EFFECTS OF FIELD-BASED TEACHING STRATEGY ON INTEREST, RETENTION AND PERFORMANCE IN CLIMATE CHANGE AMONG SECONDARY SCHOOL STUDENTS IN ANCHAU, KADUNA, NIGERIA

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NOVEMBER, 2016

DECLARATION

I declare that the work in this dissertation entitled " Effects of Field-based Teaching Strategy on Interest, Retention and Performance in Climate Change among Secondary School Students in Anchau, Kaduna, Nigeria" has been carried out by me in the Department of Science Education. The information derived from the literature were duly acknowledged in the text and referenced accordingly. No part of this dissertation was previously presented for the award of another degree or diploma at this or any other institution.

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Name of Student	Signature	Date

CERTIFICATON

This dissertation entitled " Effects of Field-based Teaching Strategy on Interest, Retention and Performance in Climate Change among Secondary School Students in Anchau, Kaduna, Nigeria" by Kabirat Omowumi YAKUBU (M.Ed/EDUC/15452/2011-2012) meets the regulations governing the award of the degree of Masters in Science Education (M.Ed) of Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to my parents Mallam Ahmad and Hajia Risikat Ajibosin, my husband, Dr Yakubu Obadaki Yusuf, and my children, Abdullahi, Abdurrahman and Maryam As-Siddiqah.

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OPERATIONAL DEFINITION OF TERMS

Academic Performance: It is the display of knowledge attained by the students in the school subject, usually measured by test scores or marks assigned by the teachers which can either be high or low.

Climate Change: This refers to any long-term change in the pattern of average weather of a specific region or the whole earth most especially increases in the mean temperature of the earth's spheres.

Field-based Teaching Strategy: It implies the teaching method which takes place outside the classroom.

Greenhouse Effect: It is the increase in temperature on earth as certain gases in the Atmosphere trap energy.

Greenhouse Gases: These are the gases that trap energy in the atmosphere and re-radiate the energy to keep the earth warm. Increase in their concentration causes increase in temperature on the earth.

Interest: It is an individual's focused attention and/or engagement with particular events and objects.

Lecture Method: This involves verbal presentation of ideas, concepts and facts to students in the classroom.

Retention: It is the ability to remember information or knowledge gained after learning.

Teaching Strategy: It is the method of teaching students in classroom.

ABBREVIATIONS USED

CG: Control Group

CCCIQ: Climate Change Concept Interest Questionnaire

CCCPT : Climate Change Concept Performance Test

EG : Experimental Group

NECO: National Examinations Council of Nigeria

O_1: Pretest

O_2: Posttest

O_3: Postpost test

WAEC: West African Examinations Council

X0: No Treatment (lecture method)

X1: Treatment using Field-based Teaching Strategy

ABSTRACT

This study investigated the effects of Field-based Teaching Strategy on Interest, Retention and Performance in Climate Change among Secondary School Students in Anchau, Kaduna, Nigeria. The study adopted the quasi experimental non-equivalent pretest, posttest control group design. The population of the study consisted of 1,655 SS II Geography students (1,010 males and 645 females). The sample for the study consisted of 75 students who were randomly assigned into experimental and control groups. 35 students in the experimental group were taught using Field-based Teaching Strategy and 40 students in the control group were taught with lecture method for six weeks. Two instruments, namely Climate Change Performance Test (CCPT) and Climate Change Interest Questionnaire (CCIQ) were developed and used for data collection. The reliability coefficient of CCPT is 0.64and that of CCIQ is 0.70. Six objectives, research questions and six hypotheses were raised. Among the hypotheses of the study is that there is no significant difference between the mean academic performance scores and retention ability of students taught Climate Change Concepts using Field-based Teaching Strategy and those taught using lecture method only. Data was analyzed descriptively using means, standard deviations , mean ranks and sum of mean ranks. Inferentially, hypotheses were tested using t-test and Mann-Whitney U-test at $p \leq 0.05$ levels of significance. Findings of the study showed a significant difference in interest, retention and performance between students taught Climate Change using Field-based Teaching Strategy and those taught using lecture method in favour of those taught using Field-based Teaching Strategy- ($p \geq 0.03, 0.01, 0.01$ respectively). Findings of the study also indicated no significant difference in interest, retention and performance between male and female students in the experimental group which implies the teaching strategy is gender friendly. Based on the findings of the study, it was recommended amongst others that geography teachers should use Field-based Teaching Strategy to teach the concepts of Climate Change.

CHAPTER ONE

THE PROBLEM

1.1. Introduction

Geography as a discipline is the study of man and his environment, that is, physical, political, economic and socio-cultural environments (Atere, 2006). According to Abdulkarim (2010), geography as an academic subject is geared towards teaching the interrelationships among phenomenon on the earth surface and those in the atmosphere. As a Senior Secondary School subject according to Obioma (2008), the Nigerian Educational Research and Development Council (NERDC) summarized the scope of geography into seven themes -Local Geography, The earth and solar system, Environment and its resources, Regional Geography of Nigeria, Map reading and interpretation, Economic and Human Geography and Introductory Geographic Information System . Weather concepts (meteorology), climate and Climate Change were embedded under the Environment and its resources theme. According to Abdulkarim (2010), Weather and Climate concepts develop the skills of observation, measurement, recording and experimenting among students . Meteorology, as with any science, is most meaningful when learned through observations, experimentation, hypothesizing, testing, and drawing conclusions (National Oceanic and Atmospheric Administration, 2013). Looking for patterns in weather observations helps students gain an understanding of the atmospheric processes because scientists have observed and tracked the spatio-temporal changes of the planetary ecosystems for several decades.

The concept of Climate Change denotes measurable increases in the mean temperature of the earth's "spheres". This warming according to Ajaero, Akukwe and Asuoha (2009), is brought about by the increasing levels of heat trapping gases (green house gases – GHGs) in the atmosphere. According to Ekpoh (2009), Climate Change refers to any long-term change in the pattern of average weather of a specific region or the whole earth. It is an abnormal variation in the earth's climate that usually occurs over duration ranging from decades to millions of years. Medugu (2011), viewed it as an increase in global temperatures. Similarly, United Nations Framework Convention on Climate Change (UNFCC) in Vilnius (2006) defined the phenomenon as a process that alters the composition of the global atmospheric temperatures. It is also seen as any long-term significant change in the expected patterns of average weather of a specific region over an appropriately significant period of time (Aviation and Global Atmosphere, 2001).

Climate Change was discussed in two categories : as an environmental issue and as a scientific field of study. Climate change as a scientific definition, is a change in the long term average weather variables in a certain region, and also changes to year–to–year variation of weather variables in that region. As an environmental issue, climate change refers to regional and global scale changes in climate due to human activities, in particular the emission of greenhouse gases, which cause changes in the heat balance of our climate (Harvey, 2000; Ajaero *et al*, 2009).

Climate change has impacts on every society and all sectors of the economy. According to Madu (2009), no social or economic sector is immuned from the impacts. Hence it is multidisciplinary in context. Climate change is a diverse and complicated issue for both scientists and members of the public (Elise, 2009). Edo (2013), reported Climate Change as one of the greatest challenges to survival and development in the 21st Century. Misconceptions on Climate Change have resulted in disjointed mitigation of its impact on communities by stakeholders, scholars and challenged geography educators to evaluate and re-model school curricular and teaching strategies . In addition, the associated vulnerability/risks associated with change of climate have to a large extent influenced the global community towards coordinated action plans for livelihood options (Abdulkarim and Sarki, 2013; Edo, 2013).

In order to achieve a holistic understanding of the intrigues of the physical environment and educate future generations on Climate Change, environmental educators and science researchers suggested the introduction of the concept to young students in schools. Assessing how students understand Climate Change and its effects will facilitate understanding the role of education in addressing this issue and identify gaps that ought to be filled by future climate change education programmes (McCright, Shea, Sweeder, Urquhart and Zeleke, 2013).

Amosun (2002) observed that, the performance of candidates in the West African Examination Council (WAEC) in Nigeria is becoming poorer every year. A critical observation of students' results of geography through a period of ten years shows that there was no improvement as no year records even up to 40% pass at credit level. WAEC as an examination body have outlined some weaknesses resulting to poor performance of students in the final year geography examination. in 2009, 2011 and 2012, the WAEC chief examiner reported that students performance in questions related to weather and climate was relatively poor both at the internal and external examination (WAEC, 2009, 2011 and 2012). An analysis of students result in geography in the National Examination Council of Nigeria (NECO) for a period of five years is presented in Table 1.1:

Table 1.1 Candidates' Performance in Geography (SSCE) 2010-2014, Nigeria

Year	Number sat	Credit (A1-C6)	Total Passed (D7-D8)	Total Failed (F9)
2010	711,689	163,438 (22.96%)	361,620 (50.81%)	149,877 (21.06%)
2011	674,686	153,613 (22.77%)	460,333 (68.23%)	32,401 (4.80%)
2012	703,316	345,921 (49.18%)	317,648 (45.16%)	33,027 (4.70%)
2013	671,991	432,239 (64.32%)	206,905 (30.79%)	28,010 (4.17%)
2014	431,230	297,495 (68.99%)	112,489 (26.09%)	19,689 (4.57%)

Source: (National Examination Council of Nigeria, 2015).

The result presented in Table 1.1actually revealed a steady decrease in the number of students that sat for the examination and an increase in the percentage of students with credit and pass and a decrease in percentage failed, but the percentage passed and failed is still a source of worry, hence the need to improve on the teaching strategies employed in the schools in order to improve students' performance, as poor teaching method and unqualified teachers are some factors highlighted out as problems affecting students' performance (Obasi, 2011).

Strategies for teaching geography range from observation, laboratory, project, inquiry, demonstration, lecture and discussion (Harichandan, Shaik and Sunni, 2010; Obeka, 2010).

Observational learning occurs when an observer's behaviour changes after viewing the behaviour of a model (Funderstanding, 2015). Learning by observation involves four separate processes: attention, retention, production and motivation. Attention and retention account for acquisition or learning of a model's behaviour; production and motivation control the performance (Funderstanding, 2015). According to Martinez and Garcia (2010), observation of an actual experience in the field or of a demonstration provides for learning through modelling.

Learning according to Halpern and Hakel (2003), which refers to academic and cognitive gain, is enhanced when it occurs under varied conditions, such as in the laboratory and in the field. Field-based education is one component of active environmental education. There is a strong agreement that fieldwork is advantageous for learning in the biosciences and nature studies has traditionally had strong connections with fieldwork, dating back to early naturalists such as Gilbert White, Charles Darwin and Wallace (Alexandar and Poyyamoli, 2014). Growing evidence indicates that supplementing labs and lectures with field-based research experiences and an approach that models the scientific process leads to increased learning and knowledge retention (Handelsman et al. 2004). According to Deslauriers and Wieman (2011), students' feelings towards science have been measured to be strong where laboratory and/or field work form a portion of the learning activities.

Educators and researchers have repeatedly acknowledged the drawbacks of teaching with a strict lecture format (Willams and McClure, 2010). In traditional teaching, the teacher decides which topics to include, in what sequence, and in what ways. The teacher is the authority and students are the passive recipients. Halpern (2000) reported that the lecture method has long since failed these educators as an effective teaching method for young students. Teaching resources for discussion, demonstration or simulations are often not used at lecture lessons. (Aminu, 2015).

An issue of concern in educational institutions across the world is the retention and success of students in their studies (Crosling, Heagney and Thomas, 2009). Academic performance is considered to be the benchmark of academic progress. According to Nwokocha and Amadike (2005), it is the yardstick for testing educational quality of a nation. It helps shape the minds of students. Engagement in meaningful learning is a universal theme advanced in literature on students' performance. Adeyemi (2008a) argued that the educational system is a productive system that has outputs. The outputs are generally defined in terms of students' test scores which denote academic achievement. Student achievement is produced by several inputs in the educational process of which the teacher as an input is the principal factor in education provision and thus affects the quality of education in a significant way (Adeyemi, 2008a). Retention, according to Bichi (2002) is the ability to retain and later recall information or knowledge gained after learning. Although the gap in retention of science content could be the result of many causes such as lack of parental involvement, cultural attitude towards, education, and the educational resources available at home of a child, the school and its teachers can have a significant impact on a student's education (Morgan, 2012). In traditional teaching, the teacher decides which topics to include, in what sequence, and in what ways. The teacher is the authority and students are the passive recipients. Although this type of teaching may improve test scores in the short term, they do little to improve student learning and content knowledge retention (Blanchard, 2010).

Interest judgements according to Hidi (2001), are defined as relatively stable preferences that are focused on objects, activities, or experiences. Greater congruence between one's Interests and one's environment leads to greater satisfaction, performance, and persistence in activities. Academic interest in one domain is correlated with achievement in that domain. Interest is a commonly used expression in day-to-day life. Interest has a great influence on human behaviour. A study carried out by Uitto (2011), on secondary school students' interest, attitudes and values concerning school science related to environmental issues in Finland, he found out that students were not especially interested in environmental issues of which Climate Change is included. According to Tankersley (2009), Climate Change is a concern among undergraduates, driving a surge of interest in science and engineering on campus nationwide in the United State. Some educators suggest that concern about Climate Change is galvanizing more undergraduate students to turn toward a subject involving science and engineering. This finding is in agreement with the findings of Ifeakor (2007) that teaching science through activity-based methods has a significant effect in fostering students' interest in science subjects than the conventional method of teaching. In the work of Ozdemir (2012) in Turkey, about 80% of the 200 students sampled loved geography lesson with an increasing level of interest on natural hazards and other environmental problems and they have paid attention to publications related to the problems such as global warming. Mohammed (2014), found out that lack of interest was a major problem affecting the teaching and learning of geography in the schools.

The issue of gender is an important issue in learning science. Onyeizugbo (2003) is of the view that sex roles are held rigid in Africa where gender differences are highly emphasized. Certain vocations and professions have traditionally been regarded as men's (medicine, engineering, architecture) and others as women's (nursing, catering, typing). What are regarded as complex and difficult tasks are allocated to the boys, whereas girls are expected to handle the relatively easy and less demanding tasks. According to Erinosho (2005), gender issues, both on the part of the teachers and students, have been documented to affect performance generally. Kolawole (2007), said that there are still significant differences in the cognitive, affective and psychomotor skill achievement of students in respect of gender.

1.1.1 Theoretical Framework

Theories of learning served as framework to support teaching and learning methods. The theoretical basis for Field-based Teaching Strategy is Piaget's developmental theory of learning and thinking that the child should be able to explore his environment for effective learning.

According to Taber (2011), the Piagetian theory (a constructivism theory) advocates that provisions for direct experiential, relational opportunities assist and enhance learning. Constructivism gives rise to the idea that learners are not passive recipients of information, but that they actively construct their knowledge in interaction with the environment and through the reorganization of their mental structures. Learners are therefore viewed as sense-makers, not simply recording given information but interpreting it. This view of learning led to the shift from the “knowledge-acquisition” to “knowledge-construction” metaphor.

In a constructivist classroom, according to Gray (2007), learners are actively involved, the environment is democractic, the activities are interactive and student-centered. The teacher facilitates a process of learning in which students are encouraged to be responsible and autonomous. To the constructivist, knowledge resides in the individual learner, and as such, learning is a process through which an individual tries to make sense of what is taught by trying to fit it into his/her existing knowledge structure and prior experience (Erinosho, 2008). So, the use of active instructional techiques like the Field-based Teaching Strategy which is a component of active learning can help build up students’ knowledge of science and perform better.

This study also emphasised the behaviourist theory of learning which focuses on interest and retention ability of learners. Behaviourism is primarily concerned with observable and measurable aspects of human behaviour (John B. Watson, 1878-1958). In defining behaviour, behaviourist learning theories emphasize changes in behaviour that result from stimulus-response associations made by the learner. Behaviour is directed by stimuli. An individual selects one response instead of another because of prior conditioning and psychological drives existing at the moment of the action (Parkay and Hass, 2000). The implication of this theory as observed by

Aggrawal (2008) is that conditioned response developed desirable habits, interests attitudes and sense of belonging to children. This study will use Field-based learning as stimuli and its effect will be observed on the students' retention and interest in learning of Climate Change.

1.2 Statement of the Problem

Poor academic performance of students in Geography (WAEC, 2011) has been linked to poor teachers' performance in terms of accomplishing the teaching task, which have been attributed to instructional strategy (Sabitu and Nuradeen, 2010; Aderogba, (2012); Rilwan, Akahomen and Gbakeji, 2014). According to Abdulkarim (2011), limited use of instructional strategies and materials by staff and students for teaching geography are regarded as the major challenges of teaching geography in secondary schools of Nigeria.

The teaching of geography in Nigeria has focused on the use of conventional teaching method, which always makes teachers to dominate the class while the learner remain passive. The use of conventional method often responsible for learners' low interest and poor academic achievement of students in the subject. It discourage open questions, inquiry and active participation of students and makes geography classes difficult and boring (Sofowora and Egbedokun, 2010). This study aims at addressing this problem by exposing the geography students to Field-based Teaching Strategy. In addition, this study examines the effects of Field-based Teaching Strategy on the performance, retention and interest of students in learning Climate Change using male and female students in Anchau Educational Zone, Kaduna State.

