interactive Instructional Television on Students' Academic Achievement in Social Studies, Zaria Quality Assurance Zone, Kaduna State, Nigeria. The design of the study was the pre-test post-test non-equivalent comparison group design. The study population consisted of 31,001 junior secondary school students in the Zaria Quality Assurance Zone, Kaduna State, Nigeria. The study found significant differences between the mean academic achievement scores of students taught Social Studies using interactive instructional

television and those taught with conventional lecture methods. Educational technology currently assumes a significant and foundational role in the educational domain, facilitating the enhancement of students' cognitive, psycho-emotional, social, and motor proficiencies[8].

However, the result of this study is contrary to the study which indicated that interactive video and virtual field trip instructional packages had adverse effects on the academic achievement of students [9].

**Main Effect of Treatment (Interactive Video Variation (IVV) and Control) on Students' Achievement in the Ecology aspect of Biology**

The findings reveal that after adjusting for the covariance, (pre-test in EAT), the effect of Interactive Video Variation on students' achievement in the Ecology aspect of Biology was statistically significant, $F_{(1,108)} = 36.504$, $p < 0.05$. Consequently, the null hypothesis which stated that there was no significant main effect of the Interactive Video Variation (IVV) Strategy on students' academic achievement in Ecology was therefore rejected. The 25.3% variance experienced in students' achievement in Ecology was accounted for by the treatment (Interactive Video Variation (IVV) Strategy). Also, the findings further reveal that the Experimental Group Interactive Video Variation (IVV) Strategy has the highest mean score $\bar{x} = 22.737$ followed by participants in the Control Group (Control) with the mean score $\bar{x} = 15.521$. The results confirmed that the difference between the experimental group and the Control Group was statistically significant.

This finding corroborates the study on the effect of video instructional package (VIP) on secondary school students' academic achievement in Biology in Makurdi metropolis, Benue state Nigeria by a group of scholars. The findings revealed that there was a significant difference in the achievement of students taught Biology VIP and those taught with lecture method[4]. Another study examined the effects of video-based instructional packages on the achievement of secondary school Biology students in Suleja, Niger state,

Nigeria the effectiveness of video-based instructional packages on Biology students' achievement in mammalian skeletal, osmosis, and diffusion. The findings of the study revealed that video-based instructional packages improved students' achievement in Biology[10]. The findings from this study support recent research conducted on the effectiveness of multimedia learning packages in enhancing secondary school students' attitudes toward Biology in Ile-Ife Osun state, Nigeria, employing a quantitative and qualitative research approach. The results revealed that multimedia instructional packages used in teaching and learning Biology in secondary schools enhanced students' engagement and positive attitudes toward learning[6].

The interactive nature of IVV allows students to explore relationships, make conjectures about their properties, and test those conjectures in Ecology thereby enhancing achievement in Biology. This finding aligned with the study on the effect of Video Instructional strategy on Biology Students' academic performance in Port Harcourt, Rivers State. The result revealed that the experimental group obtained a higher mean performance score and no significant difference existed between location and academic performance[11].

Another study investigated the effectiveness of interactive video in the achievement of Geography for sixth grades in Madaba Government schools, the results of the study showed that there were significant differences between the experimental and control groups. The study detected the effectiveness of interactive video in increasing academic achievement in geography[7]. Likewise, research conducted by a group of scholars on the effect of interactive video on social studies learning motivation for fifth grade at SDN, concluded that there was an influence of the use of interactive video media on social studies learning motivation for class V SDN Kaliwungu[12].

More so, the finding from this study is in consonant to similar study in Kenya conducted in Chemistry which is somehow closely related to the current study. The study investigated the effect of Computer-Aided Instruction (CAI) on students' achievement in Atomic Structure Periodic Table and Chemical Families as against the use of the conventional instructional method (CIM). It was found that the students who were taught with the CAI obtained higher scores. .

It was observed that studying science using a variation of video clips had various advantages over lecture-based methods, and as a consequence, it offered the following set of criteria: a video should address misconceptions[13]. Interactive video variation clips accelerate students to become active learners, proving it to be better than passive learning. Student taught science with multimedia learning videos variation learning faster and obtained better scores than those taught only with textbooks [14]. Leaning through Videos had demonstrated to be more effective than traditional methods of teaching and learning[15]. This finding is therefore in line with the results of some similar previous studies which reveled that leaning with multimedia techniques has positive consequences on learners' academic achievement compared to the traditional strategy, and that multimedia enhances students learning interest and efficiency [6].

**Main Effect of Treatment (Virtual Field Trips Strategy and Control) on Students' Achievement in the Ecology aspect of Biology.**

The test of hypothesis reveals that after adjusting for the covariance, (pre-test score in EAT), the effect of treatment on students' achievement in the Ecology aspect of Biology was significant, $F_{(1, 157)} = 62.511$, $p < 0.05$. The simple implication is that 28.5% of the variance experienced in students' achievement in the Ecology aspect of Biology was accounted for by the treatment (virtual field trips strategy). Findings further revealed that the Experimental group (Virtual Field Trips Strategy) has the highest mean score of ($\overline{X}$= 22.430). In contrast, the control group has the lowest mean score of ($\overline{X}$= 15.685). The

results confirmed that the difference between the Experimental group (virtual field trips strategy) and the Control Group was significant.

Proper and effectual use of VFT will enhance students' achievement and aid in good retention of what they have gained in the classroom. It is a way of impacting students' learning experiences in the universe which enables learners to understand the importance of what has been learned while boosting their knowledge and motivating them to learn[16, 17]. In relation to this finding, if teaching and learning through field trip is properly and effectively done, it will afford students opportunity to become actively engaged in scientific process, manipulating object, have deep understanding of certain concepts and phenomena[18]. In addition, the current findings support the study carried out on the effects of computer simulation and field trip instructional strategies on students' achievement and interest in Ecology in Plateau Central Education Zone. The results of the study indicated that the use of computer simulation and field trip instructional strategies enhanced students' interest and achievement in Ecology[19].

It is also in line with a study on the effectiveness of a Virtual Field Trip (VFT) module in learning Biology at the University of Malaysia Kamisah OSAMAN Faculty Of Education whose results showed significant differences between students taught using VFT and students who were taught using conventional methods for objective, structure, and essay-type questions. The study concluded that teaching and learning by using the VFT module, integrated with ICT, has a positive impact on student achievement when compared to conventional methods[20]. This present study also agrees with a study on the effect of a Field Trip teaching strategy on senior secondary one (SS1) students' achievement in Ecology in Anambra state which reveals that the use of field trips (FTIS) is more effective in enhancing students' achievement in Ecology than the conventional lecture method (CLM). Also, there was no significant difference in the students' achievement in Ecology

due to gender[21]. It also corroborates with a recent study which examined the effect of field trip instructional strategy on students' interest and achievement in Ecology in Nasarawa State, Nigeria whose findings revealed that a significant difference existed in the interest and achievement of students taught Ecology concepts using Field Trip instructional strategy and conventional method[22]. The result of the present study equally falls in line with another study on effect of two modes of field trip method on students' achievement in Ecology in Nsukka which showed that students in virtual field trip group have higher achievement in Ecology compare with those in real field trip group[23]. This is also supported by other studies, which affirmed that the field trip strategy used in teaching and learning promotes and encourages active engagement in learning, self-motivation, discovery learning, and learning by experience[13,18].

Students' demographics play a key role in determining the effectiveness of the instructional package. Especially, gender has featured prominently in most studies either as an independent or intervening variable. This study also investigated how gender influences students' achievement scores in Ecology in both control and experimental groups. On the main effect of Gender on students' achievement in the Ecology aspect of Biology, it was discovered that the effect was not statistically significant. Female participants had higher academic achievement in the Ecology achievement ($\overline{X}$ = 20.88) than male participants with low achievement mean scores in Ecology ($\overline{X}$ = 19.75). The pairwise comparisons of the mean score indicated a mean difference of 1.128 between Male students and their female counterparts which was not statistically significant. This means that the student's scores in the post-test in EAT after adjusting for a covariate (pre-test score), were irrespective of their sexes. This may be associated with the fact that both male and female were exposed to the same instructional strategies. Hence, they tend to benefit the same way.

The finding is in line with the study conducted on effect of two modes of field trip in Nsukka where gender has no significant effect on student achievement in Ecology[23]. This present study is in agreement with a study conducted by a group of researchers in which no significant difference was recorded among the gender[24]. In like manner, it corroborates with the findings of a recent study on effect of predict- observe- explain and virtual laboratory strategies on secondary school physics students' attitude and achievement in simple harmonic motion which found no significant interaction effect of predict-observe-explain and gender on academic achievement of student in simple harmonic motion. This was corroborated by the findings that there was no significant difference in students" achievement in Biology[26].

In addition, the findings aligned with previous research conducted in Biology where the tenth grade Biology student that were taught with simulated experiment revealed that there was no gender difference in their academic achievement[27]. This present study also agrees with a study cross river where gender have no significance effect on academic achievement and retention in Basic science[28].

The finding was however contrary to the views of other researchers who found a significant gender differences in the academic achievement between male and female students[29]. It also disagrees with another study on gender differences in academic performance of Students studying Science Technology Engineering and Mathematics (STEM) subject at the university of Ghana which revealed that male performed better than females, and the study further reported that gender stereotypes added to a great extent to differences in academic achievement in higher institution[30]. While some researchers found significant differences between male and female students' achievement in science in general and Biology in particular, others found no difference in their achievement in the same subjects. Also, this finding contradicts those who found gender

differences in the academic achievement of undergraduate students they studied, where their male participants performed significantly better than the female participants in all learning tasks, regardless of the type of multimedia used [31].

The findings revealed that the main effect level of situational interest, on students' achievement in the Ecology aspect of Biology was statistically significant ($F_{(1,189)} = 4.859$, $p < 0.05$). This implies that the students' situational interest accounted for 15% of the variance experienced in academic achievement in the Ecology aspect of Biology. The estimated marginal means further show that students with low situational interest had higher performance in the Ecology aspect of Biology ($\overline{X} = 21.166$) than students with high situational interest ($\overline{X} = 19.457$) performance in the Ecology aspect of Biology. The mean difference of 1.710 was observed between the two groups and the mean difference was statistically significant, meaning that the students' levels of situational interest had a significant influence on achievement in the Ecology aspect of Biology. The findings are a testament that situational interest can influence students' levels of learning, their academic achievement, and the quality of their learning experience. This finding is in line with a study on the effects of computer simulation and field trip instructional strategies on students' achievement and interest in Ecology in Plateau Central Education Zone, which the results indicated that the use of computer simulation and field trip instructional strategies enhanced students' interest and achievement in Ecology[19].

Another researcher worked on student achievement and interest and it was recorded that interest powerfully influences our academic and professional choices. The results of the study indicated that the use of computer simulation and field trip instructional strategies enhanced students' interest and achievement in Ecology[12, 32]. A researcher conducted a study on students' interest and academic performance in history in secondary schools in Ikom local government area. The result showed that students' interest in history

significantly influenced their performance in the subject[33]. Meanwhile, the findings negate the study of other researchers one of which said that necessity of interest in learning does not only mean that someone is interested in learning about something[8]. It also means that when someone is interested in something, it becomes easy and enjoyable to learn about that topic. Students' interests do not emerge authentically at all times from their investigation of the world [34, 35].

In addition, the findings support previous studies on interest and how it relates to students' achievement. They found that middle school students' interest in geology increased due to their situational interest being activated through the use of Slowmotion, an app students use to create stop-motion videos[36]. The increase in interest follows previous research on the use of augmented reality technology to support student interest in astronomy [37]. Though this study does not use augmented reality, the findings from that study suggest the students who engaged in the augmented reality lessons increased their astronomy interest and achievement compared to students who didn't receive the intervention[37]. This supports the use of technology in meaningful ways to increase students' situational interest in learning the Ecology aspect of Biology.

Furthermore, results on interaction effect of gender on students' academic acheiievement showed that the interaction effect of treatment and gender on students' achievement in the Ecology aspect of Biology was not statistically significant. The Estimated Marginal Means of students' academic achievement in Ecology by treatment and Gender, with the highest mean of 23. 287 were recorded by female students in the Experimental groups while male students in the Control group recorded the least mean of 15.028. The finding also revealed that the interaction effect of treatment and gender on students' achievement in the Ecology aspect of Biology was not statistically significant. This implies that the effect of the teaching strategy was consistent across genders. This finding agrees with

other researchers who reported that no gender differences in learning strategy and students' achievement in secondary school Biology [38]. The findings of this study lend credence to other studies in Biology, basic science, and chemistry that compared conventional methods with video instructional package, scaffolding strategy, instructional simulation, self-regulated learning strategy, and multiple intelligence-based instructional strategy respectively that reported a non-significant interaction effect of instructional strategies and gender on students" achievement [25, 27, 1, 38] . However, it contradicts previous studies that reported that gender had a significant difference in academic achievement in Biology [40, 11].

On the other hand, there was no significant interaction effect of treatment and level of situational interest on students' achievement in the Ecology aspect of Biology ($F_{(1,189)} = 0.502$, $p > 0.05$). That is, the academic achievement in the Ecology was not jointly affected by the instructional approach (IVV, VFT) employed and their level of situational interest. In many research studies, interest has been found to provide no significant effect on achievement in Biology in school. This was also supported by previous study that affirmed that ICT-based instruction promotes student-centered learning. It was further explained that it focuses on students' needs, abilities, interests, and learning styles with the teacher as a facilitator of learning. According to the relevant research on interest generally presents conflicting conclusions on the relationship between environmental stimuli, individual interest, situational interest, and learning performance [25]. However, a recent study showed that individual interest did not directly affect learning performance [42].

In addition, the findings revealed that there was no significant interaction effect of gender and level of situational interest on students' achievement in the Ecology aspect of Biology ($F_{(1,189)} = 1.996$, $p > 0.05$). This simply infers that the interaction of the student's gender and level of situational interest is inconsequential in enhancing their academic

achievement in Ecology. It is expected that gender and level of situational interest should jointly propel the students' achievement in Ecology since both gender and interest are considered as positive reinforcement and motivation which quickens students' curiosity and urge for further learning [43]. However, in support of the findings of the current study, a previous study observed that gender had no significant influence on students' interest in English grammar. In another development, another study found gender differences in pedagogic and didactic interest in favour of female student teachers [44].

Finally, results showed that the three-way interaction effect of treatment, gender, and situational interest, on students' achievement in the Ecology aspect of Biology was not significant ($F_{(2, 189)} = 1.383$, $p > 0.05$). By implication, it is evident from the current study that the three variables combined cannot influence students' achievement in the Ecology aspect of Biology and the fact that both male and female were given equal treatment may account for this result. This corroborates findings from previous studies on the interactive effect of treatments, gender, and situational interest on students' achievement in a science-related subject [20, 45, 46,].

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# Chapter Five

# Conclusion

This chapter presents the summary of the findings in this study, the conclusion as well as the recommendations and suggestions for further study.

## 5.1 Summary of Findings

This study examines effects of Interactive Video Variation and Virtual Field Trips Strategies on Biology student achievement in Ecology in Abeokuta Metropolis, Ogun State.

There was a significant main effect of treatment (IVV, VFT, and Control Method) on students' academic achievement in Ecology aspect of Biology $F_{(2,189)} = 40.510$, $p < 0.05$.

There was no significant main effect of Gender (Male and Female) on students' academic achievement in Ecology aspect of Biology. There was a significant main effect of level of situational interest (High and Low) on students' academic achievement in the Ecology aspect of Biology ($F_{(1,189)} = 4.859$, $p < 0.05$). There was no significant interaction effect of treatments (IVV and VFT) and gender on students' academic achievement in the Ecology in Biology ($F._{(1,189)} = 0.232$, $p = 0.793, > 0.05$)

There was no significant interaction effects of treatments (IVV and VFT) and level of situational interest on students' achievement in the Ecology aspect of Biology ($F_{(1,189)} = 0.502$, $p > 0.05$). There was no significant interaction effect of Gender and level of

situational interest on students' achievement in the Ecology aspect of Biology ($F_{(1,189)} = 1.996$, $p > 0.05$). There was no significant three-way interaction effect of treatment, gender and situational interest, on students' achievement in the Ecology of Biology significant ($F_{(2, 189)} = 1.383$ , $p > 0.05$).

**5.2 Conclusion**

The main inference draw from the study is that the treatment (Interactive Video Variation and Virtual Field Trips) positively influenced students' Learning outcomes in the Ecology aspect of Biology. Interactive Video Variation significantly enhances students' understanding and retention of ecological concepts. Also, Virtual Field Trips improve students' spatial awareness and ability to apply ecological principles to real-world scenario. Combining Interactive Video Variation and Virtual Field Trips yielded the most substantial improvements in students' achievement in the Ecology aspect of Biology. These findings suggest that incorporating interactive and immersive technologies can increase students' engagement, interest and motivation. Enhance depth knowledge, understanding, develop critical thinking and problem-solving skills. It could be concluded therefore that when appropriate instructional strategy is well implemented the students learning outcomes could be enhanced. It was also discovered from this study that full integration of modern technology into our educational system will be more beneficial to the educational system. Also from the study, it was concluded that situational interest has an influence on students' achievement in Ecology. Lastly, Gender difference was not a barrier in this study. No significant main effect of gender was recorded on students' achievement in the Ecology aspect of Biology. It is a clear indication that an appropriate instructional strategy is capable of neutralizing gender effect.

**5.3 Recommendations**

Recommendation was made based on the findings of this study that:

1. Biology teachers need to be dynamic in the adoption of instructional strategy and see the need to embrace constructivism approach to teaching most especially IVV and VFT as this will not only enhance students' achievement but also foster retention since the treatment is significant.

2. Teachers need to maximize the advantages of technology such as the use of Interactive Videos to ease their lesson deliveries, promote learning and Virtual Field Trips in teaching Ecology where physical Field Trip is not possible for money, fear of kidnapping accident and others in place of the lecture method.

3. Teachers should adopt appropriate instructional strategy that is capable of neutralizing gender effect as it was clearly indicated in the study that gender difference was not a barrier in this study.

4. Teachers should always adopt instructional strategies that can increase students' interest to learn since situational interest has an influence on students' achievement and students" should fully involved in the instructional activities that will enhance their engagement, interest and motivation in Ecology learning and other aspect of Biology.

5. Curriculum planners, policy makers should lay more emphasis on the need to embrace a constructivism approach to teaching and learning Biology. Government should invest more in educational technology infrastructure and develop policy to support innovative teaching methods among the teacher especially Biology teachers and educational administrators should inculcate the use of digital Video instructional strategies in teaching of science subjects.

6. Government should provide adequate training through workshops and seminar to serving teachers so as to equip them with relevant and up to date knowledge about innovative instructional approaches to teaching in discharging their duties.

7. Both students and teachers should be allowed more access to computer room as this will afford them the opportunity to use the facilities for the teaching of other subjects like Biology and not only for computer study.

**5.4 Contribution to Knowledge**

It was established from this study that Interactive Video Variation (IVV) and Virtual Field Trips (VFT) are capable of boosting students' achievement in Ecology as well as enhancing their retention ability in Biology. The findings of this study expose the importance and effectiveness of IVV and VFT in enhancing students' achievement in Ecology aspect of Biology, Meanwhile, the advantages of modern innovative technology in education is not hidden, but from the inferences drawn from this study, teachers and school administrators see the need to maximized the greatest advantages embedded in modern technology not only to improve students' achievement but also to easy their instructional delivery. Also, the importance and the influence of situational interest on students' achievement have been empirically established. The result of this research work will add to the body of knowledge and existing literature when published. The findings of this study will serve as eye openers to school administrators to maximize the benefit embedded in the use of modern technology in our educational system. The result of this research work will help the curriculum planners to recommend the use of Interactive Video Variation and Virtual Field Trips strategies for Biology teaching in schools.



**5.5 Suggested Areas for Further Research**

1. A similar study can be carried out at the lower class using these strategies
2. Other researchers can use these strategies for other subject aside Biology.
3. This study can be extended to students in private schools in other to confirm whether the same result will be generated.

4. The study can be replicated in other part of the country for more empirical fact about the effectiveness of the instructional strategies adopted.



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**Statistical Data**

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**Appendix I**

**Ecology Achievement Test (EAT) Pre-Test.**

**Name of School:** _____

**Class:** _____ **Gender:** _____ **Age:** _____

**Instruction: Answer all questions by ticking the correct option.**

1. A plant that grows in a situation that is neither too wet nor too dry is likely to be
   (a) Xerophyte
   (b) Mesophyte
   (c) Hydrophyte
   (d) Epiphyte
2. All are examples of xerophytes except
   (a). cactus
   (b). Aloe vera
   (c). Water lilly
   (d). Pine
3. A mango tree or plant is an example of

(a). Hydrophyte

(b). Epiphyte

(c). Xerophyte

(d). Mesophyte

4. A plant that remains permanently in water or submerged and completes its life cycle in water is

(a). Hydrophyte

(b). Halophyte

(c). Mesophyte

(d). Xerophyte

5. Which of the following physical factors is likely to affect the distribution of plants in a pond?

(a). Light

(b). Humidity

(c). Wind

(d). Temperature

6. If a pond contains waterweed, tadpoles, tap minnows (fish) and is visited after by Herons (birds). What would be the possible food chain?

(a). Waterweed → Tap-minnows → Heron → Tadpole

(b). Waterweed → Tadpole → Tap-minnows → Heron

(c). Waterweed → Heron → Tap-minnows → Tadpole

(d). None of the above.