1.3 Objectives of the Study

The study investigated the effects of Field-based Teaching Strategy on interest, retention and performance of studentsin the concepts of Climate Change . Specifically, the study was guided by following objectives to:

i. examine the effects of Field-based Teaching Strategy on Senior Secondary School students' academic performance in the concepts of Climate Change.

ii. determine the effects of Field-based Teaching Strategy on students' retention in the concepts of Climate Change.

iii. investigate the effects of Field-based Teaching Strategy on students' interest in the concepts of Climate Change.

iv. examine the effects of Field-based Teaching Strategy on the academic performance of male and female students in the concepts of Climate Change.

v. examine the effects of Field-based Teaching Strategy on the retention ability of male and female students in the concepts of Climate Change.

vi. examine the effects of Field-based Teaching Strategy on male and female students' interest in the concepts of Climate Change.

1.4 Research Questions

The following research questions guided the conduct of this study:

1. What is the difference between the mean scores of geography students taught Climate Change using the Field-based Teaching Strategy and those taught using the lecture method?
2. What is the difference between the retention level of geography students taught Climate Change using Field-based teaching strategy and those taught using the lecture method?
3. What is the difference between the interest level of geography students taught Climate Change using the Field-based Teaching Strategy and those taught using the lecture method?

4. What is the difference between the mean score of male and female geography students taught Climate Change using Field-based Teaching Strategy?
5. What is the difference between the retention level of male and female geography students taught Climate Change using Field-based Teaching Strategy?
6. What is the difference between the interest level of male and female geography students taught Climate Change using Field-based Teaching Strategy?

1.5 Null Hypotheses

The following null hypotheses were tested at $p \leq 0.05$ level of significance:

Ho_1: There is no significant difference between the mean scores of geography students taught Climate Change using Field-based Teaching Strategy and those taught using lecture method.

Ho_2: There is no significant difference between the retention ability of students taught Climate Change using Field-based Teaching Strategy and those taught using lecture method.

Ho_3: There is no significant difference between the interest level of geography students exposed to Climate Change using Field-based Teaching Strategy and those taught with lecture method.

Ho_4: There is no significant difference between the mean scores of male and female geography students taught Climate Change using Field-based Teaching Strategy.

Ho_5 : There is no significant difference between the retention ability of male and female geography students taught Climate Change using Field-based Teaching Strategy.

Ho_6 : There is no significant difference between the interest level of male and female geography students taught Climate Change using Field-based Teaching Strategy.

1.6 Significance of the Study

This research seeks to assess the effects of Field-based Teaching Strategy on the retention, performance and interest of geography students in the concepts of Climate Change. The findings of this research will hopefully benefit the students, teachers, curriculum planners, textbook publishers and fellow researchers.

Students' understanding and interest in the concepts of Climate Change will be improved upon as Field-based Teaching strategy take the students outside the classroom where they will get in contact with the real world. This hopefully will help them develop learning skills like observation recording and reporting and hence meaningful learning. The teachers will also appreciate the value of taking the students out into the field and reduce the stress of talking all the time. As such he will be able to observe and understand the skills possess by individual students. The principals of schools may find the result of this study useful and as such, encourages and emphasizes the use of the Field-based Teaching methods especially in science subjects.

The curriculum planners on their own part may also emphasize the Field-based activities in the curriculum. Text book publishers will also find this study useful to emphasize Field-based Teaching activities when they publish materials on Climate Change Concepts for secondary schools. Fellow researchers may also use the findings from this study to carry out the research in other areas and to even improve on it. Most importantly, this research hopefully will be of benefit to the schools in the study region (Anchau Educational Zone) .

1.7 Basic Assumptions

This study is based on the assumptions that the geography students in Anchau Educational Zone are taught by qualified geography teachers and all the schools use the same syllabus (National Curriculum) for teaching geography lessons.

1.8 Scope/Delimitation of the Study

The study focuses on the effect of Field-based Teaching strategy on the retention, performance and interest of geography students in Climate Change Concepts in Anchau Educational Zone of Kaduna State. The study is restricted to public secondary schools of this zone including the male and female students. The population of the study consists of SS 2 students offering geography. This is due to the fact that SS 2 students have covered a substantial areas in the course. The Climate Change Concepts to be used for the study include: definition of weather and climate, elements of weather and climate, definition of Climate Change, causes of Climate Change, greenhouse effect, effects of Climate Change and solutions to the problem of Climate Change. The time extent for the study is six weeks.

CHAPTER TWO

REVIEW OF RELATED LITERATURES

2.1 Introduction

The focus of this study is to investigate the effects of Field-based Teaching Strategy on interest, retention and performance of geography students in the concepts of Climate Change in Anchau, Kaduna State. In chapter one, objectives of the study, research questions and null hypotheses were outlined. This chapter reviews literature relevant to the study. The chapter is presented under the following subheadings:

- Concept and Scope of Geography Education
- Concept of Climate Change
- Geography/Science Teaching Methods in Senior Secondary Schools
- Field-Based Teaching Strategy
- Lecture Method
- Gender and Academic Performance in Geography/Science Education
- Retention and Academic Performance
- Interest in Teaching and Learning
- Overview of Related Studies on Field-based Teaching Strategy
- Implications of Literature Reviewed on the Present Study

2.2 The Concept and Scope of Geography Education

Geography is a branch of science that studies lands, its features, and inhabitants as well as the phenomena of the planet Earth. The first person to use the word geography was Eratosthenes and literally means "writing about the Earth" (Harichandan *et al* , 2010). Geography is a fascinating subject and means much more than writing about the earth but it's a difficult discipline to define. It reveals all the wonderful changes and activities that have been going on in the world since the beginning of time. Geography draws from across the physical, cultural, economic and political spheres to the local and the global. Through Geography, the diversity of landscapes, peoples and cultures is appreciated, Geography is therefore a vital subject resource for 21st century global citizens, enabling us to face questions of what it means to like sustainably in an interdependent world. Essentially geography was a study of mankind. Today, geography can be defined as a science of man on the earth studying the action and interaction between man and nature.

Geography is an academic subject taught in senior secondary school level (FGN, 2004). Geography derives a lot of material from Biology, Sociology, Mathematics, Chemistry, Physics and Astronomy. The subject matter of geography includes study of natural environment of man and also the study of social and cultural environment. Thus geography has a very wide scope unparalleled by any other subject geography is a science and an art (Harichandan *et al.*, 2010). According to Strahler and Strahler (2006), geography is divided into two broad realms: physical geography (which examines the natural processes occurring at the Earth's surface- climate, landforms, soils, vegetation, water resources) and human geography (which deals with social, economic and behavioural process that differentiate places like population, agriculture, transportation, settlement patterns, regional development, tourism, economic activities, politics). It has its educational value in its power of observation, memory, imagination, judgement and reasoning (Kozar and Marcketti, 2008).

The objectives of teaching Geography according to Atere (2006), include: Educating learners on the characteristics of their immediate environment; The acquisition of skills that facilitate comprehending the spatial relations of features and phenomena; To develop in learners the critical thinking ability, accuracy and objectivity for proper and logical investigation; To develop in learners a comprehension of the spatial relationship and various features on the surface of the earth; To enable learners comprehend the habitation of man within his environment. Geography in accordance with the National Policy on Education should also help the Nigerian Secondary School Students to develop skills and techniques for accurate, orderly objective geographical investigations to be carried out both in the classroom and in the immediate environment.

The new geography curriculum of Nigeria reflects the total experience to which all learners must be exposed (Obioma, 2008). This curriculum came into being from workshop and meetings held by a committee of experts chaired by the National Educational Research and Development Council (NERDC) between January 2007 and March 2008 at Ibadan. Then Climate Change as a topic under the Environment and its resources theme was included, making the curriculum to compose of fifty-two contents to be covered within a total periods of nine terms. The contents, objectives, activities for both teachers and learners, teaching materials and evaluation guide were all provided in the curriculum according to Obioma (2008).

2.3 The Concept of Climate Change

"Climate Change" was reported as global fluctuations of atmospheric phenomena (Aviation and Global Atmosphere, 2001). The Intergovernmental Panel on Climate Change, IPCC (2007) defined Climate Change as a change in climate over time, whether due to natural variability or as a result of human activity. According to Oglesby (2010), variability on time scales longer than a few decades (longer than a standard climatic averaging period- 35years) is usually referred to as Climate Change. Global Climate Change is the most important science issue of the 21st century, challenging the very structure of our global society (Maslin, 2009).

Brezina (2008), said it is one of the most crucial issues that humanity will have to address during the 21st century. It is a major societal issue that many citizens do not understand , do not take seriously, and do not consider to be a major public-policy concern (Doughman and DiMento, 2007). The problem is that Climate Change is not just a scientific concern, but encompasses economics, sociology geopolitics, local politics, and individual's choice of lifestyle.

The earth absorbs radiation from the sun, mainly at the surface. This energy is then redistributed by atmospheric and oceanic circulations and radiated to space at longer ("terrestrial" or "infrared") wavelengths. On average, for the earth as a whole, incoming solar energy is balanced by outgoing terrestrial radiation. Any factor that alters radiation received from the sun or lost to space or the redistribution of energy within the atmosphere and between atmosphere, land and ocean can affect climate. A change in radiative energy available to the global Earth/atmosphere system is termed as (in previous IPCC reports) as radiative forcing. Increases in the concentrations of GHGs reduce the efficiency with which the surface of the earth radiates heat to space. More outgoing terrestrial radiation from the surface is absorbed by the atmosphere and is emitted at higher altitudes and colder temperatures. This process results in positive radiative forcing, which tends to warm the lower atmosphere and the surface. This radiative forcing is the enhanced greenhouse effect- an enhancement of an effect that has operated in the Earth's atmosphere for billions of years as a result of naturally occurring greenhouse gases. Any changes in the radiative balance of the Earth, including those resulting from an increase in the greenhouse gases will tend to alter atmospheric and oceanic temperatures and associated circulations and weather patterns(Aviation and Global Atmosphere, 2001).

Greenhouse Effect is the rise in temperature on Earth as certain gases in the atmosphere trap energy. These gases are known as the Greenhouse gases (GHGs). Many of the GHGs are actually life- enabling, for without them, heat would escape back into space and the Earth's average temperature would be a lot colder. They are also called heat-trapping gases such as carbon dioxide, methane, nitrous oxide, and chloroflourocarbons. They exist naturally in the atmosphere, where they keep the earth warm enough for plants and animals to live. But people are adding extra greenhouse gases causing the earth to get warmer, setting off all sorts of other changes around the world- on land, in the oceans, and in the atmosphere (EPA, 2010). A warming like this leads to a change which affects weather in various ways. The GHGs do not stay in one place after they are added to the atmosphere, they become globally mixed as air moves around the world. Even though some countries produce more GHGs than others, emissions from every country contribute to the problem. That's one reason why Climate Change requires global action (EPA, 2010).

2.3.1 Factors of Climate Change

In general, Climate Changes prior to the Industrial Revolution in the 1700s can be explained by natural causes, such as changes in solar energy, volcanic eruptions, and natural changes in GHGs concentration (NRC, 2010). Recent Climate Changes, however, cannot be explained by natural factors alone. Research indicates that natural factors are very unlikely to explain most observed warming, especially warming since the mid-20th century. Rather, human activities can very likely explain most of that warming (NRC, 2010). Climate Change science embodies an effort to understand an inherently interdisciplinary problem that has interwoven human and natural causes (Rebrich and Gautier, 2005). As such, Climate Change factors are splitted into two groups – man-made (anthropogenic factors), and natural factors.

Prominent natural factors that can trigger change in climate are continental drift, volcanicity, ocean currents, the earth's tilt (Endersbee, 2008). According to scientists, back then, the continents of the world were all part of one large landmass. This Continental drift has an impact on the climate because it changed the physical features of the landmass, their position and the position of water bodies. The separation of the continents changed the flow of ocean currents and wind patterns, which in turn affects the climate. Volcanic eruptions are associated with the discharge of sulphur dioxide, water vapour, dust, ash and cinder into the stratosphere. The ash, dust and cinder rise high enough to form a blanket of ash and cinder that blurr solar rays from reaching the Earth's surface. Solar rays is reflected off the ash and cinder thus lowering the average temperature. Mount Pinatubo (Philippines) erupted in 1991and released 17 million tonnes of sulphur dioxide. This reduced the global heat average and sunshine intensity by 10%, and cooled the earth by 0.5^0c for about a year (Slide Share, 2009).

Changes in the tilt of the earth affect the severity of the seasons. Critical tilt generate warmer summers and colder winters while less tilt means cooler summers and milder winters. Oceans as sources of atmospheric oscillations absorb twice as much of the sun's radiation as the atmosphere and the land surface. Water vapour and clouds over the ocean have also resulted in a net loss of solar energy with a net cooling effect (EPA, 2010). A decrease in solar activity is thought to have triggered the little Ice Age between approximately 1650 and 1850, when Greenland was largely cut off by ice. The repeated cycles of glacial (cold) and interglacial (warm) periods has been attributed to regular changes in earth's orbits and rotation, and the amount of Green House Gases in the earths' atmosphere. Changes occurring in the sun itself can affect the intensity of the sunlight that reaches Earth's surface. The intensity of the sunlight can cause either warming (during periods of stronger solar intensity) or cooling (during periods of weaker solar intensity) (Endersbee, 2008; USGCRP, 2009 and NRC, 2010).

Research indicated that natural factors are very unlikely to explain most observed warming, especially warming since the mid-20th century. Rather, human activities can very likely explain most of that warming (NRC, 2010; Nidirect, 2013). Most climatologists agree the main cause of the current global warming trend is human expansion of the “greenhouse effect”- warming that results when the atmosphere traps heat radiating from Earth toward space.

An Assessment Report of the IPCC (2007) indicated that 90% of human activities have contributed to the warming of the earth. The report extended that atmospheric carbon dioxide levels have risen from 280 parts per million to 379 parts per million in 150 years. The Industrial Revolution in the 19th century saw the large scale use of fossil fuel for industrial activities. These industries created jobs and over the years, people moved from rural to the cities. This trend is continuing even today (Tuckett, 2009). Man-made causes probably do the most damage. Pollution is one of the biggest man-made problems. Burning fossil fuels is one thing that causes pollution. Fossil fuels are fuels made of organic matter such as coal or oil. When fossil fuels are burned, they give off a greenhouse gas called carbon dioxide. According to Johnson (2009), Carbon dioxide is the biggest culprit in global warming, people do many things that release carbon dioxide into the air and by far the most significant is burning fossil fuels. Mining coal and oil also allows methane to escape (Pidwirny, 2013).

Another major man-made cause of global warming is population. More people mean more food, and more methods of transpiration. That means more methane because there will be more burning of fuels, and more agriculture. Because more food is needed, there is need to raise food. Since carbon dioxide contributes to global warming, the increase in population makes the problem worse because we breath out carbon dioxide. Moreover, the trees that convert our carbon dioxide to oxygen are being destroyed because we are using the land that we cut the trees down from as property for our homes and building (Nidirect, 2013). People are adding several types of greenhouse gases to the atmosphere, and each gas' effect on Climate Change depends on three main factors- How much?, How long?, How powerful? (EPA, 2010).

Carbon dioxide is the most important anthropogenic greenhouse gas. Its annual emission grew by about 80% between 1970 and 2004 (IPCC Fourth Assessment Report: Climate Change, 2007). Carbon dioxide is released into the atmosphere through processes like burning of fossil fuels to produce electricity, burning gasoline and other fossil fuels to run vehicles, cutting down and burning of trees or other vegetation, some industrial and manufacturing processes, like producing cement and certain chemicals (EPA, 2010). Raising livestock such as cows and sheep produce methane as they digest food. Manure also releases methane when they decay. Natural gas is made mostly of methane, which is released if there are even small leaks in gas pipes. Methane is often found underground with coal and can be released during mining (EPA, 2010). Farming practices add extra nitrogen to the soil, such as applying fertilizer. Certain bacteria that live in the soil turn this extra nitrogen into nitrous oxide. Burning fossil fuels, some industrial and manufacturing processes also add nitrous oxide into the atmosphere (EPA, 2010). Leaking coolants from leaky refrigerators, freezers and air conditioners in cars and homes, some industrial and manufacturing processes like producing computer chips also introduce flourinated gases into the atmosphere (EPA, 2010).

Other gases that stay in the atmosphere for a long time include chloroflourocarbons (CFCs). CFCs damage the ozone layer, so countries of the world have joined hands together and agreed to stop using these chemicals . As a result , the emissions of CFCs are already decreasing, and they will continue to decrease over time (EPA, 2010). In essence, greenhouse gases comes from all sorts of everyday activities, such as using electricity, heating our homes, transportation, agriculture, mining, deforestation, and manufacturing (Kininmonth, 2004; Johnson, 2009). The greenhouse gases don't just stay in one place after they are added to the atmosphere, they become globally mixed as they move around the world. The fifth IPCC reports states with 95% confidence that humans are the main cause of the current global warming saying it is "extremely likely that human activities have causes most of the warming of the planet's surface that have occurred since the 1950s (Abraham and Nuccitelli, 2013; Chow, 2013). This is an increase from the 90% certainty in the fourth IPCC report. As such, scientists are convinced that most of the Earth's recent warming is the result of too much of a good thing (Johnson, 2009).