7. In the marine food web, the sources of energy to the producer come from

(a). Seawaves

(b). Seawater

(c). Sun

(d). Air

8. A habitat with low rainfall, very low humidity, and exposed soil is likely to be

(a). A rainforest

(b). A Swamp

(c). A desert

(d). A mangrove

9. Ghost flower is found at the _____ strata of the forest

(a). Lower layer

(b). Ground layer

(c). Emergent layer

(d). Canopy layer

10. The first organism to grow in a new ecosystem is called

(a). Climax species

(b). Secondary species

(c). Pioneer species

(d). Consumer

11. Fire, flood, deforestation and hurricanes result in

(a). Primary succession

(b). Limax

(c). Pioneer

(d). Secondary succession

12. Organisms in the pond include all except

(a). Back swimmers

(b). Crayfish

(c). Water boatman

(d). Mite

13. A climax community is characterized by

(a). A stable composition of plant

(b). Rapid change in the composition of species

(c). Constant changes in the appearance of the species

(d). Gradual change in annual population

14. If a piece of abandoned farmland went through a series of floral and faunal changes and became established with a permanent plant and animal production it could be said to have undergone

(a). Evolution

(b). Competition

(c). Succession

(d). Transformation

15. Which of the following is not an outcome of ecological succession?

(a). There is a progressive change in species structure, organic matter and energy flow

(b). The climax stage consists of a comparatively long-lasting species composition

(c) There is no dynamic equilibrium

(d) Communities occurring later in the sequence of succession are more complex.

16. Which of these factors are common to both aquatic and terrestrial habitats?

(a). Light, rainfall, turbidity

(b). Light, temperature, tide

(c). Light, rainfall, temperature

(d). Rainfall, turbidity, salinity

17. Plants with breathing roots are characteristic features of vegetation in

(a). Tropical grassland

(b). Temperature grassland

(c). Saltwater

(d). Tropical rainforest

18. A space containing a group of interactive organisms is called

(a). Community

(b). Habitat

(c). Ecosystem

(d). Population

19. Which of the following features is not an adaptation of plants to aquatic habitat?

(a). Breathing roots for entry of air

(b). Flower raised above water for Pollination

(c). Spongy tissues containing gasses for buoyancy

(d). Hairy structure on the leaves to reduce water loss.

20. A xerophyte conserves water by possession of the following except

(a). Thick cuticle

(b). Sunker stomata

(c). Broad leaves

(d). Flesh stem

21. A good secondary succession would be

(a). A sand dune

(b). A bare rock

(c) a land that has just had a forest fire

(d). A stretch of barren land

22. In ecological succession, since lichens grow on a bare rock, they are considered to be a

(a) climax

(b). Consumer

(c). Pioneer

(d). Secondary consumer

23. The following habitat can be used in the study of succession except

(a). Savanna grassland

(b). Pond

(c). Abandoned farmland

(d). A well cultivated land

24. Tiger, Lion, Zebra can be found in

(a) Tropical rainforest

(b). Savanna

(c). Desert

(d). Marine

25. How are Savanna plants protected from bush fires?

(a). Have sunker stomata

(b). Roll their leaves during hit days

(c). Have thick barks

(d). She'd their leaves gradually throughout the year

26. In forest Ecology, the activities of one of the following organism with tree provides shelter for other organisms

(a). Hawk

(b). Owl

(c). Woodpecker

(d). Fungi

27. The transition between a river and a sea is called

(a). Pond

(b). Lotic water

(c). Estuary

(d). Marine

28. Which if the following is not a general characteristic of grassland habitat

(a). Broad leaves

(b). Intensive sunlight

(c). Low humidity

(d). Fire resistant trees

29. The forest roof is called

(a). Emergent

(b). Middle layer

(c). Lower layer

(d). Canopy layer

30. There are ____ strata in the forest

(a). 7

(b). 5

(c). 4

(d). 6.

## Appendix II

## Marking Guide for Ecology Achievement Test (EAT) Pre-Test

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

**Appendix III**

**Ecology Achievement Test (EAT) Post-Test**

**Name of School:** _____

**Class:** _____ **Gender:** _____ **Age:** _____

**Instruction: Answer all questions by ticking the correct option.**

1. A plant that grows in a situation that is neither too wet nor too dry is likely to be
   (a) Xerophyte
   (b) Mesophyte
   (c) Hydrophyte
   (d) Epiphyte
2. All are examples of xerophytes except
   (a). cactus
   (b). Aloe vera
   (c). Water lilly
   (d). Pine
3. A mango tree or plant is an example of
   (a). Hydrophyte
   (b). Epiphyte
   (c). Xerophyte
   (d). Mesophyte
4. A plant that remains permanently in water or submerged and completes its life cycle in water is
   (a). Hydrophyte
   (b). Halophyte
   (c). Mesophyte
   (d). Xerophyte
5. Which of the following physical factors is likely to affect the distribution of plants in a pond?
   (a). Light
   (b). Humidity
   (c). Wind
   (d). Temperature

6. If a pond contains waterweed, tadpoles, tap minnows (fish) and is visited after by Herons (birds). What would be the possible food chain?
   (a). Waterweed → Tap-minnows → Heron → Tadpole
   (b). Waterweed → Tadpole → Tap-minnows → Heron
   (c). Waterweed → Heron → Tap-minnows → Tadpole
   (d). None of the above.
7. In the marine food web, the sources of energy to the producer come from
   (a). Seawaves
   (b). Seawater
   (c). Sun
   (d). Air
8. A habitat with low rainfall, very low humidity, and exposed soil is likely to be
   (a). A rainforest
   (b). A Swamp
   (c). A desert
   (d). A mangrove
9. Ghost flower is found at the _____ strata of the forest
   (a). Lower layer
   (b). Ground layer
   (c). Emergent layer
   (d). Canopy layer
10. The first organism to grow in a new ecosystem is called
   (a). Climax species
   (b). Secondary species
   (c). Pioneer species
   (d). Consumer
11. Fire, flood, deforestation and hurricanes result in
   (a). Primary succession
   (b). Limax
   (c). Pioneer
   (d). Secondary succession
12. Organisms in the pond include all except
   (a). Back swimmers
   (b). Crayfish

(c). Water boatman

(d). Mite

13. A climax community is characterized by

(a). A stable composition of plant

(b). Rapid change in the composition of species

(c). Constant changes in the appearance of the species

(d). Gradual change in annual population

14. If a piece of abandoned farmland went through a series of floral and faunal changes and became established with a permanent plant and animal production it could be said to have undergone

(a). Evolution

(b). Competition

(c). Succession

(d). Transformation

15. Which of the following is not an outcome of ecological succession?

(a). There is a progressive change in species structure, organic matter and energy flow

(b). The climax stage consists of a comparatively long-lasting species composition

(c) There is no dynamic equilibrium

(d) Communities occurring later in the sequence of succession are more complex.

16. Which of these factors are common to both aquatic and terrestrial habitats?

(a). Light, rainfall, turbidity

(b). Light, temperature, tide

(c). Light, rainfall, temperature

(d). Rainfall, turbidity, salinity

17. Plants with breathing roots are characteristic features of vegetation in

(a). Tropical grassland

(b). Temperature grassland

(c). Saltwater

(d). Tropical rainforest

18. A space containing a group of interactive organisms is called

(a). Community

(b). Habitat

(c). Ecosystem

(d). Population

19. Which of the following features is not an adaptation of plants to aquatic habitat?

(a). Breathing roots for entry of air

(b). Flower raised above water for Pollination

(c). Spongy tissues containing gasses for buoyancy

(d). Hairy structure on the leaves to reduce water loss.

20. A xerophyte conserves water by possession of the following except

(a). Thick cuticle

(b). Sunker stomata

(c). Broad leaves

(d). Flesh stem

21. A good secondary succession would be

(a). A sand dune

(b). A bare rock

(c) a land that has just had a forest fire

(d). A stretch of barren land

22. In ecological succession, since lichens grow on a bare rock, they are considered to be a

(a) climax

(b). Consumer

(c). Pioneer

(d). Secondary consumer

23. The following habitat can be used in the study of succession except

(a). Savanna grassland

(b). Pond

(c). Abandoned farmland

(d). A well cultivated land

24. Tiger, Lion, Zebra can be found in

(a) Tropical rainforest

(b). Savanna

(c). Desert

(d). Marine

25. How are Savanna plants protected from bush fires?

(a). Have sunker stomata

(b). Roll their leaves during hit days

(c). Have thick barks

(d). She'd their leaves gradually throughout the year

26. In forest Ecology, the activities of one of the following organism with tree provides shelter for other organisms

(a). Hawk

(b). Owl

(c). Woodpecker

(d). Fungi

27. The transition between a river and a sea is called

(a). Pond

(b). Lotic water

(c). Estuary

(d). Marine

28. Which if the following is not a general characteristic of grassland habitat

(a). Broad leaves

(b). Intensive sunlight

(c). Low humidity

(d). Fire resistant trees

29. The forest roof is called

(a). Emergent

(b). Middle layer

(c). Lower layer

(d). Canopy layer

30. There are ____ strata in the forest

(a). 7

(b). 5

(c). 4

**Appendix IV**

**Marking Guide for Ecology Achievement Test (EAT) Post-Test**

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

**Appendix V**

**Ecology Situational Interest Scale (ESIS)**

Dear Respondent,

The Ecology Situational Interest Scale (ESIS) is designed to measure situational interest in Ecology-related topics among students. You are free to choose any option as none of them is right or wrong. Your confidentiality is therefore assured, as no name is required. Thanks.

**Instruction**: Please tick ( ) any option as it applies to you.

**Demographic Data**

**School Name**: _____

**Gender**: Male [ ] Female [ ]

**Key: Very True of Me (VTM) = 4, True of Me (TM) = 3, Untrue of Me (UM) = 2, Very Untrue of Me (VUM) =1**

| S/N | Items | VTM | TM | UM | VUM |
|---|---|---|---|---|---|
| 1 | Learning about the different types of ecosystems is new and exciting to me | | | | |
| 2 | I find the unique adaptations of animals in extreme environments fascinating | | | | |
| 3 | When studying the effects of pollution on marine life, I find it hard to focus on anything else | | | | |
| 4 | The concept of succession captures my full attention when I read about it | | | | |
| 5 | I enjoy figuring out how different species interact within an ecosystem | | | | |
| 6 | I worry about the impact of human activities on the environment | | | | |
| 7 | Solving problems related to conservation efforts is challenging and interesting | | | | |
| 8 | I am eager to learn more about the impact of climate change on different habitats | | | | |
| 9 | I would like to investigate how invasive species | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | affect biodiversity | | | | |
| 10 | I have fun participating in field trips that involve studying plants and animals | | | | |
| 11 | Reading about endangered species is enjoyable and intriguing to me | | | | |
| 12 | I enjoy learning about ways to reduce pollution | | | | |
| 13 | I enjoy spending time outdoors, such as hiking or camping | | | | |
| 14 | I'm interested in learning about renewable energy sources | | | | |
| 15 | I think exploring nature is an exciting experience | | | | |
| 16 | I enjoy exploring new eco-friendly technologies and innovations | | | | |
| 17 | I think zoos and wildlife sanctuaries are important for conservation | | | | |
| 18 | I enjoy learning about different animal species and their habitats | | | | |
| 19 | I find the content of some of the Ecology topics personally interesting. | | | | |
| 20 | The learning activities in my Biology class are gradually becoming meaningful to me. | | | | |

## Appendix VI

## Instructional Guide for Experimental Group 1 (IGIVVS)

## Lesson Note: I

**Subject Area: Biology**

**Class:** SS2

**Date: As Applicable**

**Topic: Aquatic Habitats**

**Sub-topic: Types of Aquatic Habitats**

**Period: Time:** As Applicable

**Duration**: 80Mins.

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

- ❖ Define habitat.
- ❖ Mention the three types aquatic of habitats.
- ❖ State at least four characteristics of each type of aquatic habitat.
- ❖ List examples of organisms in each habitat

**Teaching and Learning Resources: Interactive Video Variation clips**

**Instructional materials as recommended:** YouTube Virtual Field Trips on Aquatic habitat, and pond ecosystem, Computer system, projector, Clips and downloaded video showing aquatic habitats.

**Reference Materials/Books:**


i. M.C Michael: Essential Biology for Senior Secondary Schools. Tonad Publisher Limited.2018, 266-273

ii. S.T. Ramalingam: Modern Biology for Senior Secondary Schools: African First Publishers.2016, 345-354

**Previous Knowledge**: The students are familiar with streams and rivers.

**Instructional Materials**

**Previous Knowledge**: The students are familiar with streams and rivers

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

- ❖ Define habitat.
- ❖ Mention the three types of aquatic of habitat.
- ❖ State at least four characteristics of each type of aquatic habitat.
- ❖ List examples of organisms in each habitat

**Content**

Aquatic habitat

Types of aquatic habitat

Characteristics of the different types of aquatic habitat

Distributions of organisms in aquatic habitat

**Presentation**

**Step 1**: The teacher revises the last lesson topic briefly.

**Step 2**: The teacher introduces the topic by asking the students to mention the names of rivers or streams in their communities.

**Step 3**: The teacher explains the content by playing YouTube videos on the topic for students.

**Step 4**: The teacher presses the pause button periodically and asks questions from the students after which she presses the play button to allow the completion of each video.

**Step 5:** The teacher asks some of the students to play the video again for better understanding.

**Evaluation**

1. What is a habitat?
2. With two examples each, state the three kinds of aquatic habitats.
3. State four characteristics of the different types of aquatic habitat.

**Assignment**

1. Construct two food chains each on the three types of aquatic habitat

2. List five plants and animals found in aquatic habitats.

## Appendix VII

## Instructional Guide for Experimental Group 1

## Lesson Note II

**Date: As Applicable**

**Subject: Biology**

**Class: SS 2**

**Topic: Terrestrial Habitats**

**Sub-Topic: Types of Terrestrial Habitat**

**Duration: 80 Minutes**

**Period: As Applicable**

**Reference**:

M.C Michael: Essential Biology for Senior Secondary Schools. Ogun: Tonad Publisher Limited. 2018, 274-282

S.T. Ramalingam: Modern Biology for Senior Secondary Schools**.** Onitsha: Africana First Publishers.2016, 354-366

**Instructional Materials:** Youtube videos on terrestrial habitats and forest Ecology.

**Previous Knowledge**: The students are familiar with areas that are flooded with water especially during the rainy season and they are also familiar with forest.

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

- Define terrestrial habitat
- List four types of terrestrial habitats.

- ❖ State four characteristics of marsh and forest habitats.
- ❖ List four plants and animals present in marsh and forest habitats.
- ❖ State three adaptations of organisms in marsh and forest habitats.
- ❖ Give two examples of food chain in each types of habitat.

**Content**

**Terrestrial Habitats**

Types of terrestrial habitat

Characteristics of marsh habitat

Characteristics of forest and adaptive features of forest organisms

Distribution of organism in marsh and forest

**Presentation**

**Step 1**: The teacher revises the last topics briefly with the student.

**Step 2**: The teacher introduces the topic with few questions to find out their previous knowledge about the topic such as what is habitat? Mention the two major types of habitat.

**Step 3**: The teacher then tells the student that the days' topic is terrestrial habitat.

**Step 4**: Teacher explains the content of the lesson with the aid of YouTube videos on Terrestrial habitats and forest Ecology which she plays for students one after the other. Teacher pause the videos at interval and asks questions to ensure learning is taking place.

**Step: 5** Students replay the videos as they take notes of important points of the topic.

**Step 6**: Students asks questions on the topic.

**Evaluation**

Teacher evaluates the lesson with the following questions

1. List four types of terrestrial habitats
2. State four characteristics of a marsh
3. List four plants and animals found in the marsh.
4. Describe a forest habitat using its characteristics.
5. Give two examples of food chain in a forest.

**Assignment:** Students are to state five adaptive features each of :

1. Marsh and forest habitat plants.

2. List types of relationships existing among forest organisms.

## Appendix VIII

**Instructional Guide for Experimental Group 1**

**Lesson Note III**

**Date: As Applicable**

**Subject: Biology**

**Class: SS2**

**Topic: Terrestrial Habitats**

**Sub-Topic: Grassland and Desert Habitats**

**Duration: 80 Minutes**

**Period: As Applicable**

**Reference Books**:

M.C Michael : Essential Biology for Senior Secondary Schools. Tonad Publisher Limited. 2018, 275-280

S.T. Ramalingam : Modern Biology for Senior Secondary Schools. Africana First Publishers. 2016. 354-359.

**Instructional Materials:** YouTube videos on grassland and desert habitats.

**Previous Knowledge**: The students have been taught marsh and forest habitats.

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

- Describe grassland.
- State four characteristics of grassland.
- List four examples of plants and animals of the grassland and desert

- ❖ List types of desert and state four characteristics of desert habitat
- ❖ Enumerate five adaptive features of desert organisms.

**Content**

1. Grassland [Savanna]

Characteristics of Grassland

Plants Distribution and Adaptation in Grasslands

Animals Distribution and Adaptation in A In Grasslands

Food Chains in Grassland

2. Arid Lands [Deserts]

Characteristics of a Desert

Plants Distribution and Adaptation in Deserts

Animal Distribution and Adaptation in Deserts

Food Chains in Arid Lands

**Presentation**

**Step 1**: The teacher introduces the lesson by asking questions on the last lesson such as: what type of habitat is terrestrial habitat? List types of terrestrial habitat.

**Step 2**: The teacher plays videos of: African habitats, Desert ecosystem and habitat and adaptation of plants one after the other as means of explaining the lesson content.

**Step 3**: The teacher pause each video at interval to ask questions from the students to ensure learning is taking place.

**Step 4**: Students asks questions at the end of each video before the start of another video.

**Step 5**: Students watches the video all over for good retention.

**Evaluation**

Teacher evaluates the lesson with the question below:

1. Describe grassland.
2. State four characteristics of grassland.
3. List 4 examples of plants and 4 animals of the grassland and desert.
4. State four adaptive features of desert animal.

**Assignment**

Students are to:

1. State five adaptive features of desert trees.

2. Construct a food chain each on savanna and desert habitats

## Appendix IX

**Instructional Guide for Experimental Group 1**

**Lesson Note IV**

**Date**: As applicable

**Subject:** Biology

**Class:** SS2

**Topic:** Plant Adaptation

**Duration:** 80 Minutes

**Period:** As Applicable

**Reference**:

M.C Michael: Essential Biology for Senior Secondary Schools. Ogun: Tonad Publisher Limited.2018, 120-121.

E.O Omotesho**:** The Core of Biology for Senior Secondary Schools by Mikalex Publishers Limited, Revised Edition 2021, 311-312

**Instructional Materials:** Cactus plant, Alovera, mango plant and video clip on plant adaptation.

**Previous Knowledge**: The students are familiar with Aloe vera, Corn and Mango.

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

1. Define adaptation
2. Define plant adaptation

3. States at least three feature each that enables Hydrophytes, Mesophytes and Xerophytes adapts them to their habitat.

**Content**

Plants Adaptation

1.Hydrophytes characteristics and adaptation

2. Mesophytes characteristics and adaptation

3. Xerophytes characteristics and adaptation

**Presentation**

**Step I:** Teacher introduces the lesson by probing into students' previous knowledge with questions like what are the features in plant that enables it to grow on land? Name one plant each that can be found around the river, on the farm land and in the desert.

**Step II:** Teacher links their answers to the lesson topic plants adaptation to different habitats.

**Step III**: Teacher explains the lesson content as she presses the play button on the computer to display two interactive videos one after the other from YouTube on: adaptation of hydrophytes and habitats and adaptation of plants on the projector for students.

**Step IV**: Teacher presses stop, pause, previous and next buttons at interval to have easier control of the instrument and allows learners to get the best from this instructional strategy.

**Step V:** The student plays the videos all over by themselves under the teachers' watch for easy assimilation.

**Step VI:** On completion of the instructional videos teacher allows learners to ask question base on what they have learnt as she answers their questions

**Evaluation:** Teacher evaluates the lesson with the following questions:

1. What is adaptation?

2. What do you understand by plant adaptation?

3. Mention three adaptive features each of hydrophytes, mesophytes and xerophytes.

**Assignment**

Student are to write out four differences between adaptation in hydrophytes, and Xerophytes with two example of plants in each case.

## Appendix X

**Instructional Guide for Experimental Group 1**

**Lesson Note V**

**Date:** As Applicable

**Subject:** Biology

**Class:** SS2

**Topic:** Ecology of Population

**Sub-Topic:** Ecological Succession

**Duration:** 80 Minutes

**Period:** Applicable

**Reference Books**:

M. C. Micheal: Essential Biology for Senior Secondary Schools: Tonad Publisher Limited. 2018, 283-286

S.T. Ramalingam: Modern Biology for Senior Secondary Schools: Africana First Publishers. 2016, 368-370.

**Instructional Materials:** YouTube videos on primary and secondary succession as well as pond succession.

**Previous Knowledge**: The students have learnt about forest habitat which is one of the major places where succession takes place.

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

- ❖ Define ecological succession.
- ❖ Identify the two types of succession.
- ❖ Explain with illustration succession on pond and farmland

**Content**

Ecological succession

Types of Succession

Succession in Pond

Types of Succession

**Presentation**

**Step 1**: The teacher revises the last topics briefly.

**Step 2**: The teacher introduces the lesson by asking some of the students to explain what will be done to a piece of land covered with vegetation before it can be built upon.