2.3.2 Impacts of Climate Change

Climate Change is a real and urgent challenge that is already affecting people and the environment worldwide. Recent scientific findings indicate that a changing climate has a significant impact on our planet (UNICEF, 2007). The report of the IPCC (2007), concluded that only immediate and sustained action will stop Climate Change from causing irreversible and potentially catastrophic damage to our environment. Greenhouse gases can stay in the atmosphere for an amount of years ranging from decades to hundreds and thousands of years. No matter what we do, Climate Change is going to have some effect on Earth. Climate Change has global impacts relative to both its causes and its effects. These impacts, however are not distributed evenly but have created dissimilar effects across different latitudes, altitudes and even groups of people, within the same location (Malthias and Ibarraran, 2009). Some of the manifestations of Climate Change on the Earth are discussed:

a. Increase in Average Global Temperature: one of the most immediate and obvious impacts of Climate Change is the increase in temperatures around the world. The average global temperature has increased by about 1.4^0 F(0.8^0C) over the past 100 years, according to the National Oceanic and Atmospheric Administration (NOAA). Since record keeping began in 1895, the hottest year on record for the 48 contiguous U.S States was 2012 (Lallanilla, 2013). Worldwide, 2012 was also the warmest year on record, according to NOAA. And nine of the warmest years on record have occurred since 2000. This rise in average temperature have far-reaching effects on the earth's climate patterns and on all living things. Many of these changes have already begun (NRDC, 2013). Higher temperatures have led to increased drought and wildfires, heavier rainfall and a greater number of category 4 and 5 hurricanes (NRDC, 2013).

b. Extreme Weather Events: Scientists predict that extreme weather events such as heat waves, droughts, blizzards rainstorms, hurricanes, wildfires, flooding will continue to occur more often and with greater intensity due to Climate Change (Lallanilla, 2013). According to Trenberth (2011), the intensity of Atlantic hurricanes has increased in recent years, a pattern that is consistent with Climate Change. Warming oceans store increasing amounts of heat energy and fuel stronger storms. The global increase in drier, hotter areas and the trend in which dry areas are becoming drier can both be traced to the human influence (Stott, 2010). In particular, the greenhouse gas emissions have contributed significantly to recent drying by driving warming over land and ocean (Dai, 2011). Flooding represents one of the most dangerous hazards to human settlements and is one of the most potentially momentous impacts of Climate Change. As the climate changes, a warming of the seas creates "thermal expansion". According to Milly (2002), the frequency of great floods (100-year floods in large basins) increased substantially during the 20th century.

As the planet warm, dry areas of land that are susceptible to wildfires are likely to be ravaged by even more frequent and destructive episodes.. In 2012, the average size of wildfires in the U.S exceeded decadal trends, with a pattern for incidents of fewer fires but with larger size (NRDC, 2013). From a broad perspective, all weather events are now connected to Climate Change. While natural variability continues to play a key role in extreme weather, Climate Change has shifted the odds and changed the natural limits, making certain types of extreme weather more frequent and more intense.

c. Rising Sea Level and Ocean Acidification : Sea level is rising and at an accelerating rate, and will continue to rise during this century (NRDC, 2013; Union of Concerned Scientist, 2013).This trend linked to global warming puts thousands of coastal cities, and even whole islands at risk of being claimed by the ocean. The two major causes of global sea-level rise are thermal expansion caused by the warming of the oceans (since water expands as it warms) and the loss of land-based ice (such as glaciers and polar ice caps) due to increased melting (IPCC, 2007). Melting polar ice in the Arctic and Antarctic region, coupled with melting ice sheets and glaciers across Greenland, North America, South America, Europe and Asia, are expected to raise sea levels significantly. Rising sea levels put our coasts at risk such as shoreline erosion and degradation, amplified storm surges, permanent inundation and salt water intrusion- increasing the salinity of fresh water used for drinking and agriculture (Union of Concerned Scientist, 2013).

The rapid uptake of heat energy and carbon dioxide by the ocean results in a series of changes in seawater carbonate chemistry, including reductions in pH and carbonate saturation state, as well as increase in dissolved carbon dioxide and bicarbonate ions. Acidification will directly impact a wide range of marine organisms, but especially those that build their shells and skeletons from calcium carbonate, such as corals, oysters, snails, and phytoplankton and zooplankton, the tiny plants and animals that form the base of the marine food web (Doney, Fabry, Feely and Klep, 2009). The impacts on corals is of great concern because they produce massive calcium carbonate structures called reefs that provide habitat for many marine animals, including commercially important fish and shellfish species that uses the reefs as nursery ground. Coral reefs are vital to humans as sources of food and medicine, protection from storms, and the focus of eco-tourism (Doney, *et al*, 2009). According to NRDC, scientists predict that a 3.6^0F increase in temperature would wipe out 97% of the world's coral reefs (NRDC, 2013).

d. Health Implications: Changes in climate affect the average weather conditions that we are accustomed to. Warmer average temperatures will likely lead to hotter days and more frequent and longer heat waves. This could increase the number of heat-related illnesses and deaths. Increases in the frequency or severity of extreme weather events such as storms could increase the risk of dangerous flooding, high winds, and other direct threats to people and property. Changes in temperatures, precipitation patterns, and extreme events could enhance the spread of some diseases (EPA, 2013). More frequent and severe heat waves will result in a greater number of heat-related deaths. Heat waves can lead to heat stroke and dehydration and are the most common cause of weather-related deaths (CCSP, 2008; USGCRP, 2009).

Extreme weather events could cause injuries and in some cases death. It can also indirectly threaten human health in a number of ways. For example, it can reduce the availability of fresh food and water, interrupt community utility and health care services (CCSP, 2008), and contribute to carbon monoxide poisoning from portable electric generators used during and after storms. Changes in climate may enhance the spread of some diseases. Higher air temperatures can increase cases of Salmonella and other bacteria-related food poisoning because bacteria grow more rapidly in warm environments. These diseases can cause gastrointestinal distress and, in severe cases, death (USGCRP, 2009). Heavy rainfall or flooding can increase water-borne parasites such as Cryptosporidium and Giardia that are sometimes found in drinking water (USGCRP, 2009). Heavy rainfall events cause storm water runoff that may contaminate water bodies used for recreation (such as lakes and beaches) with other bacteria (Confalonieri *et al.*, 2007).

Disease-carrying mosquitoes are spreading as the climate allows them to survive in formally inhospitable areas. Malaria has been detected in new higher-elevation areas in Indonesia and Africa, posing new risks to millions of impoverished people whose health is already challenged (NRDC, 2013). Climate Change could increase smog pollution in some areas and intensify pollen allergies and asthma. Scientists project that warmer temperatures from Climate Change will increase the frequency of days with unhealthy levels of ground-level ozone, a harmful air pollutant, and a component in smog (CCSP, 2008; EPA, 2010). Ground-level ozone can damage lung tissue and can reduce lung function and inflame airways. This can increase respiratory symptoms and aggravate asthma or other lung diseases.

Warm, stagnant air tends to increase the formation of ozone, as such, Climate Change is likely to increase levels of ground-level ozone in already polluted areas of the United States and increase the number of days with poor air quality (USGCRP, 2009). Air pollution makes allergies worse. Diesel exhaust particles can interact with pollen and deliver it deeper into the lung (NRDC, 2013). Scientific studies show that a higher level of carbon dioxide spurs an increase in the growth of weeds such as ragweed whose pollen triggers allergies and exacerbates asthma (Confalonieri et al., 2007; CCSP, 2008; USGCRP, 2009; NRDC, 2013).

e. Ecosystem Shifts and Change in Biodiversity: Climate Change is transforming ecosystems on an extraordinary scale, at an extraordinary pace. As each species responds to its changing environment, its interactions with the physical world and the organisms around it change too. This triggers a cascade of impacts throughout the entire ecosystem. Increasing global temperatures are expected to disrupt ecosystems, pushing to extinction those species that cannot adapt. The first comprehensive assessment of the extinction risk from global warming found that more than 1million species could be obliterated by 2050 if the current trajectory continues (NRDC, 2013). According to the IPCC report, it was found that approximately 20-30% of plants and animal species assessed so far are likely to be at increased risk of extinction if global average temperature increases by more than 2.7 to 4.5 ^{0}F (Fischlin et al., 2007). Some polar bears are drowning because they have to swim longer distances to rich ice floes. The U.S. Geological Survey has predicted that two-thirds of the world's polar bear population will be extinct by mid-century due to melting of the Arctic ice cap. Over the past 25 years, some Antarctic Penguin populations have shrunk by 33% due to declines in winter sea-ice habitat (NRDC, 2013).

f. Agriculture and Water Sensitivities : The relationship between water, energy, agriculture and climate is a significant one (Grace Communications Foundation, 2013). Agriculture is highly exposed to Climate Change, as farming activities depend on climatic conditions. Changes in temperature, amount of carbon dioxide, and the frequency and intensity of extreme weather could have significant impacts on crop yields. For any particular crop, the effect of increased temperature will depend on the crop's optimal temperature for growth and reproduction (USGCRP, 2010). In some areas, warming may benefit the types of crops that are typically planted there. However, if warming exceeds a crop's optimum temperature, yields can decline.

g. More extreme temperature and precipitation can prevent crops from growing. Extreme events, especially floods and droughts, can harm crops and reduce yield. For example, in 2008, the Mississippi River flooded just before the harvest period for many crops, causing an estimated loss of $8 billion for farmers (USGCRP, 2009). Also, torrential rain led to the flooding of cultivated fields in Togo and Ghana, causing loss of farm crops (Ofedi and Grain, 2009). Dealing with drought could become a challenge in areas where summer temperatures are projected to increase and precipitation is projected to decrease. As water supplies are reduced, it may be more difficult to meet water demands. Many weeds, pests and fungi thrive under warmer temperatures, wetter climates, and increased carbon dioxide levels (EPA, 2013).

Heat waves, which are projected to increase under Climate Change could directly threaten livestock. Heat stress affects animals both directly and indirectly. Over time, heat stress can increase vulnerability to disease, reduce fertility, and reduce milk production. Drought may threaten pasture and feed supplies. Drought reduces the amounts of quality forage available to grazing livestock. Climate Change may increase the prevalence of parasites and diseases that affect livestock. Increases in carbon dioxide may increase the productivity of pastures, but may also decrease their quality (EPA, 2010). According to Gillis (2013), a United Nations Panel of Scientists says that globally, rising temperatures will make it harder for crops to thrive. Climate Change will pose sharp risks to the world's food supply in coming decades, potentially undermining crop production and driving up prices at a time when the demand for food is expected to soar, scientists have found.

In many areas, Climate Change is likely to increase water demand while shrinking water supplies. Warmer temperatures, increases the rate of evaporation of water into the atmosphere, in effect increasing the atmosphere's capacity to "hold" water. Increased evaporation may dry out some areas and fall as excess precipitation in other areas (EPA, 2013). As temperature rises, people and animals need more water to maintain their health and thrive. Many important economic activities, like producing energy at power plants, raising livestock, and growing food crops, also require water. The amount of water available for these activities may be reduced as Earth warms, and if competition for water resources increases (USGCRP, 2009). According to Markham (2012), Climate Change will also have an increased impact on our water resources in near future. Altered rainfall patterns, changes to underground water sources, changes in soil humidity, glacier-melt and river-flow are said to be affected by changes in our climate. The IPCC technical report on Climate Change and water resources concludes that, despite global increases in rainfall, many regions including the Mediterranean and South Africa will suffer badly from reduced rainfall and increased evaporation.

The relationship between water, energy, agriculture and climate is a significant one. More and more, the relationship is falling out of balance jeopardizing food, water and energy security. Climate Change is a phenomenon we can no longer deny as its effects have become increasingly evident worldwide (Grace Communications Foundation, 2013).

2.3.2.1 Impacts of Climate Change in Nigeria

According to the fourth IPCC report (2007), Africa will be worst hit by the effects of Climate Change which Nigeria is part of it. A report by the British risk consultancy, Maplecroft, has ranked Nigeria sixth among countries that are vulnerable to the effects of Climate Change (Azuh, 2013). According to the report published on October 31, 2013, the index was developed to identify climate risks to populations, governments and businesses over the next 30 years. The three factors that were evaluated in coming up with the findings included exposure to extreme climate-related events; the sensitivity of populations in terms of health, education, agricultural dependence and available infrastructure; and the adaptive capacity of countries to combat the impacts of Climate Change.

The 2013 index, which rated 193 countries, reported that rising sea levels, flooding and other extreme climate-related events would threaten the future of the countries that were rated high or extreme. Nigeria is one of those expected to be most affected by the impacts of Climate Change through sea level rise along her coastline, desertification, erosion and flooding disasters, and land degradation with its variety of ecosystems, from mangrove and rainforests on the Atlantic coast in the south to the savannah in the north. Nigeria is experiencing adverse climate conditions with negative impacts on the welfare of millions of people (Medugu, 2011).

Variations in Climate Change have led to devastating consequences and effects in various parts of the country (Ozor, 2009). Specifically, he stated that the south-south geopolitical zone is mainly affected by sea-level rise and deforestation-induced changes; south-west zone also is affected by sea-level rise and deforestation-induced changes; south-east by erosion, flooding and land degradation; North-central by changes due to de-vegetation and overgrazing; North-east and North-west by drought, desertification and heat stress. The Nigerian States aborting the Atlantic coast are all suffering from sea-level rise. The most recent studies predict a sea-level rise of up to six feet in the next twenty to fifty years (saharareporters.com). Most of the developments now taking place in those states will be submerged under water. Nigerian's fresh water and vegetation may be negatively impacted as the salt water of the oceans inordinate the rivers and lakes. Mangrove forests and fish may be rendered extinct. The already polluted waters in the oil producing areas of Nigeria are likely to move northwards and cause havoc in the only land areas spares in the north.

As temperature rises and rainfall pattern becomes more unpredictable, crop yields are expected to drop significantly. Also extreme weather events such as thunderstorms, heavy winds and floods devastate farmlands and can lead to crop failure. Pests and diseases migrate in response to climatic changes and variations. According to Odjugo (2010), the excessive heat, increasing water stress ,air pollution and suppressed immune system occasioned by Climate Change will result in increasing incidence of excessive death due to heat exhaustion, famine, water related diseases (diarrhea, cholera and skin diseases), inflammatory and respiratory diseases (cough and asthma), depression, skin cancer and cataract.

According to Oladipo (2012), the most practical effects noticeable by the entire Nigerian public are the vagaries of seasons and flooding. In Nigeria, flood disaster has been perilous to people, communities and institutions. In 2012, the riverine communities in rivers Niger and Benue, and other part parts of the country were affected by flooding chasing the inhabitants away. It shattered both the built-environment and underdeveloped plan of the country. It claimed many lives, and millions of properties got lost due to its occurrences. This was attributed to the heavy rain of the year when the level of water in the reservoirs of Kainji and Jebba rose (Etuonovbe, 2013). Large expanse of farmlands have been devastated by flooding while livestock have been washed away. In Kogi State, the floods affected at least 5,775 farmers (Onu, Ogbemudia and Ofabor, 2012). Actually, the nine Local Government ravaged by flood are the 'food baskets', the major rice producers of the state. About 200,000 hectares of rice farms and other crops in 41 wards of the state were washed away.

2.3.3 Climate Change Mitigation

The enormity of Climate Change is daunting and dispiriting. The most significant step we can take to reduce Climate Change is to reduce carbon pollution by setting practical, feasible limits on the major sources such as cars and power plants (NRDC, 2013). Under the Clean Air Act, the nation's bedrock air pollution law, the Environmental Protection Agency (EPA) has the authority and responsibility to establish limits for carbon pollution from all major sources which the U.S supreme court reaffirmed in 2007. Investing in clean energy and green jobs by manufacturing solar panels and wind turbines and retrofitting homes. Studies show that investing in clean energy technologies would produce more jobs than similar investments in oil and gas. Investments in clean energy will also help end addiction and usher in a new secure energy future (NRDC, 2013). Good driving and good car maintainance can limit the amount of greenhouse gas emission from a vehicle. Driving of smarter cars like cars that drive on electricity, such as plug-in hybrids and Scotts RAV4, dramatically cut oil use, reducing global warming pollution and save money. If we make our cars more efficient over the next ten years, we'll cut global warming by more than 350million metric tons and save 2 million barrels of oil a day (EPA, 2013). Moving closer to work is another way to dramatically curtail transportation fuel needs. Using of mass transit, switching to walking, cycling or some other mode of transport that does not require anything other than human energy will also help to some extent. Studies show that a neighbourhood where people walk more is healthier, safer and friendlier (NRDC, 2013).

Individual choices can have an impact on global Climate Change. Reducing your family's heat trapping emissions does not mean forgoing modern conveniences; it means making smart choices and using energy-efficient products, which may require an additional investment up front, but often pay you back in energy savings within a couple of years (Union of Concerned Scientist, 2013). Well-designed and properly implemented pollution standards deliver multiple benefits. First and foremost, we will have cleaner and a safer environment, which not only benefits our health, but also our quality of life and economy. Laws like the Clean Air Act, which is reducing some pollutants by more than 90%, save tens of thousands of lives each year and hundreds of thousands hospital visits.