**Step 3**: The teacher plays a video on primary succession to explain the lesson content.

**Step 4**: The teacher explains secondary succession as she shows them another video on secondary succession.

**Step 5**: Teacher pause the video to ask questions from the student.

**Step 6**: Students asks questions based on what they have learnt..

**Evaluation**

1. Define ecological succession.
2. State the two types of succession.

3. With the aid of illustration only explain succession on a pond and a rock.

Assignment: Student should list ten ecological disturbances that can lead to secondary succession.

## Appendix XI

**Instructional Guide for Experimental Group 1**

### Lesson Note VI

**Date: As Applicable**

**Subject: Biology**

**Class: SS2**

**Topic: Ecology of Population**

**Sub-Topic: Secondary Succession**

**Duration: 80 Minutes**

**Period: As Applicable**

**Reference Books:**

M. C Michael: Essential Biology for Senior Secondary Schools, Tonad Publisher Limited, 2018, 283-286

S.T. Ramalingam : Modern Biology for Senior Secondary Schools. African First Publishers, 2016, 368-370

**Instructional Materials:** Videos on primary and secondary succession

**Previous Knowledge**: The students were introduced to ecological succession during the last lesson.

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

- ❖ Differentiate between primary and secondary succession.
- ❖ State five characteristics of succession.
- ❖ State the outcome of succession.

**Content**

**Secondary Succession**

Burning of Farmland

**Differences between Primary and Secondary Succession**

**Presentation**

**Step 1**: The teacher introduces the with brief revision of last lesson

**Step 2**: Teacher asks students to define succession and list type of succession

**Step 3**: The teacher plays the videos on pond succession, primary and secondary succession to explain the lesson content one after the other.

**Step 4**: The teacher pause the video to ask questions to ensure learning is take place.

**Step 5**: The student states the differences between primary and secondary succession.

**Step 6**: The teacher presses play button on the computer in other to complete the lesson content.

**Step 7**: Students asks questions from the teacher while the teacher answer their questions.

**Evaluation**

Students should answer the following questions:

1. State three differences between primary and secondary succession.

2. Enumerate five characteristics of succession.

3. State three outcome of succession.

## Appendix XII

**Instructional Guide for Virtual Field Trips Strategy (IGVFTS)**

**Lesson Note: I**

**Date:** As Applicable

**Subject:** Biology

**Class:** SS2

**Topic:** Aquatic Habitats

**Sub-topic:** Types of Aquatic Habitats

**Period:** As Applicable

**Duration**: 80Mins.

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

- ❖ Define habitat.
- ❖ Mention the three types aquatic of habitats.
- ❖ State at least four characteristics of each type of aquatic habitat.
- ❖ List examples of organisms in each habitat

**Teaching and Learning Resources:** Virtual Field Trips Strategy

**Instructional materials as recommended:** YouTube Virtual Field Trips on Aquatic habitat, and pond ecosystem, Computer system, projector, Clips and downloaded video showing aquatic habitats.

**Reference Materials/Books:**

M.C Michael: Essential Biology for Senior Secondary Schools. Tonad Publisher Limited.2018, 266-273

S.T. Ramalingam: Modern Biology for Senior Secondary Schools: African First Publishers.2016, 345-354

**Previous Knowledge**: The students are familiar with streams and rivers.

**Content**

Aquatic Habitat meaning

Types of aquatic habitats

Characteristics of the types of aquatic habitats

Distribution of organisms in aquatic habitats

**Presentation**

**Step 1**: The teacher revises the last lesson topic briefly.

**Step 2**: The teacher introduces the topic by asking the students to mention the names of rivers or streams in their communities.

**Step 3**: The teacher explains the content of the lesson by pressing the play button on the computer keyboard to allow the students to go on Virtual Field Trips on YouTube to aquatic habitats, and pond ecosystems.

**Step 4**: The teacher presses the pause button periodically and asks questions from the students after which she presses the play button to allow completion of the virtual field trip documentation.

**Step 5:** The students ask questions from the teachers for better understanding.

**Evaluation**

The teacher evaluates the lesson with the questions below:

1. What is a habitat?

2. With two examples each, state the three kinds of aquatic habitats.

3. State four characteristics of the different types of aquatic habitat.

**Assignment**

1. Construct two food chains each on the three type of aquatic habitat

2. List five plants and animals found in aquatic habitat.

## Appendix XIII

**Instructional Guide for Virtual Field Trips Strategy (IGVFTS)**

**Lesson Note II**

**Date:** As Applicable

**Subject:** Biology

**Class:** SS2

**Topic:** Terrestrial Habitats

**Sub-topic:** Types of Terrestrial Habitats

**Period: Time:** As Applicable

**Duration**: 80 mins.

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

- ❖ Define terrestrial habitat
- ❖ List four types of terrestrial habitats.
- ❖ State four characteristics of marsh and forest habitats.
- ❖ List four plants and animals present in marsh and forest habitats.
- ❖ State three adaptations of organisms in marsh and forest habitats.
- ❖ Give two examples of food chains in each type of habitat.

**Instructional Materials:** YouTube virtual field trip documentary on terrestrial habitats and forest Ecology.

**Reference Materials/Books:**


i. M.C Michael: Essential Biology for Senior Secondary Schools. Tonad Publisher Limited.2018, 274-282

ii. S.T. Ramalingam: Modern Biology for Senior Secondary Schools: African First Publishers.2016, 345-354

**Previous Knowledge**: The students are familiar with areas that are flooded with water, especially during the rainy season and they are also familiar with forests.

**Content**

Terrestrial Habitats

Marsh

Forests

Characteristics of a Forest

Plants Distribution and Adaptation

Animal Distribution And Adaptation

**Presentation**

**Step 1**: The teacher revises the last topics briefly with the student.

**Step 2**: The teacher introduces the lesson by asking questions to find out their previous knowledge about the topic such as what is a habitat. Mention the two major types of habitat.

**Step 3**: The teacher then tells the student that the days' topic is terrestrial habitat.

**Step 4**: The teacher explains the content of the lesson with the aid of documentaries on virtual field trips to terrestrial habitats and forest Ecology one after the other.

**Step 5**: The teacher pauses each virtual field trip documentary at intervals and asks questions to ensure learning is taking place.

**Step 6**: Students explore the virtual field trips again as they take notes of important points of the topic.

**Step 7**: Students asks questions on the topic.

**Evaluation**

Teacher evaluates the lesson with the following questions

1. List four types of terrestrial habitats

2. State four characteristics of a marsh

3. List four plants and animals found in the marsh.

4. Describe a forest habitat using its characteristics.

5. Give two examples of food chains in a forest.

**Assignment:**

Students are to state five adaptive features of each:

1. Marsh and forest habitat plants.

2. List types of relationships existing among forest organisms.

**Appendix XIV**

**Instructional Guide for Virtual Field Trips Strategy (IGVFTS)**

**Lesson Note: III**

**Date: As Applicable**

**Subject: Biology**

**Class:** SS2

**Topic: Terrestrial Habitats**

**Sub-topic: Grassland and Desert Habitats**

**Period: Time:** As Applicable

**Duration**: 80 mins.

**Reference Materials/Books:**

i. M.C Michael: Essential Biology for Senior Secondary Schools. Tonad Publisher Limited.2018, 275-280
ii. S.T. Ramalingam: Modern Biology for Senior Secondary Schools: African First Publishers.2016, 345-359

**Instructional Materials:** YouTube virtual field trips documentaries on grassland and desert habitats.

**Previous Knowledge**: The students have been taught marsh and forest habitats.

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

- Describe grassland.
- State four characteristics of grassland.

- List 4 plants and 4 animals of the grassland and explain how each organism adapts to this habitat. ‘
- List types of desert and state four characteristics of desert habitat
- Enumerate five adaptive features of desert plants and animals.
- List examples of organisms in the desert.

**Content**

**Presentation**

**Step 1**: The teacher introduces the lesson by asking questions on the last lesson such as: what type of habitat is terrestrial habitat? List types of terrestrial habitat.

**Step 2**: The teacher plays a virtual field trip documentary on African habitats, Desert ecosystems and the adaptation of plants to different habitats one after the other as a means of explaining the lesson content.

**Step 3**: The teacher pauses each virtual field trip documentary at intervals to ask questions from the students to ensure learning is taking place.

**Step 4:** Students ask questions at the end of each virtual field trip documentary before the start they explore the next one.

**Step 5:** Students explore the virtual field trips documentary all over for good retention.

**Evaluation**

The teacher evaluates the lesson with the question below:

1. Describe grassland habitat.
2. State four characteristics of grassland.
3. List 4 plants and 4 animals of the grassland and
4. Explain how each adapts to this habitat.

**Assignment**

Students are to:

1. State five adaptive features of desert animals.

2. Construct a food chain each on savanna and desert habitats

## Appendix XV

**Instructional Guide for Virtual Field Trips Strategy (IGVFTS)**

**Lesson Note: IV**

**Date:** As Applicable

**Subject:** Biology

**Class:** SS2

**Topic:** Plant Adaptation

**Sub-topic:** Grassland and Desert Habitats

**Period: Time:** As Applicable

**Duration**: 80 mins.

**Reference Materials/Books:**

i. M.C Michael: Essential Biology for Senior Secondary Schools. Tonad Publisher Limited.2018, 120-121

ii. E.O Omotesho: The Core of Biology for Senior Secondary Schools by Mikalex Publishers Limited, Revised Edition 2021, 311-312

**Instructional Materials:** Cactus plant, Alovera, mango plant and chart shoeing water lily.

**Previous Knowledge**: The students are familiar with aloe vera, corn and mango.

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

Define adaptation

Define plant adaptation.

Define hydrophytes, mesophytes and xerophytes.

States at least three features each that enable Hydrophytes, Mesophytes and Xerophytes to adapt to their habitats.

**Content**

Plants Adaptation

Hydrophytic adaptations

Adaptation of Mesophytes

Adaptive Feature of Xerophytes

**Presentation**

**Step I:** Teacher introduces the lesson by probing into students' previous knowledge with questions like what are the features in plant that enables it to grow on land? Name one plant each that can be found around the river, on the farm land and in the desert.

**Step II:** Teacher links their answers to the lesson topic: plants adaptation to different habitats.

**Step III**: The teacher explains the content of the lesson by allowing the student to explore virtual field trips on hydrophytes via YouTube.

Step IV: Teacher also teaches the student mesophytes and xerophytes by allowing the student to explore virtual field trips on habitats and plants adaptation via YouTube.

**Step V:** Students asks question on the topic from the teacher.

**Evaluation**

Teacher evaluates the lesson with the following questions:

1. What is adaptation?

2. What do you understand by plant adaptation?

3. Define the following terms: Hydrophytes, mesophytes and xerophytes

4. Mention three adaptive features each of hydrophytes, mesophytes and xerophytes.

**Assignment**

Students are to write out four differences between adaptation in hydrophytes, and Xerophytes with two examples of plants in each case.

**Appendix XVI**

**Instructional Guide for Virtual Field Trips Strategy (IGVFTS)**

**Lesson Note: V**

**Date:** As Applicable

**Subject:** Biology

**Class:** SS2

**Topic:** Ecology of Population

**Sub-topic:** Ecological Succession

**Period: Time:** As Applicable

**Duration**: 80 mins.

**Reference Materials/Books:**

1.M.C Michael: Essential Biology for Senior Secondary Schools. Tonad Publisher Limited.2018, 283-286

ii.S.T. Ramalingam: Modern Biology for Senior Secondary Schools: African First Publishers.2016, 368-370

**Instructional Materials:** YouTube Virtual field Trips documentary on primary succession, secondary succession and pond succession.

**Previous Knowledge**: The students have learnt about forest habitat which is one of the major places where succession takes place.

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

- ❖ Define ecological succession.
- ❖ Lists the two types of succession.

❖ Explain with illustration primary succession on pond

**Content**

Ecological Succession

Types of succession

Primary succession

Succession in Pond

**Presentation**

**Step 1**: The teacher revises the last topics briefly.

**Step 2**: The teacher introduces the lesson by asking some of the students to explain what will be done to a piece of land covered with vegetation before it can be built upon.

**Step 3**: The teacher plays the virtual field trips documentary on primary succession and pond succession to explain the lesson content.

**Step 4**: The teacher explains secondary succession as she shows them another virtual field trips documentary on secondary succession.

**Step 5**: Teacher pause the documentary to ask questions from the student to ensure they are learning.

**Step 6**: Students asks questions based on what they have learnt..

**Evaluation**

1. Define ecological succession.

2. State the two types of succession.

3. With the aid of illustration only explain succession on a pond .

**Assignment**

Students should list ten ecological disturbances that can lead to secondary succession.

## Appendix XVII

**Instructional Guide for Virtual Field Trips Strategy (IGVFTS)**

**Lesson Note: V**

**Date:** As Applicable

**Subject:** Biology

**Class:** SS2

**Topic:** Ecology of Population

**Sub-topic:** Secondary Succession

**Period: Time:** As Applicable

**Duration**: 80 mins.

**Reference Materials/Books:**

i. M.C Michael: Essential Biology for Senior Secondary Schools. Tonad Publisher Limited.2018, 283-286
ii. S.T. Ramalingam: Modern Biology for Senior Secondary Schools: African First Publishers.2016, 368-370

**Instructional Materials:** Virtual field trips and documentaries on primary and secondary succession.

**Previous Knowledge**: The students were introduced to ecological succession during the last lesson.

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

- Define secondary succession
- Differentiate between primary and secondary succession.
- State five characteristics of succession.

- ❖ State the outcome of succession.

**Content**

Secondary Succession

Differences between primary and secondary succession

Characteristics Of Succession

Outcome of Succession

**Presentation**

**Step 1**: The teacher introduces the lesson with brief revision of last lesson

**Step 2**: The teacher asks students to define succession and list the type of succession

**Step 3**: The teacher plays the virtual field trips documentary on pond succession, primary and secondary succession to explain the lesson content one after the other.

**Step 4**: The teacher pause the virtual field trips documentaries and ask questions to ensure learning is taking place.

**Step 5**: The student states the differences between primary and secondary succession.

**Step 6**: The teacher presses play button on the computer in other to complete the lesson content.

**Step 7**: Students asks questions from the teacher while the teacher answer their questions.

**Evaluation**

Students should answer the following questions:

1. Define secondary succession
2. State three differences between primary and secondary succession.
3. State five characteristics of succession.
4. State three outcome of succession.

## Appendix XVIII

**Instructional Guide for Control**

**Lesson Note: I**

**Date:** As Applicable

**Subject:** Biology

**Class:** SS2

**Topic:** Aquatic Habitats

**Sub-topic:** Types of Aquatic Habitats

**Period: Time:** As Applicable

**Duration**: 80Mins.

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

- ❖ Define habitat.
- ❖ Mention the three types aquatic of habitats.
- ❖ State at least four characteristics of each type of aquatic habitat.
- ❖ List examples of organisms in each habitat

**Teaching and Learning Resources: Diagram showing the body of the water**

**Reference Materials/Books:**


i. M.C Michael: Essential Biology for Senior Secondary Schools. Tonad Publisher Limited.2018, 266-273

ii. S.T. Ramalingam: Modern Biology for Senior Secondary Schools: African First Publishers.2016, 345-354

## Content

**Aquatic Habitat**

Characteristics of Marine Habitat

Brackish or Estuary water habitat

Freshwater Habitats

Characteristics Of Freshwater Habitats

.**Presentation**

**Step 1**: The teacher revises the last lesson topic briefly.

**Step 2**: The teacher introduces the topic by asking the student to mention names of rivers or streams in their communities.

**Step 3**: The teacher defines a habitat for students.

**Step 4**: The teacher lists types of aquatic habitats for the students.

**Step 5:** The teacher discusses different types of aquatic habitat with the student.

**Evaluation**

The teacher evaluates the lesson with the questions below:

1. What is a habitat?

2. With two examples each, state the three kinds of aquatic habitats.

3. State four characteristics of the different types of aquatic habitat.

**Assignment**

1. Construct two food chains each on the three types of aquatic habitat

2. List five plants and animals found in aquatic habitats.

3. State five adaptive features of aquatic plants, that is hydrophytes

## Appendix IXX

## Instructional Guide for Control Group

**Lesson Note II**

**Date:** As Applicable

**Subject:** Biology

**Class:** SS2

**Topic:** Terrestrial Habitats

**Sub-Topic:** Types of Terrestrial Habitat

**Duration:** 80 Minutes

**Period:** As Applicable

**Reference Books**:

M.C Michael: Essential Biology for Senior Secondary Schools: Tonad Publisher Limited. 2018, 274-282

S.T. Ramalingam: Modern Biology for Senior Secondary Schools: Africana First Publishers.2016, 345-354

**Instructional Materials:** Diagram showing tress in layers terrestrial habitats.

**Previous Knowledge**: The students are familiar with areas that are flooded with water especially during the rainy season and they are also familiar with forest.

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

- Define terrestrial habitat

- ❖ List four types of terrestrial habitats.
- ❖ State four characteristics of marsh and forest habitats.
- ❖ List four plants and animals present in marsh and forest habitats.
- ❖ State three adaptations of organisms in marsh and forest habitats.
- ❖ Give two examples of food chain in each types of habitat.

**Content**

Terrestrial habitats

Marsh

Characteristics of a marsh

Organisms distribution and adaptation in marshes

Forests

Characteristics of a forest

Plants distribution and adaptation

Animals distribution and adaptation

**Presentation**

**Step 1**: The teacher revises the last topics briefly with the student.

**Step 2**: The teacher introduces the topic by explaining asking questions to find out their previous knowledge about the topic such as what is habitat? Mention the two major types of habitat.

**Step 3**: The teacher then tells the student that the days' topic is terrestrial habitat.

**Step 4** : Teacher guides the student to define terrestrial habitat

**Step 5**: Teacher lists types of terrestrial habitat for the student.

**Step 6**: Teacher discusses marsh and rainforest habitat with the students.

**Evaluation**

Teacher evaluates the lesson with the following questions

1. List four types of terrestrial habitats

2. State four characteristics of a marsh

3. List four plants and animals found in the marsh.

4. Describe a forest habitat using its characteristics.

5. Give two examples of food chain in a forest.

**Assignment**

Students are to:

1. State five characteristics of trees in rainforest habitat.

2. List types of relationships existing among forest organisms.

**Appendix XX**

**Instructional Guide for control Group**

**Lesson Note III**

**Date:** As Applicable

**Subject:** Biology

**CLASS:** SS2

**Topic:** Terrestrial Habitats

**Sub-Topic:** Grassland and Desert Habitats

**Duration:** 80 Minutes

**Period:** As Applicable

**Reference Books**:

M.C Michael: Essential Biology for Senior Secondary Schools. Tonad Publisher Limited. 2018, 275-280

S.T. Ramalingam: Modern Biology for Senior Secondary Schools. Africana First Publishers. 2016. 354-359.

**Instructional Materials:** chart showing savanna or grassland habitat.

**Previous Knowledge**: The students have been taught marsh and forest habitats.

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

- Describe grassland.
- State four characteristics of grassland.

- List 4 plants and 4 animals of the grassland and explain how each organism adapts to this habitat. ‘
- List types of desert and state four characteristics of desert habitat
- Enumerate five adaptive features of desert trees and animals.
- List examples of organisms in the desert.

**Content**

Grassland [savanna]

Characteristics of grassland

Distribution and adaptation of organisms in grasslands

Arid lands or deserts

Characteristics of a desert

Distribution and adaptation of organisms in deserts

**Presentation**

**Step 1**: The teacher introduces the lesson by asking questions on the last lesson such as: what type of habitat is terrestrial habitat? List types of terrestrial habitat.

**Step 2**: The teacher discusses grassland or savanna habitat with the student.

**Step 3**: The teacher discusses desert habitat with the students.

**Step 4:** Teacher explains the types of organisms found in savanna and desert habitats with the students.

**Step 5:** Teacher discusses the lesson content in full with the student

**Evaluation**

Teacher evaluates the lesson with the question below:

1. Describe a grassland.

2.State four characteristics of grassland.

2. List 4 plants and 4 animals of the grassland and explain how each adapt to this habit.

**Assignment**

Students are to:

1. Name five organisms found in desert

2. Construct a food chain and food web each on savanna and desert habitats

## Appendix XXI

**Instructional Guide for Control Group**

**Lesson Note IV**

**Date:** As Applicable

**Subject:** Biology

**Class:** SS2

**Topic:** Plant Adaptation

**Duration:** 80 Minutes

**Period:** As Applicable

**Reference**:

M.C Michael: Essential Biology for Senior Secondary Schools. Ogun: Tonad Publisher Limited.2018, 120-121.

E.O Omotesho: The Core of Biology for Senior Secondary Schools by Mikalex Publishers Limited, Revised Edition 2021, 311-312

**Instructional Materials:** Cactus plant, Alovera, mango plant and chart shoeing water lily**.**

**Previous Knowledge**: The students are familiar with aloe vera, corn and mango.

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

1. Define adaptation

2. Define plant adaptation.

3. Define hydrophytes, mesophytes and xerophytes.

4. States at least three feature each that enables Hydrophytes, Mesophytes and Xerophytes adapt them to their habitat.

**Content**

**Plants Adaptation**

1. Hydrophytes characteristics and adaptation

2. Mesophytes Characteristics and adaptation

3. Xerophytes characteristics and adaptation

**Presentation**

**Step I:** Teacher introduces the lesson by probing into students' previous knowledge with questions like what are the features in plant that enables it to grow on land? Name one plant each that can be found around the river, on the farm land and in the desert.