At the 5th Lagos Climate Change Summit held between March 13th to15th, 2013, with the theme 'Vulnerability and Adaptability to Climate Change in Nigeria: Lagos State Transportation, Housing and Infrastructure in Focus', it was emphasized that Lagos is considered Africa's fastest growing city as such deliberations are expected to extensively centre on the adoption of a mass transit module for Lagos, ostensibly to reduce the use of personal cars and curb carbon emission (transportation); green and environment-friendly dwelling units (housing); and high capacity and multi-purpose roads (infrastructure) (www.environewsnigeria.com).

2.4 Geography/Science Teaching Methods in Senior Secondary Schools

The term teaching methods refers to the general principles, pedagogy and management strategies used for classroom instruction (Jackson, 2012). According to Sharma (2012), methods are the ways and means through which the curriculum is transacted through teacher to the students. It is a link in the process of teaching and learning environment. Joshi (2008) define methods to include a utilization of appropriately selected curriculum materials, content and learning experiences, motivational strategies, an application of learning theories and a demonstration of a knowledge of developmental psychology or other aspects of educational psychology in the teaching-learning process. Ogbonna (2000) opines that one of the most influential factors in teaching is the teachers' method of teaching. Ahmed and Abimbola (2011) and Umar (2011) have identified poor teaching methods adopted by teachers at senior secondary school level in Nigeria as one of the major factors contributing to poor performance of students in science subjects.

There are a variety of methods and techniques for teaching the sciences as works have been done on them by different researchers among which include lecture method, laboratory technique, inquiry method, discussion method, project method and field trip method. The laboratory method of teaching is based on the principle of learning by doing. The pupils make use of their hands or eyes or very often both. The school laboratory according to Usman (2010) is an instructional facility used by the teachers to help students learn about science and how scientists investigate the world around them. The pupils are led to obtain information by their own active efforts (Joshi, 2008). It is psychologically sound because it satisfies the urge for activity which is fundamental drive in human beings. The proper material and equipment and physical setting help to motivate the students to drink deep from the well of knowledge (Joshi, 2008; Harichandan *et al,* 2010). It is through the use of the activity method that the child is helped to feel the significance of what he is learning. In this method the students are encouraged to find out, think about and experience things for themselves and by themselves. In this method the pupils are not mere listeners but are active participants in the lesson. Some of them are making experiments; others are observing and making inferences from what they observe

(Harichandan *et al*, 2010). However, the laboratory method has some demerits (Joshi, 2008; Harichandan *et al*, 2010). It is very slow method of learning. It is not so easy to make the students discover geographical facts or concepts by experiments. The method is also expensive s. The method also makes heavy demands on students since it is expected that each student should vary by performing experiment. Usman (2010) in his work proved that laboratory methods improved students' academic achievement in integrated science. He also identified two types of laboratory : indoor and outdoor laboratory The indoor type is a room/building where scientific work and research is carried out while the outdoor laboratory is an open space mapped out for scientific activities. Abdulkarim (2010) described a meteorological station as an outdoor laboratory for teaching weather concepts in geography.

According to Olajide and James (2009), inquiry method is an art of questioning, exploring and experimenting which is the process of science. Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation (Logan, 2008). Students more likely retain science content for a longer period of time with inquiry-based instruction. In scientific inquiry students engage in a thoughtful and coordinated attempt to search out, describe and explain and predict a natural phenomenon (Lohrman, 2013). As highlighted out by Hassard (2005), inquiry method of teaching are of two types: guided inquiry and open inquiry. In guided inquiry, the students determine the methods they will use to produce their own conclusions to a problem posed by the teacher, and as such, the teacher plays the role of a guide to the students. In the open inquiry, the students select the topic to be studied and the methodology used to yield their own conclusions from the investigation. Research has shown that students who have historically been low achievers in science can succeed in inquiry based-learning (Blanchard,2010). Obeka (2010) in his study revealed that inquiry method is more efficient than demonstration and lecture method in teaching geography. However, Joshi is of the view that inquiry method can be time consuming and slow and may not be suitable under the structured school curriculum.

In the discussion method, as it is true with any group learning effort, the instructor typically relies on the students to provide ideas, experiences, opinions and information. An instructor may use this during classroom periods, after the students have gained some knowledge and experience. Fundamentally; the discussion method is almost the opposite of the lecture method. The instructor's goal is to draw out what the students know, rather than to spend the class period telling them (Harichandan *et al.*, 2010). It is one of the most easily comprehended methods of teaching as students are daily involved in one form of discussion or another within or outside the school (Atere, 2006).The discussion method places emphasis on learning than teaching and encourages participation by everybody. Thus, there is a development of democratic way of thinking and arriving at decision. Students, during the course of discussion, get training in reflective thinking, which leads to deeper understanding of the historical problem under discussion. During discussion, everybody is required to express his ideas and opinions in a clear and concise manner. This provides ample opportunities to the students for training in self-expression. Spirit of tolerance is inculcated and learning is made interesting (Harichandan *et al*, 2010). Discussion can take can take place between and among small or large groups of learners during which they contribute, share, examine, suggest prove, argue, accept or reject ideas or opinions. However the teacher serves as the facilitator, guide, assistant, moderator or contributor to the discussion.

The project method stands against the traditional method of teaching where the theoretical knowledge from the book is accepted or received by the students. In propagating this method, American educationist John Dewey did much work (Harichandan *et al*, 2010). It involves doing something practical, concrete and realistic which is self-motivated, self-generated and self-directed by the learners themselves. According to Atere (2006), the role of the teacher is to inspire and guide the learners in the process of carrying out the project. Project may be individual or co-operative, large or small. It may be employed according to the mental age of the pupils, but that must be done under the guidance of an expert. Psychologically, the project method is based on the principles of learning by doing and encourages maximum amount of purposefully activity on the part of the pupils. Adopting this method, heart, head and hand are to be functional. That means both the physical and also the mental powers of the child are to be exercised or utilized (Harichandan *et al*, 2010). The merits of project method according to Atere (2006), Joshi (2008) and Harichandan (2010) are that education gets more meaning and value in comparison to the traditional methods of teaching, the students by this method, understand the importance of learning by doing and direct experience of things, this method employs the sense and not mere words or symbols, and the child derives satisfaction when he achieves something by his own efforts, and the students can evaluate their work. However, this method requires more money to be spent, trained and qualified teachers to put this method into practice are not available, and all schools do not have resources to use this method and projects are difficult to devise for all stages of teaching.

2.4.1 Field-Based Teaching Strategy

Field-based learning, excursion, field trip and fieldwork are used interchangeably in this literature. The field excursion is not an innovation of this era. Attempts to instruct in the field according to Ngcamu (2000),have been charted through the centuries up until and including the present time. Socrates and Aristotle led their followers directly to the natural environment for observation and discussion about nature.

Fieldwork is an excellent teaching approach based on sound educational principles that are well suited for hands-on investigation. Fieldwork is any educational activity that takes place outside the classroom. It may take place in the school grounds or in a local park, or in fact, anywhere where practical outside activities are possible (Ncagamu, 2000). Gross (1993), says that, Field-based learning at its core is essentially “learning by doing”. It is learner-centered, where students make discoveries by engaging in a learning experience. According to Michie (2001), fieldwork is defined as the learning process out of doors which gives reality to the subject and saves it from being arid and theoretical. From the above definitions, it is clear that common features of fieldwork are that it must be outside the classroom (learning process out of doors) and learning must take place through direct experience of reality. Fieldwork is a teaching approach that is integrative in its aims and adopts more of participative approach. Its importance could well be understood from this Chinese proverb:

Tell me, I forget

Show me, I remember

Involve me, I understand (Gold and Jenkins, 1991)

Ngcamu (2000), states that fieldwork emphasizes the importance of two basic didactic principles. The first is that of activity, whereby learners learn best by doing something, and the second is the principle of observation and perception, whereby the learners learn by the direct observation of phenomena. Others include the principles of environmental teaching, exploration and discovery, and example.

(a) Principle of activity of learning

The activity principle as a condition for effective instruction and learning, emphasizes that instruction and learning will be effective only if the learner is given the opportunity to become actively involved in the teaching-learning events (Ngcamu, 2000). This does not only imply that the learner has to be mentally active, but that the learner should also be given the chance to become physically involved during teaching. The principle of activity deliberately provides a breakaway from the learner's passive listening role in the learning situation. In fieldwork, in particular, learners are exposed to a real situation wherein they are able to participate actively by recording what they see, drawing up sketches and responding physically and mentally to any stimuli during fieldwork. After fieldwork, learners are expected to report on what has been observed in the field and in way they are actively involved in their learning.

(b) Principle of observation and perception

Fieldwork is about going out of a normal classroom situation to the field with the purpose of "seeing" or "observing". Learners learn better and understand geographical concepts much better if they have been out to observe. This principle provides pupils with first-hand experience of reality which is very important in the teaching and learning of the learners. Ngcamu (2000) take this idea further by stating that it is essential for learners to establish a certain order in the mass of concrete or observable impressions they are constantly receiving through their senses. Sensory observation of objects becomes meaningful only when it is followed by understanding and internal assimilation. Learning through observation is important because it involves discovery learning. During fieldwork learners are required to discover certain concepts and phenomena read from the textbooks. Concepts learned through fieldwork cannot be easily forgotten by learners as they do with concepts prescribed to them theoretically.

Fieldwork rescues teachers from the problem of verbalism, which is, the use of words without due regard to their real meaning. Ngcamu (2000) states that words in themselves are nothing but abstractions. They have content only when, by means of abstraction, they are coupled in a definite meaning and significance. The child comes to school with a great store of knowledge and experience, it is the task of the teacher, to verify the knowledge and experience so acquired, to extend and arrange it, and also to assemble it, together with newly acquired knowledge, into a useful and functional whole. To achieve this, educators must make use of fieldwork. If learners are forced to learn words mechanically by rote learning, or memorizing, they will indeed learn to know word symbols. However, a lack of the corresponding concrete images will render the symbols useless for application in real life situations. Words must, where applicable, go hand in hand with concrete observable material. Abstract thinking developed on this basis is most effective.

(c) Principle of environmental teaching

Fieldwork in particular will help learners to make meaning of their immediate environment. Since Geography is the study of the person and his environment, the principle of environmental teaching could well be achieved through this subject. The value of environmental teaching, through fieldwork, lies in the fact that it opens the eyes of the learners as well as educators to immediate surroundings (Ngcamu, 2000).

(d) Principle of exploration and discovery

The word exploration refers to the investigation or exploration of things. It is a hallmark of all normal children that they investigate and explain things in their life. In the case of a child, this urge to explore is referred to as curiosity. By getting learners involved in fieldwork, they are made to explore their world and become responsible for their immediate environment. They learn to make judgements, deductions and conclusions about what they see or observe during fieldwork. That is when the teacher learns that the learners in front of him or her can arrange facts and must be aided in their exploration and voyages of discovery (Ngcamu, 2000).

(e) Principle of example

This means that by taking learners out to see a particular landscape and real phenomenon, for example industries, cities and so on, generalizations could be made from that particular phenomenon, in other words, that phenomenon could serve as a representative example of what could be found in other places. Ngcamu (2000), states that the exemplar is part of the way in which the human being understands the reality which surrounds him and that of the entire world.

The merits of field-based learning as pointed out by Ngcamu (2000), are highlighted below as:

- Improving the ability of the students to retain targeted core concepts
- It enhance students’ motivation
- It broadens students’ learning experiences and knowledge base
- Learning in the field helps in the development of skills that are underrepresented in the classroom such as observation skills, measuring, recording, communication, study, and problem-solving skills.
- Learning in the field helps in the development of affective behavior as it can help learners develop environmental attitudes that will contribute to the long-term well being of the environment and therefore to the long-term health of the people.
- Fieldwork assist learners to develop the ability to perceive and acquire an aesthetic sensitivity to both natural and human living environment

- Fieldwork as a teaching method promotes the principle of integrating subjects. When learners are taken out for fieldwork, they acquire or gain knowledge from different fields of study.
- The value of fieldwork in the overall development of learners cannot be overemphasized. The experiences and knowledge gained by fieldwork activities is of direct significance, not only as far as the general education of learners is concerned, but also with regard to their overall personal development.

The demerits of field-based teaching include:

- It makes a big demand on the out-of –class time of teachers and the students, which the time-table of the schools does not permit.
- It also requires more money to be spent.

However, field experiences are most likely to be academically and intellectually valid if they are carefully planned and monitored, structured to serve specific learning goals, and preceded by orientation and preparation. Students also need to reflect actively and critically on what they are learning from the field experience and to assess the results.

2.4.2. Lecture Method

This is also referred to as conventional method or expository method of teaching. It is also referred to as the traditional method of teaching, and is the oldest method of teaching. According to Appaw (2011), it is mostly described as teacher-centred, teacher dominated, teacher activity method, or top-down transmission teaching. It involves verbal presentation of ideas, concepts and generalization of facts (Umar, 2006).The role of the student is less active and more passive in the teaching and learning interaction. Mehmet (2012) is of the view that traditional teaching practices focus on declarative knowledge and do not represent equity among students.

Lecture method is the primary teaching strategy under the teacher-centred approach in that teachers are the sole supplier of knowledge and information. It is effective in teaching basic and fundamental skills across all content areas (Jackson, 2012). Basically, the teacher controls the instructional process, the content is delivered to the entire class and the teacher tends to emphasize factual knowledge. Thus, the learning mode tends to be passive and the learners play little part in their learning process. According to Vaselinovka (2011), lecture can be informative, boring and overwhelming depending on the compelling nature of the message. The lecture method usually is a one-way communication and allows for little or none audience participation. The result is audience misunderstanding, loss of information and poor retention (Vaselinovka, 2011). Teachers are said to be comfortable with the traditional method because they remain in control of content and time. Atere (2006), is of the opinion that lecture method will be more effective in a very large class if it is combined with effective use of instructional materials and other appropriate strategies that can be employed based on the classroom situation.

Some merits and demerits have been identified with lecture method of teaching by various scholars like Ogunsanya (1992), Tamakloe, Amedahe and Atta (2005), Joshi (2008) among others as follows:

- Logistically traditional method is often easier to create than other methods of instruction.
- It is more helpful for teaching specific facts, concept or laws.
- It provides great opportunity for students to learn to take down notes.
- The teachers have greater control over what is being taught in class.

- It helps provides information on topics which are not available or easily accessible to students.
- The traditional method makes for economy since a large number of students can be taught at a time in one classroom. It is a straight forward way to impart knowledge into students.
- The traditional method enables a great amount of course content to be covered in the face of a heavy loaded syllabus or programme of instruction.

However, the demerits associated with the lecture method are as follows:

- In the traditional method, the teacher to a large extent spoon feeds the students and does not allow them to develop their powers of reasoning. Since science mainly involves activity to help students explore, the traditional method is therefore not the best for solely teaching science.
- Generally, traditional method is not suitable for students who are low on the academic ladder. They find it difficult to listen and take notes at the same time.

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- Teacher activity overshadows that of students making them play comparatively passive role in the teaching and learning process.
- There is little scope for student activity; hence traditional method goes against the principle of learning by doing.
- It does not take into consideration individual differences.
- The traditional method in most cases encourages rote learning.

Many researchers have compared the traditional method to other methods of teaching in students' achievement. They found out that students normally taught with other methods do perform better than those taught with the traditional method. In the work of Sola and Ojo (2007), the students taught with project , inquiry and lecture-demonstration methods enhanced better performance in chemistry practical than those taught using the traditional teaching method. Likewise, Wood (2007) reported that students who were exposed to the constructivists approach achieved significantly higher than their counterparts exposed to traditional method. Appaw (2011)'s work also shows that concept mapping is more effective for teaching biology than traditional method. Also, in the work of Olorukooba, Lawal and Jiya (2012), NCE biology students taught evolution concept with analogy teaching strategy performed better than their counterparts taught using lecture method.

However, there are some exceptions. Boujaoude and Attieh (2007) in their work indicated that there was no significant difference found between the experimental and the control groups who were taught chemistry using concept map and traditional methods. The findings from Adeyemi (2008b), also shows that the lecture method was found to be the best predictor of students' academic performance in geography. Owusu et al (2010) in their study used 65 students to find the effect of computer assisted instruction (CAI) on students' achievement in Biology. They reported that, students instructed with the traditional method achieved significantly higher than those instructed with computer assisted instruction (CAI).

2.5 Gender and Academic Performance in Geography/Science Education

Gender refers to the socially culturally constructed characteristics and roles which are ascribed to males and females in a society (Okeke, 2008). Gender is a major factor that influences career choice and subject interest of students (Ezeudu and Obi, 2013). Okeke (2008) and Nwajiuba (2011) described the male attitudes as bold, aggressive, tactful, economic use of words while the females are fearful, timid gentle dull, submissive and talkative. That is the reason why Umoh (2003) stated that more difficult task are usually reserved for males while the females are considered feminine in the natural setting. Thus in schools, males are more likely to take difficult subject areas like science while the females take to career that will not conflict with marriage chances, marriage responsibilities and motherhood such as humanities, languages and domestic subjects (Bichi, 2002; Okeke, 2008; Nwajiuba, 2011). Erinosho (2005) asserted that, biases and misconception about women and science are great challenges in the field of science education as people continue to describe science as a male enterprise. Jacobs and Simpkins (2006) are of the view that, girls tend to express lesser confidence in their science and maths abilities, lower expectations for success in science and math courses, and lesser interest in science and math than do boys. In Nigeria and Africa in general, gender biasness is still prevalent (Arigbabu and Mji, 2004). Onyenechere (2014) in her study documented the gender imbalance in the geography discipline in Nigerian universities. She concluded that the number of women academics is grossly inadequate.