**Step II:** Teacher links their answers to the lesson topic plants adaptation to different habitats.

**Step III**: Teacher defines adaptation to the student.

**Step IV**: Teacher guides the student to define plant adaptation.

**Step V**: Teacher defines hydrophytes, mesophytes and xerophytes for the student.

**Step VI**: Teacher discusses the characteristics of each group of plant with the student as seen in the content.

**Evaluation**

Teacher evaluates the lesson with the following questions:

1. What is adaptation?

2. What do you understand by plant adaptation?

3. Define the following terms: Hydrophtes, mesophytes and xerophytes

4. Mention three adaptive features each of hydrophytes, mesophytes and xerophytes.

**Assignment**

Student are to write out four differences between adaptation in hydrophytes, and Xerophytes with two example of plants in each case.

## Appendix XXII

## Instructional Guide for Control Group

## Lesson Note V

**Date:** As Applicable

**Subject:** Biology

**Class:** SS2

**Topic:** Ecology of Population

**Sub-Topic:** Ecological Succession

**Duration:** 80 Minutes

**Period:** Applicable

**Reference :**

M. C. Micheal: Essential Biology for Senior Secondary Schools: Tonad Publisher Ltd. Pages 283-286

S.T. Ramalingam: Modern Biology for Senior Secondary Schools: Africana First Publishers,2016, 368-370

**Instructional Materials:** diagrams showing piece of land where succession can take place.

**Previous Knowledge**: The students have learnt about forest habitat which is one of the major places where succession takes place.

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

- Define ecological succession.

- ❖ Identify the two types of succession
- ❖ Explain primary succession.
- ❖ Explain with illustration succession on pond

**Content**

Ecological Succession

Types Of Succession

Basically, there are two types of succession; these are

- Primary succession
- Secondary succession

**Presentation**

**Step 1**: The teacher revises the last topics briefly.

**Step 2**: The teacher introduces the lesson by asking some of the students to explain what will be done to a piece of land covered with vegetation before it can be built upon.

**Step 3**: Teacher define succession for the student

**Step 4**: The teacher discusses primary succession with the students.

**Step 5**: Teacher explains succession in the pond for the student

**Step 6**: Students asks questions based on what they have been taught.

**Evaluation**

1. Define ecological succession.

2. State the two types of succession.

3. With the aid of illustration only explain succession on a pond.

Assignment: Student should describe succession in estuary habitat.

## Appendix XXIII

## Instructional Guide for control Group

## Lesson Note VI

**Date:** As Applicable

**Subject:** Biology

**Class:** SS2

**Topic:** Ecology of Population

**Sub-Topic:** Secondary Succession

**Duration:** 80 Minutes

**Period:** As Applicable

**Reference Books:**

M. C Michael: Essential Biology for Senior Secondary Schools, Tonad Publisher Limited, 2018, 283-286

S.T. Ramalingam: Modern Biology for Senior Secondary Schools. African First Publishers, 2016, 368-370

**Instructional Materials:** Chart illustrating primary and secondary succession

**Previous Knowledge**: The students were introduced to ecological succession during the last lesson.

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

- Explain secondary succession.
- Differentiate between primary and secondary succession.

- ❖ State five characteristics of succession.
- ❖ State the outcome of succession.

**Content**

Secondary Succession

Differences between primary and secondary succession

Characteristics of succession, outcome of succession

**Presentation**

**Step 1**: The teacher introduces the lesson with brief revision of last lesson

**Step 2**: Teacher asks students to define succession and list type of succession

**Step 3**: Teacher discusses secondary succession with the student.

**Step 4:** The teacher guides the student to state the differences between primary and secondary succession.

**Step 5:** The teacher discusses the outcome of succession with the student.

**Step 6**: The student asks questions from the teacher.

**Evaluation**

Students should answer the following questions:

1. Define secondary succession.

2. State three differences between primary and secondary succession.

3. State five characteristics of succession.

4. State three outcome of succession.

**Assignment**

Student should list eight occurrences that can lead to secondary succession.

**Appendix XXIV**

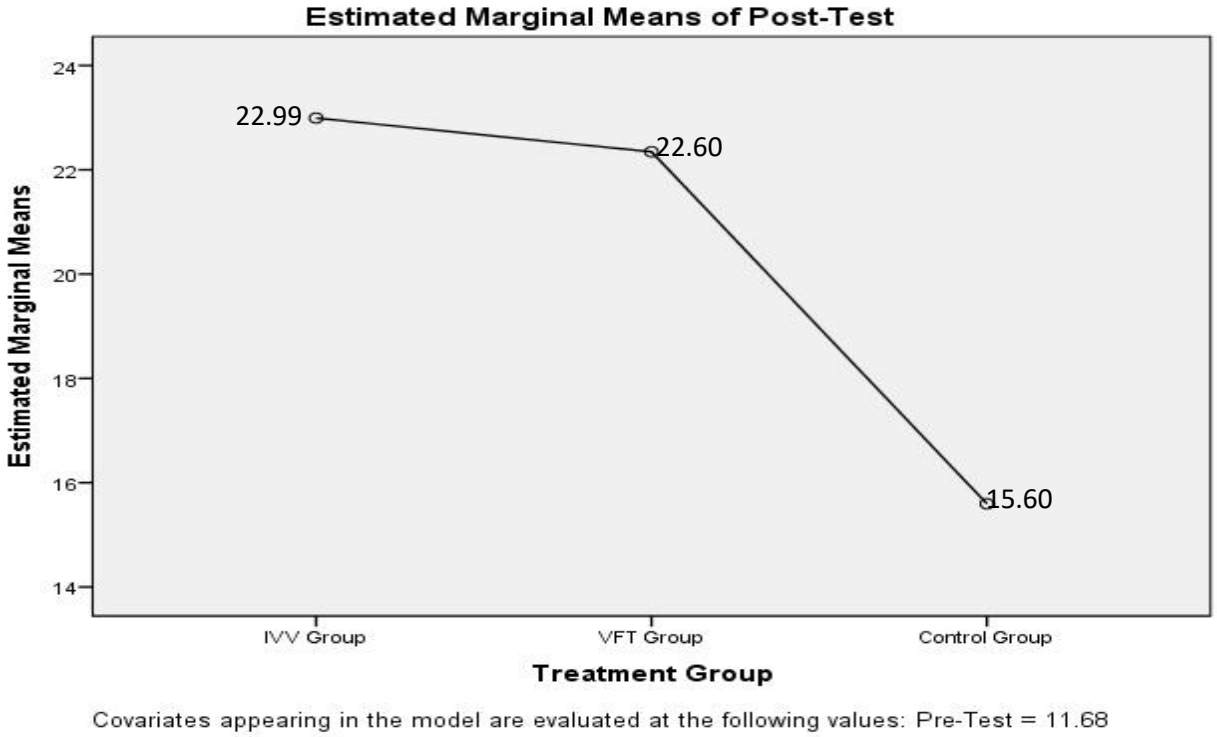


Fig. 4.1: Estimated Marginal Means of Achievement
Source: Field Survey 2025

## Appendix XXV

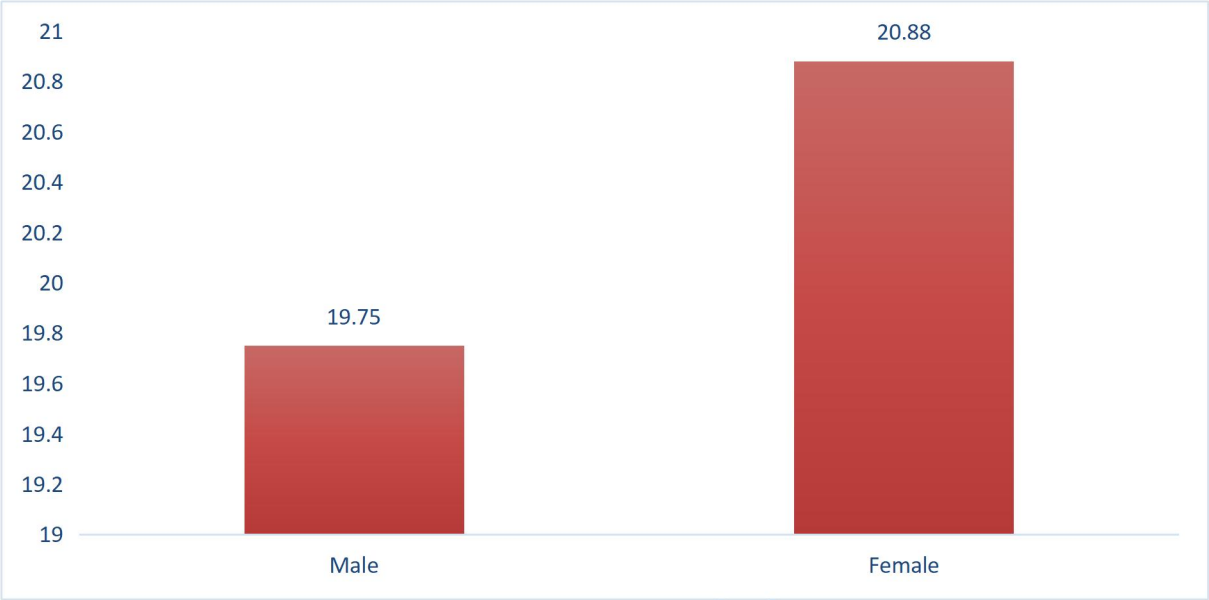


**Fig. 4.2: Estimated Marginal Means of Students' Achievement in Ecology by Gender**

## Appendix XXVI

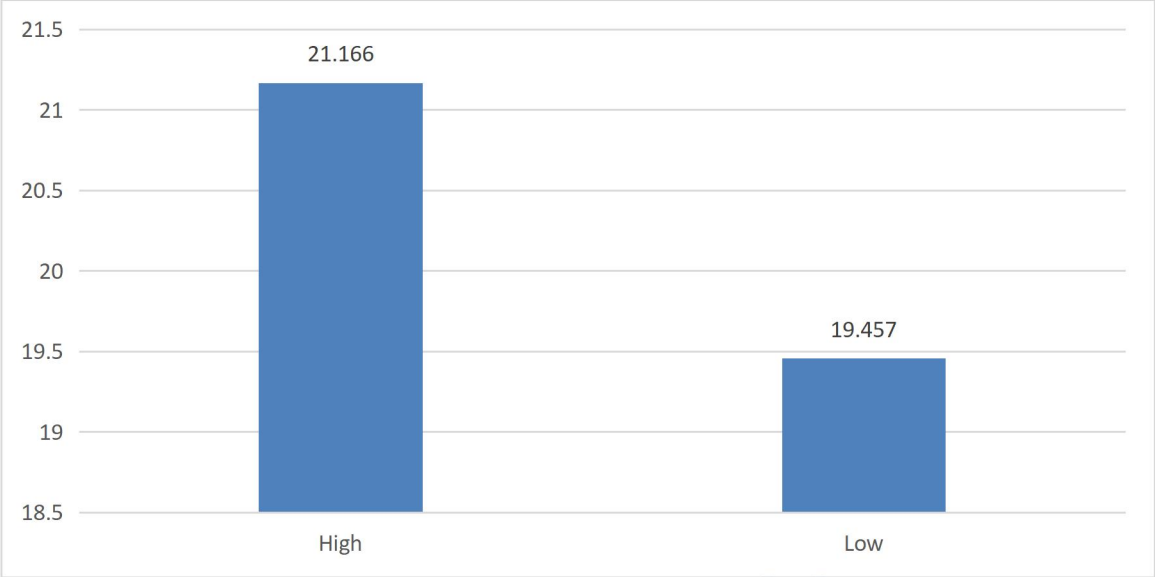


**Fig. 4.3:** Estimated Marginal Means of Students' Achievement in Ecology by Situational Interest

Source: Field work 2024.