Academic performance on the other hand refers to the display of knowledge attained or skills developed by students in the school subject usually designed by test scores or by marks assigned by the teachers which can either be low or high (Ogundukun and Adeyemo, 2010). The academic performance of students in many learning situations depends on several factors such as method of teaching, teachers' qualification, students' socio-economic background, school environment, attitude, interest and even sex of the learners (Popoola, 2010). There are many research works conducted on academic achievement/performance and gender in science education. Some shows significant differences between the males and females while others shows no difference. The findings from the work of Usman (2000) pointed out that male students are academically superior to their female counterparts in integrated science.

Uhumuavbi, Oriahi and Olusi (2003) also raised the concern and worry about female performance in Science, Technology and Mathematics not being encouraging. Njoku (2007) also reported that boys perform better than girls in Science, Technical and Mathematical subjects. Further Appaw (2011) in his work using concept mapping as a teaching method also pointed out that the male students scored significantly higher than the females.

On the contrary, Maikano (2007) in his work revealed that there is no significant difference in the academic performance of male and female students taught ecological concepts using the outdoor laboratory instructional strategy. Igbogoro (2008) carried out an investigation to determine the effect of inquiry approach on students' achievement in environmental education contents of secondary school Geography. The findings also revealed that there is no significant difference in the mean achievement scores of male and female students taught with inquiry approach. Yusuf (2009) in his research titled comparative study of gender difference in achievements in geography concluded that female students with very good results are more than that of the male students. However, pairwise comparison , using the pearson's correlation coefficient showed that the correlation between the achievements of boys and girls was very high indicating no significant difference in gender achievement in the selected schools. In a similar vein, Shittu (2012) in his study on the effect of guided inquiry strategy on the academic performance and attitude of low achievers in physics concluded that the level of performance of male low achievers exposed to guided inquiry strategy is the same with their female counterparts. Similarly, Abidoye (2015) in his study on the effect of multimedia-based instructional package on secondary school students' academic achievement in geography, revealed no significant difference between male and female students taught using the multimedia-based instructional package. Also, Aminu (2015)'s work revealed that female students taught weather concept using animated-media strategy did not differ significantly from their male counterpart.

One of the aims of this study is an attempt to shed more light on the above controversy using the Field-based Teaching Strategy. The data obtained from the students' academic performance test of Climate Change Performance test (CCPT) will be used based on gender and analyze to determine if there is any difference in gender academic performance.

2.6 Retention and Academic Performance

Retention is the ability to retain and later recall information or knowledge gained after learning (Bichi, 2002). Kundu and Tutoo (2002) defined it as a preservative factor of the mind. According to them, the mind acquires the materials and knowledge through sensation and perception. These acquired materials in the mind need to be preserved in form of images for knowledge to develop. Whenever a stimulating situation occurs, retained images are revived or reproduced to make memorization possible. Aggarwal (2008) regarded it as the process of relegation of the past experience in the sub-conscious mind of the individual in the form of mental experience. According to Sousa (2008), information is most likely to get stored if it makes sense and has meaning. A primary goal of education is to promote long-term knowledge storage and retrieval, not just memories that fade after a given lecture or conference, and the process of retaining knowledge is essential for students to become successful in learning science (Raman, 2010).

Four methods of measuring retention has been identified by Aggarwal (2008). They include: Recall or reproduction; Relearning or saving method; Recognition and Reconstruction. A good memory and retention lead to meaningful learning. Obeka (2010) identified some factors that affect knowledge retention among which are type and content of tasks to be learned, amount of original learning, instructional strategy used and length of retention interval. The goal for teachers is to have their students retain concepts and to apply those concepts to situations. The more actively involved students are in the learning process, the more likely the information will be retained; hopefully for longer periods of time (Bouman, 2012). Even though learning takes place every day, learning and retention does not always take place together. Students are exposed to new information multiple times throughout a day and are expected to remember that information the next day. Teachers become frustrated when information is not easily recalled (Bouman, 2012). Teachers need to find a way to make the information meaningful to students so that it lasts longer, hence the need to change teaching style. Anyagh (2006) said the ability to remember takes place more effectively when experiences are passed across to the learners via an appropriate instructional method.

Several researchers have worked on the effects of teaching methods on retention abilities of learners. In the study conducted by Chianson, Kurumeh and Obida (2011), it confirmed that students who were subjected to the cooperative learning strategy were able to retain the concepts of circle geometry more than those students who were taught using the conventional learning approach and maintained that how well students retain taught concept can be traced back to the teaching approach used. Bouman (2012) in his study found out that the use of inquiry learning has help improved the students' ability to remember more difficult trapezoid formula compared to some of the formula taught by traditional means. The result of the research conducted by Bahrami, Chegini, Kianzadeh, Emami and Abdi (2012) showed that in comparison to traditional teaching, game-based teaching improved learning and retention of some math concepts. The work of Ifamuyiwa and Ajilogba (2012) also revealed a no significant difference between the retention scores of male and female students exposed to problem solving model strategy in further mathematics. The research conducted by Ajai and Imoko (2015) also revealed that male and female students taught algebra using problem-based method did not differ significantly in their retention scores.

2.7 Interest in Teaching and Learning

According to Barron (2006), interest involves a particular relation between a person and the environment and is sustained through interaction. The potential for interest is in the genetic makeup of the person, and the content and the environment determine the direction of interest development. Interest has both cognitive and affective components, although the relative amount of each may vary depending on the phase of interest (Ainley, Hidi, and Berndorff, 2002). Interest is now recognized to be a critical cognitive and affective motivational variable that guides attention (Hidi, 2001), facilitates learning in different content areas (Ainley et al., 2002) and for learners of all ages (Palmer, 2009), and develops through experience. The way in which interest is generated and/or affects learning has been found to vary depending on whether a person is in an earlier or later phase of interest development (Hidi and Renninger, 2006). According to Uitto (2011), interest is important, because it is linked to the positive attitudes towards environmental responsibility. Emperical studies have repeatedly shown declines in students' interest for school subject matter as students' levels of schooling increase (Hidi, 2001), although interest of school-age students can develop with support from the tasks and/or the organization of the learning environment (Barron, Kennedy-Martin, Takuechi, and Fithian, 2009).

Factors that affect interest in learning as pointed out by Aggarwal (2008) include personal factors (socio-economic status, learners' mental health and development, age, sex, motives and wishes), ineffective teaching method, and environmental factors such as cultural factors. Interest has both subjective and objective aspects. In the subjective aspect the emphasis is on the feeling component, and in the objective aspect the emphasis is on the motor behavior of the individual. All interest have cognitive, affective as well as motor aspects. Interest give rise to certain activities. The attitude towards these activities is part of the affective domain. It is developed from personal experiences as well as from the attitudes of others especially parents, teachers and peers towards the particular activities (Shri, 2012). Dupigny-Giroux (2010) noted that educators can stimulate students' interest and begin their process of lifelong learning.

Some research work on the effect of teaching methods on students' interest have been conducted. Obeka (2009) confirmed that students taught using EPODEWALAD simulation displayed greater interest in the environmental concept of geography than the lecture group. The work of Weinberg, Basile and Albright (2011) titled effect of experiential learning program on middle school students' motivation toward mathematics and science also revealed that there was no difference in the proportion of males and females who responded that their experience in the program increased their level of interest, and the proportion of males and females who reported an increase in their interest in mathematics as a result of the program was not found to be statistically different. In the work of Ibe (2013), finding out the effect of guided inquiry and expository teaching methods on the performance and interest of secondary school students in biology, it was found out that guided inquiry method fosters students interest in biology. Also the findings of the study conducted by Obeka (2013) revealed that Development Model and Concept Mapping have significant effects on students' achievement and interest in Climate Change concepts of environmental education.

However young students in Philippine have shown growing interest in environmental issues spurred on by their own concern over the increasingly unusual weather patterns and worsening typhoon flooding that the country has seen in recent years. This interest was very much in evidence among the students who attended the forum and those that participated in the environmental project contest organized by the Communication Foundation for Asia (CFA), with the support of the Foundation for the Philippine Environment (FPE). The contest invited high schools to come up with environmental projects that would address Climate Change and involve the community in their efforts. The students' project show ingenuity, adaptability and sustainability, and varied from simple recycling, waste segregation and a floating model house (CFA, 2013). The work of Aminu (2015) also revealed that students taught weather concepts using animated-media package show positive interest than their lecture group counterparts. This study also aims at finding out the effect of field-based teaching on the interest level of the students. This will be measure in both the experimental and control groups.

2.8 Overview of Similar Studies

The educational values and benefit of instructional field programmes in the sciences have been investigated and studies have explored the possible impacts on students' attitudes; skill attainment; and Cognitive development. With science teachers, field instruction has evidenced popular support and has been ranked as being an important and valuable method for teaching science, yet actual implementation rates are quite low.

Maikano (2007) made comparison between outdoor and indoor laboratory teaching strategies on 126 SS 2 secondary school students' academic achievement and retention in ecology in Giwa Educational Zone in Kaduna, Nigeria. The study adopted a pretest, posttest quasi-experimental design. Ecology Achievement Test (EAT) was developed and used for data collection. Data was analyzed using t-test and the result revealed that, the experimental group taught ecological concept using outdoor laboratory approach achieved significantly higher than the control group taught the same concept using the indoor laboratory approach. The experimental group also had a higher retention level than the control group. Gender wise, there was no significant difference in the performance and retention level of male and female students in the experimental group.

In the research carried out by Ajaja (2010), the effects of field experiences on students' knowledge of process of science and biology achievement was examined. The design of the study was experimental, 2 x 2, pre-test, post-test control group design. The sample of the study consisted of 100 biology students drawn from a population of 220 SS 2 students in two intact classes in St. Charles College, Abavo, Rivers State. Four hypotheses were formulated among which is there is no significant difference in overall biology achievement between students exposed to field experience and those who were not. The test instruments used for the study included: Process of Science Test (PST) and Biology Achievement Test (BAT). Data were analyzed using t-test statistic at 0.05 level of significance and Pearson Product Moment Correlation Statistic. The major findings of the study revealed a significant difference in process of science test scores between students exposed to field trip experiences and those who were not exposed and a significant difference in biology achievement test scores between students exposed to field trip experiences and those who were not.

The research of Adanu (2011) investigated the effects of fieldwork on the achievements and attitudes of secondary school students in environmental education in Kogi State. The study adopted pretest posttest non equivalent group design. A sample of 225 senior secondary school (SS II) students who were offering geography was drawn through stratified random sampling from four schools. Two instruments: Geography Achievement Test (GAT) and Geography Attitude Measurement Scale (GAMS) were designed to collect data from students. Data were analyzed using analysis of co-variance (ANCOVA) at 0.05 level of significance. The findings showed that fieldwork has significant effects on the achievements and attitudes of secondary school students as there was significant difference between the mean achievement scores of students taught environmental education with fieldwork and those taught with conventional method in favour of those taught through fieldwork. Gender wise, there was no significant difference between the mean achievement scores of male and female students taught environmental education using fieldwork.

The effect of field trip on academic achievement and retention in ecology among senior secondary school students of rural and urban location in Zaria Educational Zone, Kaduna State was carried out by Ahmad (2014). The research design used was an experimental design with a population of 2934 students, out of which 200 students were sampled out. The instrument used was Ecology Achievement Test (EAT) and Ecology Retention Test (ERT). t-test statistical tool was used to analyze the data. The findings of the study showed that field trip teaching strategy favoured the experimental group in ecology concept. The experimental group taught using field trip had higher performance and retention than the control group taught using lecture method.

In India, a research was conducted by Alexander and Poyyamoli (2014) to find out the effectiveness of environmental education for sustainable development based on active teaching and learning at high school level. The main Objectives of the research were to foster the acquisition and transfer of the necessary knowledge, skills, attitudes and behaviour with reference to the protection of the environment and sustainable development in selected high schools. Four schools were selected to represent the diversity of high schools and a total of 240 students were selected from the four schools, of which 60 students from each school were selected based on their interest, motivation and commitment. The selected students were divided into two groups of which thirty students were in experimental and remaining thirty kept in control groups for each school. The experimental group students were implemented with an innovative curriculum on Environmental Education for Sustainable Development (EESD). Data was analyzed using t-test statistics. There was a significant statistical difference between the overall pre and posttest impacts on the level of environmental knowledge, behaviour, attitudes, and skills of the students from both the groups. In the posttest result, the experimental group students scored significantly higher knowledge, attitudes, skills and behaviour on air, water, biodiversity conservation and solid waste management than the students who were exposed to the traditional teaching methods with existing curriculum. It was concluded that the active teaching learning approach is more effective in facilitating environmental education for sustainable development among school children.

Ifamuyiwa and Ajilogba (2012) investigated the effect of Problem-Solving Model Strategy on secondary school students achievement and retention in Further mathematics in Nigeria using 80 students drawn from two purposively selected schools in Ogun State. The study adopted a pre-test, post-test, control group quasi-experimental design involving a 2 x 2 factorial matrix. Three instruments were developed namely- Teachers' Instructional Guide (TIG), Further Mathematics Achievement Test (FMAT) and Students Retention Test (SRT). Data were analyzed using analysis of covariance (ANCOVA) at the .05 level of significance. Findings showed that problem-solving strategy had significant main effect on students' achievement and retention in Further Mathematics. The study also found no significant difference between the achievement and retention scores of male and female students in Further Mathematics

The work of Obeka (2013) investigated the effects of Developmental Model and Concept Mapping on secondary school students' achievement and interest in Climate Change Concepts of

Environmental Education in Zaria Educational Zone, Nigeria. The design was a quasi-experimental non-equivalent control group consisting of 246 students sampled from four senior secondary schools. Two instruments namely Environmental Climate Change Instrument (ECCI) and Environmental Climate Change Interest Inventory (ECII) were developed. Data were analyzed using mean, standard deviation and analysis of covariance (ANCOVA). The findings of the study revealed that Development Model and Concept mapping have significant positive effects on students' achievement and interest in Climate Change Concepts of Environmental Education.

Aminu (2015) worked on the effects animated-media strategy on secondary school students achievement, retention and interest in weather concepts of geography in Kurfi Educational Zone of Katsina State. The study employed a pretest, posttest quasi-experimental design with a sample of 116 SS 2 students drawn from two public schools. Two instruments namely Weather Concept Achievement Test (WCAT) and Weather Concept Interest Questionnaire (WCIQ) were developed. Data were analyzed using t-test and Mann-Whitney U-test. The findings of the study revealed a significant difference in the academic achievement, retention and interest of students exposed to animated media teaching over the lecture method. Gender wise, both male and female students exposed to animated-media teaching performed equally well.

The study conducted by Ajai and Imoko (2015) assessed gender differences in mathematics achievement and retention by using Problem-Based Learning (PBL). The design of the study was pre–posttest quasi-experimental. The sample consists of 261 male and 167 female senior secondary school one (SS1) students in 10 secondary schools across education zone B of Benue State of Nigeria. The students and schools were selected through multistage sampling.

The students were taught algebra by using problem-based learning method. Algebra Achievement Test (AAT), constructed by the researcher was used to collect data. Two hypotheses were raised for the study and tested using t-test at .05 level of significance. The study revealed that male and female students taught algebra using PBL did not significantly differ in achievement and retention scores, thereby revealing that male and female students are capable of competing and collaborating in mathematics.

In the present study, the Field-based Instructional Strategy package designed will be used as a treatment to the experimental group and its effects on the academic performance, retention and interest in Climate Change will be observed on the senior secondary school students of Anchau Educational Zone in Kaduna State.

2.9 Implications of Literature Reviewed to the Present Study

The literatures reviewed explained the concept of Field-based Teaching Strategy. The concept of academic performance, retention and interest as they relate to teaching and learning as well as gender performance in geography/science education were also discussed. From the studies reviewed so far, researchers such as Ifamuyiwa and Ajilogba (2012), Obeka (2013), Aminu (2015), Ajai and Imoko (2015) have identified that instructional strategy employed by teachers in teaching sciences significantly affect the level of students academic performance, retention and interest. Also, these instructional strategies proved to be gender friendly, as both male and female students performed equally well, had almost equal retention and interest levels. The literature reviewed has also revealed that the use of lecture method of teaching has been less effective in enhancing learners' performance. This has implication for teachers and stake holders in science education, as this will gear them up in exploring other effective teaching strategies.

The review also helped to reveal the number of studies related to the field that have been done previously. However, most of the literatures reviewed on the use of Field-based instructional technique concentrated on academic performance/ understanding of concepts and retention of concepts taught (Maikano, 2007; Ajaja, 2010; Adanu, 2011; Ahmad, 2014; Alexander and Poyyamoli, 2014). This study discovered a gap. Apparently, there were no studies conducted on the effects of Field-based Teaching Strategy on students' Interest in learning. Hence, this study tends to fill this gap. This present study has incorporated interest as variable to be measured. The literatures reviewed has also guided the development of the research instrument and instructional package for teaching Climate Change and its effect will be observed on the academic performance, retention and interest of secondary students in a relatively different location (Anchau Educational Zone), using a different concept (Climate Change) in Geography.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This study investigates effects of Field-based Teaching Strategy on retention, performance and interest of geography students in Climate Change Concepts in Anchau Educational Zone of Kaduna state. Chapter two presents a review of related literatures based on the topic. This chapter describes the methodology to be used in conducting the research. Specifically, the chapter has the following sub-headings:

- Research Design
- Population of the Study
- Sample and Sampling Technique
- Instrumentation
- Validation of Instruments
- Pilot Study
- Reliability of Instruments
- Item Analysis
- Administration of Treatment
- Data Collection Procedure
- Method of Data Analysis

3.2 Research Design

This study adopted pretest, posttest control group quasi-experimental research design Pretest was administered to both the experimental and control groups as recommended by

Kerlinger (1973). The reason for the pretest is to determine the equivalence of the two groups in their ability level. The treatment which is the Field-based Teaching Strategy (X1) was administered to the Experimental Group (EG). The Control Group (CG) was taught using lecture method (X0). The posttest ($O2_A^I$) was administered after the treatment to determine if there is any significant difference in the mean performance of the students and interest in the Climate Change concepts taught. Postpost test ($O3_R$) was finally administered to the students using the same test item in order to determine their retention ability. The illustration of the research design is presented in figure 3.1:r5

$$\mathbf{EG} \longrightarrow \mathbf{O1_A^I} \longrightarrow \mathbf{X1} \longrightarrow \mathbf{O2_A^I} \longrightarrow \mathbf{O3_R}$$

$$\mathbf{CG} \longrightarrow \mathbf{O1_A^I} \longrightarrow \mathbf{X0} \longrightarrow \mathbf{O2_A^I} \longrightarrow \mathbf{O3_R}$$

Fig.3.1: Research Design Illustration

EG- Experimental Group (Field-based Teaching Strategy group)

CG- Control Group (Lecture Method group)

X1- Treatment 1(Using Field-based Teaching Strategy)

X0- Treatment 2 (lecture method only)

O1- Pretest

O2- Posttest

O3- Postpost test

A: Academic performance

I: Interest

R: Retention

3.3 Population of the Study

The population of this study consists of all the SS II geography students of public schools in Anchau Educational Zone in Kaduna State. There are 16 senior secondary schools (Co-Educational and single sex) found in this educational zone with a population of 1655 SS II geography students consisting of 1010 males and 645 females. The students are predominantly hausa by tribe with an average age of 16years. The detail of the population of the study is given in Table 3.1:

Table 3.1: Population of the Study

S/N	Name of School	Type of School	Gender		Total
			Male	Female	
1	GSS Galadima	Co-Ed	41	29	70
2	GSS Paki	Co-Ed	45	7	52
3	GSS Kwassam	Co-Ed	20	24	44
4	GSS Kargi	Co-Ed	83	37	120
5	GSS Anchau T/L	Co-Ed	125	55	180
6	GSS Ikara	Co-Ed	120	60	180
7	GSS N/Doya	Co-Ed	41	7	48
8	GSS Kauru	Co-Ed	85	38	123
9	GSS Zuntu	Co-Ed	70	24	94
10	GSS Auchan	Co-Ed	69	20	89
11	GSS Damau	Co-Ed	55	35	90
12	GSS Makarfi	Co-Ed	95	70	165
13	GSS Soba	Co-Ed	88	20	108
14	GSS Dutsenwai	Co-Ed	73	44	117
15	GSSS Soba	S/Sex	-	83	83
16	GGSS M/Kubau	S/Sex	-	92	92
	Total		**1010**	**645**	**1655**

Source: Anchau Educational Zone/ Ministry of Education, Kaduna State (2015)

Co-Ed- Co-Educational Schools

S/sex- Single sex Schools

3.4 Sample and Sampling Technique

A total of 75 SS II geography students drawn from two public senior secondary schools of Anchau Educational Zone constituted the sample for this study. The two schools- GSS Ikara and GSS Makarfi, were purposively sampled out from the population because of accessibility and were assigned control and experimental group using simple random sampling technique involving balloting without replacement. The total sample of 75 students were randomly selected with the aid of random table of numbers (Kerlinger, 1973)- 35 for experimental and 40 for control groups. The choice of 75 students as the sample for this study is in line with the central limit theory which according to Tuckman (1975), suggested that the minimum of 30 participants can be used to establish a relationship between groups in an experimental research of this type.

However, the sampled schools are far apart from one another and as such, interaction between them was avoided. The details of the sample is presented in the Table 3.2:

Table 3.2: Sample for the Study

School	Group	Male	Female	Total
GSS Makarfi	Experimental	20	15	35
GSS Ikara	Control	25	15	40
Total		45	30	75

3.5 Instrumentation

Two instruments were developed this study. The instruments are:

- Climate Change Performance Test (CCPT)
- Climate Change Interest Questionnaire (CCIQ).

3.5.1 Climate Change Performance Test (CCPT)

This is an instrument used to investigate the performance and retention ability of geography students in Climate Change prior and after the treatment. It consist of 42 items with options, adapted from SSCE past questions, EPA (2013) and Edugreen (2015). The instrument was developed from four topics of Climate Change Concepts. The item takes into consideration the six Educational Taxonomy of Bloom (Bloom, Engelhart, Furst, Hill and Krahwohl, 1956) such that knowledge has 12 questions, comprehension has 9 questions, application has 7 questions, analysis has 5 questions, synthesis has 4 questions and 5 questions also for evaluation. The details of CCPT, the marking scheme and the answer sheet are presented in appendix A, while the item specification (which is a reflection of the number of questions for the sub-topics) and test-blue print for CCPT are presented in the Tables 3.3 and 3.4:

Table 3.3 Item Specification for CCPT based on Sub-topics selected

Sub-topics selected	**Items**	**Total**
Defination of the Climate Change Concept	1,2,3,14,15,16,20 and 28	08
Factors of Climate Change	4,5,6,7,8,9,10,17,30,31,38 and 40	12
Impacts of Climate Change	11,12,13,18,21,22,25,27,32,33,34,35,36, 39,41 and 42	16
Solutions/remedies in reducing Climate Change	19,23,24,26,29 and 37	06
Total		42

Table 3.3 shows the number of questions each sub-topics has. Definition of Climate Change has 8 items, factors of Climate Change has 12 items, impacts of Climate Change has 16 items and solutions/remedies in reducing Climate Change has 6 items- a total of 42 items.

Table 3.4 Test-Blue print for CCPT Construction

Content	Weight (100%)	Know. (28.6%)	Comp. (21.4%)	App. (16.7%)	Anal. (11.9%)	Synth. (9.5%)	Eval. (11.9%)	Total. (100%)
1.Defination of the Concept of Climate Change.	(19.1%)	2	2	1	1	1	1	8
2. Factors of Climate Change.	(28.6%)	5	2	2	1	1	1	12
3. Impacts of Climate Change.	(38%)	4	4	3	2	1	2	16
4. Solutions/Remedies in reducing Climate Change.	(14.3%)	1	1	1	1	1	1	6
Total	(100%)	12	9	7	5	4	5	42

Adapted from Obeka, (2010)

Table 3.4 shows the test-blue print for CCPT construction taking into consideration the six Educational Taxonomy of Bloom, such that knowledge has 12 questions, comprehension has 9 questions, application has 7 questions, analysis has 5 questions, synthesis has 4 questions and 5 questions also for evaluation.

3.5.2 Climate Change Concept Interest Questionnaire (CCIQ)

The CCIQ is a 21 item interest inventory questionnaire developed by the researcher to determine the interest of students on Climate Change concepts. The questionnaire was adapted from UNICEF (2013), and constructed based on the Likert five-point scale of Strongly Agree

(S.A); Agree (A); Undecided (U); Disagree (D); and Strongly Disagree (S.D). The five-point Likert-type scale appears easy to construct, produces more homogeneous scales, permits spread of variance and allows subjects to indicate their degree of feeling or opinion (Lehmann and Mehrens, 1991). Each item in the questionnaire carries weight in the order of priority from five to one in positive interest responses and from one to five in negative interest responses. Details of the Climate Change Interest Questionnaire (CCIQ) items is presented in Appendix D.

3.5.3 Instructional Instruments

The instructional instruments used for this study include the lesson plan, charts and pictures, video clips and the field(farmlands, markets and school compound). Six weeks lesson plans were prepared for both the experimental and control groups. The same topics were taught to both groups and they are reflected in the lesson plans, only the methodology differed. The experimental group were taught on the field while the control group had their lessons in the classroom. The details of the lesson plans are presented in Appendices D an E.

3.6 Validation of the Instruments

3.6.1 Validation of Climate Change Performance Test (CCPT)

This instrument, Climate Change Performance Test (CCPT) was validated by three qualified experts with qualification of PhD and senior lecturers from the departments of Science Education and Geography, Ahmadu Bello University, Zaria. This is in addition to the initial validation of the instrument by the supervisory team. The experts were requested to examine and assess the entire test items with respect to:

- Whether the CCPT instrument is valid and conforms to the objective of the content and specifications it was to test.
- Whether the test items are clear, precise and free from ambiguity.

- Checking for possible errors and suggesting corrections.

The items in the instrument were found to be satisfactory by all the experts. Due to their impacts, some of the questions were restructured and the 42 test items were retained. For example, the use of the impact of Climate Change instead of effect was encouraged, remediation instead of reduced was also emphasized. Time duration for the performance test was also emphasized and the use of rain amount or occurrence was also emphasized in question 40.

3.6.2 Validation of Climate Change Interest Questionnaire (CCIQ)

This instrument, Climate Change Interest Questionnaire, was validated by two experts each in the departments of Educational Psychology, Guidance and Counseling, and Science Education, Ahmadu Bello University, Zaria, with qualification of PhD and senior lecturer. This is also in addition to the initial validation of the instrument by the supervisory team. The experts were also requested to check for possible errors in the instrument, certify if the questions are testing the interest of students in climate change concepts and if the items are appropriate for the level of the students under study. The instrument was corrected and their suggestions led to the reframing of some of the items/statements. For example personalization of items 11,12,13,16,17 and 18 were emphasized. The use of border lines to separate options (strongly agree, agree, undecided, disagree and strongly disagree) was also emphasized.

3.7 Pilot Testing

The instruments Climate Change Performance Test (CCPT) and Climate Change Interest Questionnaire (CCIQ) were pilot-tested on the SS II geography students of Government Secondary School, Anchau Takalafiya. This is one of the schools that formed the population for the study. Thirty-five students comprising of 20 boys and 15 girls participated in the pilot testing.

The aim of the pilot testing is to determine the characteristics of the test items which include reliability coefficient, facility index and discrimination index. The length of time taken for students to respond to the test item (CCPT) was also determined. For instance, the first student to finish the test used about thirty minutes while the last student to submit used about fifty minutes, hence the duration for the CCPT test was fixed at fifty minutes. The result of the facility and discrimination indices are presented in Appendix E.

3.8 Reliability of the Instruments

3.8.1 Reliability of Climate Change Performance Test (CCPT)

The result of the pilot testing which was administered to thirty-five students of Government secondary school, Anchau Takalafiya was used to compute the reliability coefficient of CCPT. The instrument (CCPT) was administered once to the students, marked and using the Kr-20 formula, the reliability coefficient of 0.64 was computed. This signifies a positive reliability, hence the instrument is consistent and reliable for the study. The facility index (F) and the discrimination index (D) of the test items were also determined (Appendix C).

3.8.2 Reliability of Climate Change Interest Questionnaire (CCIQ)

The reliability of the (CCIQ) was also determined from the result of the pilot testing conducted. Here, the reliability coefficient was determined using the Cronbach's Alpha statistical tool with the aid of SPSS. From the result obtained, reliability of the instrument was found to be 0.70. This suggest a positive reliability and the instrument is reliable to measure the interest of the students.

3.9 Item Analysis

Item analysis was carried out from the pilot study scores to determine item difficulty and discrimination indices. Difficulty Index (facility index) according to Sambo (2008), is defined as a measure of percentage of candidate who got the item right over the total number of candidates that attempted the item. The facility index gives an indication of the easy or difficulty of an item. It is determined by using the formular:

$$P = \frac{R}{T} \times 100$$

R = number of candidate that got the item right

T = total number of candidate.

Facility index of 75% or higher is regarded as easy in terms of facility level whereas an index of 25% or less is regarded as hard. Items with difficulty index between 30% to 70% are acceptable. Discrimination index according to Sambo (2008) on the other hand is the ability of the item to separate between high and low ranking students in the entire test. To compute the discrimination index (D.I), the formular

$$D = \frac{R_U - R_L}{N}$$ is used.

Where D = Discrimination Index

R_U = number of candidate that got the item correct in the upper 27% of the group

R_L = number of candidate that got the item correct in the lower 27% of the group

N = number of candidates in the 27% upper or lower part of the group.

According to Bichi (2002) and Sambo (2008), items of discrimination index of 0.40 and above are very good for the study, 0.30-0.39 are reasonably good, 0.20-0.29 are marginal items that need improvement, while items of 0.19 and below are poor items to be discarded. Thus, in this study, the items above 0.20 were accepted for final selection of CCPT instrument. Thirty five items were finally selected for the CCPT.

3.10 Administration of the Treatment

The Field-based Teaching Strategy was observed as a treatment. The researcher and two geography teachers from Government Senior Secondary School, Makarfi helped to monitored the students on the field. Most of the fieldwork took place in the school compound, farmlands and market areas. The Field-based Teaching Strategy also incorporated the use of slides and charts to explain some phenomena. The treatment involved brief introduction to the topic, going to the field, observations of the phenomena by the students from the field/pictures/diagrams/slides, small group discussions and activities, interactions between teacher and students, evaluation/assessment. The students were divided into five groups (seven students in a group consisting of four boys and three girls) which allowed for their active participation . Group leaders were appointed to each group to co-ordinate their activities. The students were instructed on what to do according to the lesson plan (Appendix D and E).

Each student was provided with an exercise book in which they recorded what was learnt. After each fieldwork, the students returned to their group and they were allowed to discuss and put together their experiences. Each group was asked to present their experiences to the rest of the groups. The researcher (teacher) also interacted with the students at the end of their presentations. On the other hand, the control group received lectures in the classroom (Lecture method). They were taught in the classroom. During the lesson, the teacher dominated most of the lecture with little participation of the students. The exercise lasted for a period of six weeks. The lesson plans of both group addressed the same instructional objectives (Appendices D and E). The same concepts were also used to teach both the groups. The teaching focused on definition of Climate Change, factors of Climate Change, impacts of Climate Change and remediation of Climate Change. The flowchart for treatment procedure is presented in Fig 3.2.

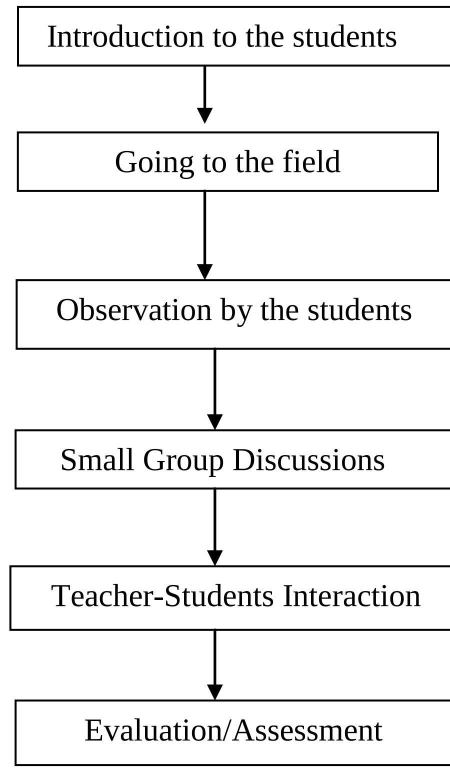

Fig 3.2 Flowchart of Field-Based Teaching Strategy
Source: Adapted from Fred (2007).

3.11 Data Collection Procedure

At the end of the treatment, post test was administered on the students. Pretest of both instruments were administered to the students prior to the treatment in order to determine equivalence in academic performance and interest level in both the experimental and control groups, while the post test scores of the CCPT will help to measure the performance of the students, and that of the CCIQ will help determine the interest level of the students. The postpost test was administered to the students two weeks after the posttest in order to measure the retention ability of the students using the CCPT only. Students' answer sheets was attached to the question papers in both pre-test and post test while at postpost test, students submitted only the answer sheet.

The scripts was collected and marked using the marking scheme (Appendix B). Each correct response scored one point. On the other hand, the CCCIQ has 21 items. Each option carries weight in the order of priority from five to one in the positive interest responses and from one to five in negative interest responses. The scores was collated into experimental and control groups, and also based on gender (male and female). Afterwards, the data generated from the scores was subjected to statistical analysis.

3.12 Technique of Data Analysis

The students' scores from the posttests of both instruments and postpost test of the CCPT was subjected to analysis with the help of SPSS Statistical package. The descriptive statistics such as mean, standard deviation, mean rank and sum of rank were used to answer the research questions, while the inferential statistics i.e independent sample t-test and Mann-Whitney U-test were used to test the null hypotheses at 0.05 level of significant.