## Appendix XXVII

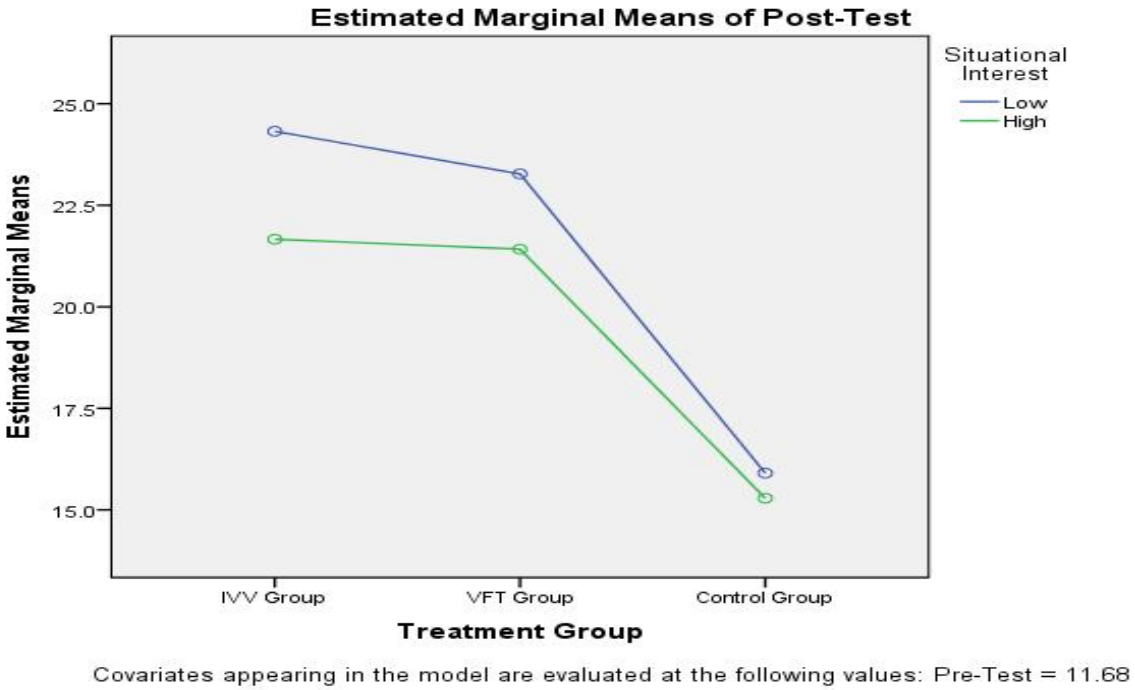


**Fig. 4.4:** Estimated Marginal Means of Students' Achievement in Ecology by Treatment & Situational Interest.

## Appendix XXVIII

**Abbreviations**

| | |
|---|---|
| CM: | Convectional Method |
| IVV: | Interactive Video Variations |
| VFT | Virtual Field Trips |
| WAEC: | West Africa Examination Council |
| NECO: | National Examination Council |
| ESII: | Ecology Situational Interest Inventary |
| EAT: | Ecology Achievement Test |

## Appendix XXIX

## Bio-data

### A. Personal Data

1. Full Name: Motunrayo Idowu, ADEOSUN
   D1 Itesiwaju CDA, off Apakila Road, Camp, Abeokuta, Ogun State, motunrayoadeosun12@gmail.com & 08039509151, 09014110374
2. Date and Place of Birth: 2nd December, 1978 / Abeokuta
3. Nationality: Nigerian
4. Martal Status: Married
5. No. of Children: 2, Ages 15 & 13
6. Name andAddress of Spouse: Mr Adeosun, Okanlawon Adeniyi, 25, Road D1 Itesiwaju CDA, off Apakila Road, Camp, Abeokuta, Ogun State, adeniyi.adeosun7@gmail. Com & 08060914222
7. Name and Address of Next of Kin: Mr. Adeosun, Okanlawon Adeniyi, 25, Road D1 Itesiwaju CDA, off Apakila Road, Camp, Abeokuta, Ogun State.
8. Date of Assumption of Duty in current establishment: 01/09/2006
9. Status on first appointment in current establishment: Full employment/ permanent
10. Present Position: Class teacher/ Level 13
11. Date of last promotion: 01/07/2022
12. Date of confirmation of appointment: 01/09/2008
13. If not confirmed why:
14. Present Salary: #208,492.26k
15. Faculty : Education
16. Department : Science Eduaction

### B. Education

Educational Institutions Attended with Dates and Qualification:

i. Primary Education: Saints Michael African Church Primary School, Ilugun-Ijebu Ogun State . 1985 – 1991 1st Sch. Leaving Cert.

ii. Secondary Education:
Raluwen High School, Atan-Ijebu 1991 – 1997 WASSCE

iii. Higher Education:

| | | |
|---|---|---|
| Federal College of Education, Osiele, Abeokuta | 2001 – 2004 | NCE |
| Tai Solarin University of Education, Ijebu-Ode | 2006 – 2011 | BSc/Ed |
| Lead City University, Ibadan | 2019-2021 | M.SC(Ed) |

iv. Lead City University, Ibadan 2022 - 2025 Ph(D) Inview

C. Awards and Fellowships:

**D. 1. Work Experience with Date**

| | | |
|---|---|---|
| i. | Mercyland International School, Oke-Ilewo, Abeokuta | 2004 |
| ii. | Excel Kiddies, Onikoko, Abeokuta | 2005 |
| iii. | Oke-Ona Grammar School, Iberekodo, Abeokuta | 2006–2012 |
| iv. | Nawar-ud-deen Grammar School, Obantoko, Abeokuta | 2012 |
| v. | Muslim High School, Isolu, Abeokuta | 2012 -2022 |
| vi. | Egba Odeda High School (Senior) Odeda | 2022-2025 |
| vii. | Lagos State University, Federal College of Education Abeokuta Study Centre (Adjunct Lecturer) : | 2022-2025 |
| viii. | Centre for Undergraduate Programes, Federal College of Education Abeokuta in affilation with University of Ibadan (Adjunct Lecturer): | 2023-2025 |

. 2. Course taught within the current academic sessions

i. BOT 414 : Economic Botany, 3E
ii. ZOO 306: General Histology, 2C

iii.TEE 336: Biology Method II, 3C

iv. BOT 211: Lower Plants, 3R

3. Current undergraduate Studies Supervision: 3Students

4. Current undergraduate Studies Supervision: Nil

E. **Membership of Professional Bodies**:

i. Qualified Teacher Status(QTS),
ii. Academic Staff Union of Secondary Schools (ASUSS)
iii. Science Teacher Association of Nigeria (STAN)
iv. Teacher Registration Council of Nigeria (TRCN)

F. **Publications** :

**1. Thesis/ Dissertation**:

i. Laboratory Facilities and Public Senior Secondary School Students' Academic Achievement in Biology in Abeokuta Metropolis, Ogun state International Journal of Education and Evaluation (IJEE) E-ISSN 2489-0073, P-ISSN 2695-1940 10( 3), 2024., 304-323.www.ijee.io

ii. Improvisation An Effective Means for Science Instructional Materials in Nigeria(Dec., 2024) International Journal of Education and Evaluation (IJEE) E-ISSN 2489-0073, P-ISSN 2695-1940 10( 3) December 2024.

iii. Incidence and Practical Tip on the Control of Sexually Transmitted Diseases (STDs) Among Females (A Case Study of Federal College of Education, Osiele, Abeokuta).
iv. Effect of Teachers Education on Student Academic Performance in Integrated Science in Abeokuta North Local Government Area of Ogun State.
v. Laboratory Facilities, Teaching Methods and Public Senior Secondary School Students' Academic Achievement in Biology in Abeokuta, Ogun State

2. Books/Monographs: Nil

3. Published Refereed Conference Proceedings: Nil

4. Papers Accepted for Publication:

5. Book Reviws and Commentaries in Scholarly journals:

6. Technical Reports:

7. Other publications:

8. Creative Work: Improvisation of instructional material for science teaching'

**G. Notable Scholarly or Professionl Accomplishments;**

i. Incidence and Practical Tip on the Control of Sexually Transmitted Diseases (STDs) Among Females (A Case Study of Federal College of Education, Osiele, Abeokuta).
ii. Effect of Teachers Education on Student Academic Performance in Integrated Science in Abeokuta North Local Government Area of Ogun State.
iii. Laboratory Facilities, Teaching Methods and Public Senior Secondary School Students' Academic Achievement in Biology in Abeokuta, Ogun State.

**H. Major Conferences/Workshops Attended:**

i. Skill Improvement Course for Integrated Science Teachers in the Junior Secondary Schools in Ogun State.
ii. Retraining of Junior Secondary Schools on Basic Science.
iii. Train the Trainers Workshop for Biology Teachers
iv. Capacity building seminar for trustees, commotee members and all stakeholders of cooperative societies and unions in Ogun State.

**I. Services Within the University:**

**1. Services within the Dept.**
**2. Services within the Faculty:**
**3. Services Within the University:**

**4. Services Outside the University (Local, State or National or internaltional)**

**J. Extra Curriculat Activities : Singing**
**K. Others**
**L. Name and Addresses of Referees**

i Prof. L.T. Egbeyale
HOD, Department of Animal Production and Health,
College of Animal Science and Livestock Production,
Federal University of Agriculture, Abeokuta (FUNNAB)
Abeokuta,Ogun State.
Tel. 08060743664

ii Prof. Philias O. Yara
HOD, Science Education,
Faculty of Education,
Lead City University Ibadan, Oyo State
Tel 08034715891



**Signature** **Date**

**The University Compliance Certification**

This is to certify that the thesis by Motunrayo Idowu, ADEOSUN with the matriculation number LCU/PG/000547 in the Department of Science Education, Faculty of Education, Lead City University, Ibadan is in full compliance with the approved University Format and style.

**Signature** **Date**

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