Null Hypotheses Testing

Ho_1: There is no significant difference between the mean scores of geography students taught Climate using Field-based Teaching Strategy and those taught using lecture method.

This null hypothesis was tested using independent t-test statistic at 0.05 level of significance.

Ho_2: There is no significant difference between the mean retention ability of students taught Climate Change using Field-based Teaching Strategy and those taught using lecture method.

Independent t-test statistic at 0.05 level of significance was used to test this hypothesis.

Ho_3: There is no significant difference between the interest level of geography students exposed to Climate Change using Field-based Teaching Strategy and those taught with lecture method.

This hypothesis was tested using Mann-Whitney U-test statistic at 0.05 level of significance.

Ho_4: There is no significant difference between the mean scores of male and female geography students taught Climate Change using Field-based Teaching Strategy.

Independent t-test statistic was used to test this hypothesis at 0.05 level of significance.

Ho_5 : There is no significant difference between the mean retention ability of male and female geography students taught Climate Change using Field-based Teaching Strategy only.

This hypothesis was tested using independent t-test statistic at 0.05 level of significance.

Ho_6 : There is no significant difference between the interest level of male and female geography students taught Climate Change using Field-based Teaching Strategy only.

This hypothesis was also tested using the independent t-test statistic at 0.05 level of significance.

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

This chapter contains data analysis, result and discussions. The results are presented according to the sequence of the research question and hypothesis which guided the study. Specifically, the chapter has the following sub-headings:

- Analysis and Result Presentation
- Summary of Major Findings
- Discussion of Results

4.2 Analysis and Result Presentation

Answering Research Questions

The six research questions raised were answered using descriptive statistic. Means and standard deviations were used in answering the research questions except for the third research question, where mean rank and sum of ranks were used.

Research Question One: What is the difference between the mean scores of Geography students taught Climate Change using the Field-based Teaching Strategy and those taught using the lecture method.

The means and standard deviations of post test scores of experimental and control groups are calculated and presented in Table 4.1

Table 4.1: Means and Standard Deviations of Post test Scores of CCPT for Experimental and Control Groups

Group	N	Mean	Standard Deviation	Mean Difference
Experimental	35	24.29	1.62	
				1.41
Control	40	22.88	3.71	

Table 4.1 shows the experimental group has a mean score of 24.29 and standard deviation of 1.62, while the control group has a mean score of 22.88 and standard deviation of 3.71, and a mean difference of 1.41. This shows that geography students taught Climate Change using Field-Based Teaching Strategy achieved higher academically by mean score of 24.29 than their lecture group counterpart with mean score of 22.88.

Research Question Two: What is the difference between the retention level of geography students taught Climate Change using Field-based Teaching Strategy and those taught using the lecture method only.

Here, the means and standard deviations of the postpost test scores of experimental and control groups were calculated and presented in Table 4.2.

Table 4.2: Means and Standard Deviations of Postpost Test Scores of CCPT for Experimental and Control Groups

Variable	N	Mean	Standard Deviation	Mean Difference
Experimental	35	24.37	2.00	
				2.85
Control	40	21.53	3.88	

From the result in Table 4.2 , the mean score of experimental group is 24.37 with a standard deviation of 2.00, as against that of control group with a mean score of 21.53 and a standard deviation of 3.88. This shows that geography students taught Climate Change using Field-based Teaching Strategy retained the learned concepts more than students taught using lecture method only.

Research Question Three: What is the difference between interest level of geography students taught Climate Change using the Field-based Teaching Strategy and those taught using the lecture method only.

Here, the mean rank of students' post interest scores in experimental and control group were compared and presented in Table 4.3.

Table 4.3: Mean Rank Interest Scores of CCIQ for Experimental and Control Groups

Variable	N	Mean Rank	Sum of Rank	Mean Rank Difference
Experimental	35	56.71	1985.00	
				35.08
Control	40	21.63	865.00	

From Table 4.3, the mean rank value of 56.71 was obtained in the experimental group with a value of 1985.00 as the sum of rank, while in the control group, a mean rank value of 21.63 with a sum of rank value of 865.00 was also obtained. A high mean rank difference of 35.08 was computed and this shows that the experimental group developed a higher interest in Climate Change than the control group. As such, Field-based Teaching Strategy has a positive impact on students' interest towards Climate Change.

Research Question Four: What is the difference between the mean scores of male and female geography students taught Climate Change using Field-based Teaching Strategy.

Here, means and standard deviations of post test scores of CCPT for male and female students in experimental group were computed and presented in Table 4.4.

Table 4.4: Means and Standard Deviations of Post Test Scores of CCPT for Male and Female Students in Experimental Group.

Variable	N	Mean	Standard Deviation	Mean Difference
Male	20	24.20	1.64	
				0.20
Female	15	24.40	1.63	

Result in Table 4.4 above shows that the mean post test score of male students in experimental group is 24.20, with standard deviation of 1.64. Likewise, the female students in experimental group also have a mean score of 24.40 and standard deviation of 1.63. A low mean difference of 0.20 was observed. This shows that both male and female students taught Climate Change using Field-based Teaching Strategy have almost similar mean academic score in their post test.

Research Question Five: What is the difference between the retention level of male and female geography students taught Climate Change using Field-based Teaching Strategy.

Means and standard deviations of postpost test scores of CCPT for male and female students in experimental group were compared. The detail of the result is presented in Table 4.5

Table 4.5: Means and Standard Deviations of Postpost Test Scores of CCPT for Male and Female Students in Experimental Group.

Variable	N	Mean	Standard Deviation	Mean Difference
Male	20	24.20	1.99	
				0.40
Female	15	24.60	2.06	

Table 4.5 shows the mean postpost test scores of the male students in the experimental group as 24.20 with standard deviation of 1.99, while that of the female students shows a mean score of 24.60 and standard deviation of 2.06. Also, a mean difference of 0.40 was observed which is in favour of the female students, but is actually low. This result indicate that both the male female students taught Climate Change using Field-based Teaching Strategy have almost the same mean retention score in their post-post test.

Research Question Six: What is the difference between the interest level of male and female geography students taught Climate Change using Field-based Teaching Strategy.

Means and standard deviations of the post interest score of the male and female students in experimental group were computed and presented in Table 4.6.

Table 4.6: Mean and Standard Deviation of Interest Score of CCIQ for Male and Female Students in Experimental Group.

Variable	N	Mean	Standard Deviation	Mean Difference
Male	20	91.60	2.82	
				0.67
Female	15	90.93	2.91	

Table 4.6 shows the mean interest score of male students in the experimental group as 91.60 and a standard deviation of 2.82, while that of the female students revealed a mean interest

score of 90.93 and a standard deviation of 2.91. The mean difference computed was 0.67 and it is also low. This implies that both male and female students in the experimental group have almost the same mean interest score.

Testing Null Hypotheses

Ho_1: There is no significant difference between the mean scores of geography students taught Climate Change using Field-based teaching Strategy and those taught using lecture method.

t-test analysis was used to test hypothesis 1 using data of post test scores of students in experimental and control groups. The result of the analysis is presented in Table 4.7

Table 4.7: Results of t-test Analysis of Post Test Scores of Students in Experimental and Control Groups

Groups	N	Mean	S.D	df	t	p	Decision
Experimental	35	24.29	1.62				
				73	2.18	0.03	Sig*
Control	40	22.88	3.71				

*Significant at $p \leq 0.05$ level

Table 4.7 shows that the t-value computed is 2.18 and the P-value of 0.03 is observed at degree of freedom of 73. Since the critical P-value of 0.03 is less than the alpha value of 0.05, there is significant difference in the academic performance of the students in experimental and control group. This null hypothesis is rejected. The significant difference is in favour of experimental group taught Climate Change using Field-based Teaching Strategy as revealed in their mean scores. This implies that the experimental group performed better academically than the control group, hence, Field-based Teaching Strategy is more effective than the lecture method.

Ho_2: There is no significant difference between the mean retention ability of students taught Climate Change using Field-based Teaching Strategy and those taught using lecture method.

In testing hypothesis two, data of postpost test scores of the students in experimental and control groups were used. t-test statistics was also used to analyse the data. The detail of the result is presented in Table 4.8

Table 4.8: Results of t-test Analysis of Postpost Test Scores of Students in Experimental and Control Groups

Groups	N	Mean	S.D	df	t	p	Decision
Experimental	35	24.37	2.00				
				73	4.06	0.01	Sig*
Control	40	21.53	3.88				

*Significant at $p \leq 0.05$ level

Statistics in Table 4.8 shows that the t-value of 4.06 is obtained is and the P-value observed is 0.00 at the degree of freedom of 73. The critical p-value of 0.01 is less than the alpha value of 0.05. This shows that there is significant difference between the experimental and control groups. Hence, this null hypothesis is rejected. The significant difference is in favour of the experimental group who were exposed to Climate Change using Field-based Teaching Strategy as revealed in their mean score. Hence, Field-based Teaching Strategy improved students' retention ability more than the lecture method.

Ho$_3$: There is no significant difference between the interest level of geography students exposed to Climate Change using Field-based Teaching Strategy and those taught with lecture method.

Mann-Whitney U-test was used to test this hypothesis, using the post interest ranking of the students in both experimental and control group. The detail of the results is presented in Table 4.9.

Table 4.9: Results of Mann-Whitney U-test Analysis of Interest Level of Students in Experimental and Control Groups

Group	N	Mean Rank	Sum of Rank	U	p	Decision
Experimental	35	56.71	1985	45.00	0.001	Sig*
Control	40	21.63	865			

*Significant at $p \leq 0.05$ level

Results in Table 4.9 shows that the mean rank value of 56.71 was obtained by the experimental group and a sum of rank of 1985. On the other hand, the mean rank value of the control group was 21.63 and the sum of rank was 865. The Mann-Whitney U value was 45.00.Since the P-value of 0.001 is less than 0.05, there is significant difference between the interest ability of the students in the experimental and control group in favour of the experimental group who were exposed to Climate Change using Field-based Teaching Strategy. Hence, the null hypothesis is rejected. This implies that Field-based Teaching Strategy increased the interest level of students in Climate Change than the lecture method.

Ho$_4$: There is no significant difference between the mean scores of male and female geography students taught Climate Change using Field-based Teaching Strategy.

Post test scores of the male and female students in experimental group were used. The t-test statistics was also used to analyse the data. The detail is presented in Table 4.10.

Table 4.10: Results of t-test Analysis of Post Test Scores of the Male and Female Students in Experimental Group only

Variable	N	Mean	S.D	df	t	p	Decision
Male	20	24.20	1.64				
				33	-0.36	0.72	Not Sig*
Female	15	24.40	1.63				

*Not Significant at $p \leq 0.05$ level

From the statistics in Table 4.10, it is shown that the t-value of -0.36 is obtained and a P-value of 0.72 at the degree of freedom of 33. The critical P-value of 0.72 is greater than the alpha value of 0.05. This implies that there is no significant difference, hence, this null hypothesis is retained. This means that there is no significant difference in the academic performance of both male and female students taught Climate Change using Field-based Teaching Strategy. This implies that Field-based Teaching Strategy is effective for improving the performance of both male and female students.

Ho_5: There is no significant difference between the mean retention ability of male and female geography students taught Climate Change using Field-based Teaching Strategy only.

Postpost test scores of CCPT for male and female students of experimental group were used. The t-test statistics was used to analyse the data. The result is presented in Table 4.11.

Table 4.11: Results of t-test Analysis of Postpost Test Scores of the Male and Female Students in Experimental Group

Variable	N	Mean	S.D	df	t	p	Decision
Male	20	24.20	1.99				
				33	-0.58	0.57	Not Sig*
Female	15	24.60	2.06				

*Not Significant at $p \leq 0.05$ level

Statistics in Table 4.11, it is observed that the t-value of -0.58 is obtained and a P-value of 0.57 at the degree of freedom of 33. The critical P-value of 0.57 is greater than the alpha value of 0.05. This implies that there is no significant difference between the male and female students in the experimental group, hence, the null hypothesis is retained. This indicates that there is no significant difference in the retention ability of both male and female students taught Climate Change using Field-based Teaching Strategy. Hence, Field-based Teaching Strategy is effective in improving the retention ability of both male and female students.

Ho_6: There is no significant difference between the interest level of male and female geography students taught Climate Change using Field-based Teaching Strategy only.

In testing hypothesis six, data of post interest scores of male and female students of experimental group was used. The t-test statistic was used to analyse the data. The result is presented in Table 4.12.

Table 4.12: Results of t-test Analysis of Post Interest Scores of the Male and Female Students in Experimental Group only

Variable	N	Mean	S.D	df	t	p	Decision
Male	20	91.60	2.82	33	0.68	0.50	Not Sig*
Female	15	90.93	2.91				

*Not Significant at $p \leq 0.05$ level

From the result in Table 4.12, it is observed that the t-value of 0.68 is obtained and a P-value of 0.50 at the degree of freedom of 33. The critical P-value of 0.50 is greater than the alpha value of 0.05. This implies that there is no significant difference, hence, the null hypothesis is retained. This implies that there is no significant difference in the interest level of both male and female students taught Climate Change using Field-based Teaching Strategy. This indicates that Field-based Teaching Strategy is effective in increasing the interest level of both male and female students.

4.3 Summary of the Major Findings

From the results presented in this study, the summary of the major findings are:

1. Research question one shows a greater mean difference in the academic performance of the students in experimental and control group, in favour of the experimental group.
2. Research question two also shows a greater difference in the mean retention ability of the students in experimental and control group, also in favour of the experimental group.
3. Research question three revealed disparity in the mean interest level of the students in experimental and control group, also in favour of experimental group.

4. Research question four shows no difference in the mean difference in the academic performance of male and female students in experimental group.
5. Research question five also shows no difference in the mean difference in the retention ability of male and female student ts in experimental group.
6. Research question six also shows no difference in the mean difference in the interest ability of both male and female students in experimental group.
7. There is significant difference between the academic performance scores of geography students taught Climate Change using Field-based Teaching Strategy and those taught using lecture method only. Students in the experimental group performed better than control group.
8. There is also significant difference between the retention ability of geography students taught Climate Change using Field-based Teaching Strategy and their lecture group counterpart. The significance difference is in favour of Field-based Teaching Strategy group.
9. There is significance difference between the interest ability of the students exposed to Climate Change using Field-based Teaching Strategy and those taught using lecture method only. The significance difference is in favour of Field-based Teaching Strategy group.
10. There is no significant difference in the academic performance of male and female students exposed to Climate Change using Field-based Teaching Strategy.
11. There is also no significant difference in the retention ability of male and female students exposed to Climate Change using Field-based Teaching Strategy.

12. There is no significant difference in the interest ability of male and female students exposed to Climate Change using Field-based Teaching Strategy enriched with lecture.

4.4 Discussion of Results

The data generated from this study were analysed and the results were presented in section 4.2. This section deals with the discussion of the results according to the sequence of the research questions and hypotheses.

From the findings in Tables 4.1 and 4.7, the study reveals that experimental group recorded the highest mean score than the lecture group, which shows that there is a significant difference in the academic performance of the students in experimental group and control group. A significant difference implies rejection of the null hypothesis which states that there is no significant difference in the academic performance of geography students taught Climate Change using Field-based Teaching Strategy and those taught with lecture method only. This finding is supported by Maikano (2007), Sola and Ojo (2007), Ajaja (2010), Adanu (2011), Usman (2010), Appaw (2011),Ifamuyiwa and Ajilogba (2012), Alexander and Poyyamoli (2014), Ahmad (2014) and Aminu (2015). Maikano (2007) found out that the experimental group taught ecological concept using outdoor laboratory approach achieved significantly higher than the control group taught the same concept using the indoor laboratory approach. The major findings of Ajaja (2010) revealed a significant difference in biology achievement test scores between students exposed to field trip experiences and those who were not. The work of Adanu (2011) also showed a significant difference between the mean achievement scores of students taught environmental education with fieldwork and those taught with conventional method in favour of those taught through fieldwork. This study also find support in the work of Ahmad (2014), which revealed that, field-trip teaching strategy favoured the experimental group as they performed better than their counterpart in the lecture group.

From the result in Tables 4.2 and 4.8, it was found out that there is significant difference in the retention ability of geography students exposed to Field-based Teaching Strategy and their lecture group counterpart. The significance difference is in favour of the experimental group as revealed in their mean score and t-value. This finding is also in concurrence with that of Maikano (2007), Chianson et al (2011), Bahrami et al (2012), Bouman (2012), Ifamuyiwa and Ajilogba (2012), Ahmad (2014) and Aminu (2015). Chianson et al (2011)'s work revealed that students who were subjected to the cooperative learning strategy were able to retain the concepts of circle geometry more than those students who were taught using the conventional learning approach. Bouman (2012) in his study also found out that the use of inquiry learning has help improved the students' ability to remember more difficult trapezoid formula compared to some of the formula taught by traditional means. Ahmad (2014)'s work also revealed that students exposed to the field-trip teaching strategy retained the taught concepts better than their lecture group counterpart.

Tables 4.3 and 4.9 compared the interest level of the students in the experimental and control group. From the findings of this table, result revealed significant difference in the interest level of the students in Climate Change due to exposure to Field-based Teaching Strategy and lecture method. The significant difference is in favor of experimental group as revealed in the mean rank value, mean value and the U-value and t-value. This finding is in agreement with that of Obeka (2009, 2013), Ibe (2013) and Aminu (2015). Obeka (2009) confirmed that students taught using EPODEWALAD simulation displayed greater interest in the environmental concept of geography than the lecture group. Likewise, Ibe (2013) found out that guided inquiry method fosters students interest in biology. Also, Obeka (2013) in his work, revealed that Development Model and Concept Mapping have significant effects on students' interest in Climate Change Concepts of environmental education. In addition, Aminu (2015) also revealed that students taught weather concepts using animated-media package show positive interest than their lecture group counterparts.

From the result in Tables 4.4 and 4.10, it showed that there is no significant difference in the academic performance of male and female students exposed to Field-based Teaching Strategy in Climate Change. This finding is in agreement with those of Maikano (2007), Yusuf (2009), Adanu (2011), Shittu (2012) and Aminu (2015). Maikano (2007) found no significant difference in the academic performance of male and female students taught ecological concepts using the outdoor laboratory instructional strategy. Adanu (2011)'s work showed no significant difference between the academic achievement of male and female students taught environmental education with fieldwork. Shittu (2012) revealed that the level of performance of male low achievers exposed to guided inquiry strategy is the same with their female counterparts. Aminu (2015) also concluded that female students taught weather concept using animated-media strategy did not differ significantly from their male counterpart. This finding is however in disagreement with those of Uhumuavbi et al (2003), Njoku (2007) and Appaw (2011). Njoku (2007) reported that boys perform better than girls in Science, Technical and Mathematical subjects. Further Appaw (2011) in his work using concept mapping as a teaching method also pointed out that the male students scored significantly higher than the females.

Tables 4.5 and 4.11 showed that there is no significant difference in the retention ability of male and female students exposed to Field-based Teaching Strategy in Climate Change. This finding is in agreement with the work of Ajai and Imoko (2015), which revealed that male and female students taught algebra using problem-based method did not differ significantly in their retention scores. This finding also corroborates the work of Ifamuyiwa and Ajilogba (2012) which revealed a no significant difference between the mean retention scores of male and female students exposed to problem solving model strategy in further mathematics.

Tables 4.6 and 4.12 also revealed a no significant difference in the interest level of male and female students exposed to Field-Based Teaching Strategy in Climate Change. This finding is in agreement with the work of Weinberg et al (2011) which revealed a no significant difference in the interest level of male and female students exposed to mathematics using experiential learning programme.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The study deals with determining the effects of Field-based Teaching Strategy on secondary school students' interest, retention and performance in Climate Change in Anchau Educational Zone of Kaduna State. This chapter focused on the summary of the research findings, conclusion, implication of the study and recommendations. The chapter is presented under the following subheadings:

- Introduction
- Summary
- Major Findings
- Conclusion
- Contributions to Knowledge
- Recommendations
- Limitation of the Study
- Suggestions for Further Studies

5.2 Summary

This study investigated the effects of Field-Based Teaching Strategy on Secondary School Geography Students' Interest, Retention and Performance in Climate Change in Anchau Educational Zone of Kaduna State. It also investigated the effects of gender related differences on students' academic performance, retention and interest in the concept of climate change based on Field-based Teaching Strategy, and is presented in five chapters.

The study was prompted by poor academic performance of students in Nigeria which has been linked to poor teachers' performance in terms of accomplishing the teaching task, which have been attributed to instructional strategy. The study has six objectives, one of which seeks to examine the effects of Field-based Teaching Strategy on senior secondary school students' academic performance in Climate Change. This is guided by six research questions and six hypotheses respectively. The study was delimited to only SS II students of public secondary schools offering geography in Anchau educational zone of Kaduna state. This study also reviewed literatures on; Concepts and scope of geography education; concept of Climate Change; Geography/Science teaching methods in senior secondary schools; Gender and academic performance in geography/science education; Retention and academic performance as well as interest in teaching and learning. The review has some implications to the present studies as it also introduce the concept of interest based on gender which was lacking in other Field-based related studies.

The study adopted pretest, posttest control group quasi-experimental research design. Experimental group received treatment using Field-based Teaching Strategy while control group received lecture method only. A sample size of 75 students was randomly selected from a population of 1655 SS II students for the study. Two instruments namely, Climate Change Performance Test (CCPT) and Climate Change Interest Questionnaire (CCIQ) were developed and validated by experts to guide data collection. The six research questions raised were answered using mean and standard deviation while the hypotheses testing involve the use of t-test and Mann-Whitney U test at 0.05 level of significant. The SPSS statistical package was used for the analysis of the data obtained. From the result of findings, it was confirmed that there is significant difference in the academic performance of geography students exposed to Climate

Change using Field-based Teaching Strategy and those exposed to lecture method only in favour of the experimental group. It was also revealed that there is significant difference in the retention ability and interest level of students taught climate change concepts using Field-based Teaching Strategy and those taught using lecture method only also in favour of experimental group. The result further confirmed no significant difference in the academic performance, retention ability and interest level of male and female students exposed to Field-based Teaching Strategy. This implies that the strategy is gender friendly.

The study concluded that Field-based Teaching Strategy is effective in improving academic performance, retention and interest of students towards climate change concept. The study contributes to body of knowledge in geography/science education in the sense that Field-based Teaching Strategy was found to be more effective than the lecture method in improving students' performance, interest and retention in Climate Change. The study recommended among others that geography teachers should adopt the use of Field-based Teaching Strategy in teaching the Climate Change concepts of geography.

5.3 Major Findings

1. Geography students exposed to Field-based Teaching Strategy shows significant difference in their academic performance scores than their lecture group counterpart.
2. There is significant difference in the retention ability of geography students exposed to Climate Change using Field-based Teaching Strategy and their lecture group counterpart. The significant difference is in favour of experimental group.
3. There is significant difference in the interest ability of the students exposed to climate change using Field-based Teaching Strategy and those taught using lecture method only, in favour of the experimental group.

4. There is no significant difference in the mean scores of male and female students exposed to Climate Change using field-based teaching strategy.
5. There is no significant difference in the retention ability of male and female students exposed to Climate Change using Field-based Teaching Strategy.
6. There is no significant difference in the interest ability of male and female students exposed to Climate Change using Field-based Teaching Strategy.

5.4 Conclusion

Based on the findings of this study, it is concluded that students taught Climate Change Concepts using Field-based Teaching Strategy performed better academically, exhibit a high level of retention, and shows a higher interest level than their lecture group counterparts. Also, the male and female students do not differ significantly from one another in academic performance, retention ability, and interest ability.

5.5 Contributions to Knowledge

This study, "Effect of Field-based Teaching Strategy on the academic performance, retention and interest of secondary school students in Climate Change" has contributes to knowledge in geography/science education and other areas in the following ways:

- The study revealed that students exposed to Climate Change using Field-based Teaching Strategy had higher mean scores, interest level and retention level than those exposed to lecture method. This implies that Field-based Teaching Strategy was more efficacious than lecture method. Hence, Field-based Teaching Strategy has been found more effective in improving students' performance, interest and retention in Climate Change of geography.

- Teachers can now see reasons to adopt Field-based Teaching Strategy for effective teaching and learning, because it allows for students active participation, especially in Climate Change of geography.
- Field-based Teaching Strategy has been proven to be gender friendly, hence the need to give both males and females equal chance to learn and interact with instructional materials.
- Climate Change Performance Test (CCPT) was developed for this study and it was found to be effective in improving students' academic performance and retention in Climate Change of geography education.
- Also, Climate Change Interest Questionnaire (CCIQ) was developed too to measure students' interest toward Climate Change concepts and is unique in the field of geography education at senior secondary school level.

5.6 Recommendations

On the basis of the findings emanating from this study, the following recommendations are made:

1. Geography teachers should adopt and use Field-based Teaching Strategy to teach Climate Change concept of geography.
2. Both federal and state ministries of education in the country should monitor and enforce field work in geography education at the secondary school levels, and adequate funding should be provided because of its cost implication.
3. Curriculum planners in the country should help in designing of Field-based work and be incorporated in the curriculum in the teaching and learning of geography at senior secondary school level.

4. Field-based Teaching Strategy is gender friendly because it aided learning among the male and female students, hence, it is recommended for both gender.
5. In-service training programmes in the form of seminars and workshops organized for geography teachers by ministries of education and teachers training institutes should also focus on Field-based Teaching Strategy for the teaching of Climate Change Concepts.

5.7 Limitations of the Study

This study has the following limitations:

1. Financial constraint constitute a limitation to this study, especially the aspect of transportation and catering for the welfare of the students.
2. Security challenge also constitute another limitation especially with respect to moving the students out of the school premises.
3. The study is restricted to only two secondary schools in Anchau Educational Zone of Kaduna State, as such it limits the scope of generalization.
4. A sample size of 75 SS II geography students was used. It is possible that when larger sample size is used, the result might differ.
5. The samples used for the study were limited to public schools owed by the Kaduna State Government. Private and federal schools were not involved. It is also possible that if such schools were involved, the result of findings may be different from the one obtained.

5.8 Suggestions for Further Studies

This study can further be extended in the following ways:

1. Government agencies and professional bodies such as National Educational Research and Development Council (NERDC) should shoulder the responsibility of sponsorship of further research investigations on the efficacy of Field-based Teaching Strategy in

improving performance, interest and retention of students in other of fields of study in education.

2. The scope and sample size can also be expanded with a view to finding out if similar or different results may be obtained.
3. Further studies should also extend into private and federal schools. Comparison should also be made among the federal state government and private schools with a view to finding out if similar or different results may be obtained.

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APPENDIX A

CLIMATE CHANGE PERFORMANCE TEST (CCPT), MARKING SCHEME AND ANSWER SHEET

SECTION A: BIODATA

Name of School…………………………………………………..

Class………………….. Sex: Male ( ) Female ( )

Age……………….

SECTION B: PERFORMANCE TEST Duration 50 minutes

Instructions:

1. Use HB pencil for this examination.
2. Write your school name, class, age and sex in the space provided in your answer sheet.
3. Answer all the questions. Questions 1-27 is followed by four options lettered A-D. Find out the correct option and shade on your answer sheet the space which bears the same letter as the option you have chosen. Questions 28-42 is followed by two options true/false. You are also required to find out the correct option and shade it on your answer sheet.
4. Shade only one option for each answer. If you change your mind on any answer, completely erase the first shading.

YOU CAN NOW START.

1.The difference between Climate and Climate Change is that Climate -------------------------------

A. changes from time to time.

B. changes after 35 years.

C. never changes.

D. is constant for a long time.

2. Variability of atmospheric process longer than 35 years is called -----------------------------------
A. climate change
B. global warming

C. climate

D. weather

3. The energy that keeps the Earth warm comes from the ---------------------

A. Moon

B. Star

C. Sun

D. Sea

4. Recent climate changes can be explained by

A. natural causes.

B. anthropogenic causes.

C. natural and anthropogenic causes.

D. none of the above.

5. The rise in temperature of the Earth when solar energy is trapped is called

A. climate change.

B. weather changes.

C. extreme heat.

D. greenhouse effect.

6. Which of these is not a natural cause of climate change?

A. Continental drift

B. Volcanoes

C. Earth's tilt

D. Deforestation

7. Which of these greenhouse gases is the most abundant in the atmosphere?

A. Carbon dioxide

B. Methane

C. Nitrous oxide

D. Chloroflourocarbon

8. If Earth had no greenhouse effect, it would be -----------------------

A. hotter

B. colder

C. covered with water

D. the same as it is now

9. All these are human causes of Climate Change **EXCEPT** -------------------

A. transportation

B. deforestation

C. ocean currents

D. industrialization

10. Carbon dioxide can be produced from the following except

A. burning of fossil fuels

B. industrial process

C. deforestation

D. leaky refrigerator

11. Which of the following has been linked to Climate Change?

A. Drought

B. Flooding

C. Melting of ice

D. All of the above

12. All these are extreme weather events **EXCEPT**

A. rainstorms

B. hurricanes

C. rising sea level

D. flooding

13. The immediate impact of climate change is --------------------

A. rising sea level

B. increase in temperature

C. flooding

D. wildfire

14. Which type of energy transfer occurs when energy travels from the Earth to the atmosphere?

A. Radiation

B. Circulation

C. Conduction

D. Convection

15. Which type of energy transfer occurs as energy travels from the sun to Earth?

A. Radiation

B. Circulation

C. Conduction

D. Convection

16. Most of the solar radiations that enter Earth's atmosphere is absorbed by

A. clouds

B. gases in the atmosphere

C. Earth's surface

D. aerosols in the atmosphere.

17. Greenhouse gases are also called ----------------------

A. heat-emitting gases

B. cold-emitting gases

C. heat-trapping gases

D. cold-trapping gases

18. Which year was regarded as the warmest year on record?

A. 2010

B. 2011

C. 2012

D. 2013

19. Why should Climate Change be remediated?

A. So that we can have a cleaner environment.

B. So that we can have enough money

C. So that we can have more industries

D. So that agricultural activities can be improved.

20. The Intergovernmental Panel on Climate Change (IPCC) --------------------------------

A. constructed the Kyoto Protocol.

B. is an international panel that concluded that climate change has influenced biomes and economies.

C. fines companies.

D. performed the research included in the climate change findings.

21. Which of the following statements is not correct?

A. Climate Change enhances the spread of diseases.

B. Air pollution affects air quality.

C. Agriculture is highly exposed to Climate Change.

D. Climate Change does not have impacts on the ecosystem.

22. Northern part of Nigeria is prone to the following impacts of Climate Change except

A. drought.

B. sea-level rise.

C. desertification.

D. land degradation.

23. Which of the following is true?

A. It's too late to stop Climate Change

B. Only politicians can make a difference to Climate Change

C. Everyone can do their bit to help stop Climate Change

D. none of the above

24. Which of these is the best way to stop Climate Change around your school?

A. Leave computers and lights on when leave a room.

B. Recycle rubbish and use energy efficient light bulbs.

C. Only use one side of your paper and leave litter around the playground.

D. encourage the burning of grasses and rubbish around the school.

25. Impact of Climate Change can be reduced around the house by

A. closing the windows and switching on all the lights during the day.

B. turning on the television even when you are not watching it.

C. boiling a full kettle for one cup of tea and leaving the taps running.

D. using energy-efficient appliances.

26. Causes of Climate Change can be reduced by

A. walking to school.

B. using jets from one location to another.

C. riding old buses to the market.

D. riding on motorcycles to playgrounds.

27. If the climate becomes warmer, sea levels will ---------------------------------------

A. rise, because water expands when it gets warmer

B. rise, because of glaciers and ice sheets melting

C. rise, both because of ice melting AND because of water expanding when it gets warmer

D. fall, because hot water evaporates faster.

28. Climate Change could occur in only one part of the World.

True ( ) False ( )

29. Investing in clean energy can help reduce Climate Change

True ( ) False ( )

30. Climate Change originated from the sea only

True ( ) False ( )

31. Water vapour is the least of the greenhouse gases

True ( ) False ( )

32. Climate Change is not being experienced in Nigeria

True ( ) False ( )

33. Pollution is the least of man-made problems

True ( ) False ( )

34. Climate Change has made certain types of extreme weather conditions more frequent

True ( ) False ( )

35. Rising sea-level has no effect on coastal settlements

True ( ) False ( )

36. Mosquitoes thrive very well as temperature increases

True ( ) False ( )

37. The 'Green Schools Design' approach suggests an environmentally sustainable schools

True ( ) False ( )

38. The glass walls in a greenhouse reduce airflow and increase the temperature of the air inside.

True ( ) False ( )

39. Climate Change has caused migration

True ( ) False ( )

40. Farmers cannot predict rain occurrence because of Climate Change

True ( ) False ( )

41. Fruits have distorted seasonal period of maturity because of Climate Change

True ( ) False ( )

42. Climate Change cause longer days

True ( ) False ( )

APPENDIX A (CONT'D)

ANSWER SHEET FOR CLIMATE CHANGE CONCEPTS PERFORMANCE TEST (CCCPT)

SECTION A: BIODATA

Name of School……………………………………………………………………………………

Class……………………….. Sex: Male ( ) Female ( )

Age…………….

Section B

Please shade the correct answer appropriately.

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

APPENDIX A (CONT'D)
MARKING SCHEME OF CLIMATE CHANGE CONCEPT PERFORMANCE TEST (CCCPT)

1. B	22. B
2. A	23. C
3. C	24. B
4. B	25. D
5. D	26. A
6. D	27. C
7. A	28. F
8. B	29. T
9. C	30. F
10. D	31. F
11. D	32. F
12. C	33. F
13. B	34. T
14. A	35. F
15. A	36. T
16. B	37. T
17. C	38. T
18. C	39. T
19. A	40. T
20. B	41. T
21. D	42. F

Total = 1mark * 42 = 42marks

APPENDIX B

CLIMATE CHANGE INTEREST QUESTIONNAIRE (CCIQ)

Dear Student,

You are requested to answer this questionnaire as correctly as possible. It is a list of items designed to examine the level of interest of students in climate change concepts. Be informed that the information provided will be used only for research and will be treated with utmost confidentiality.

SECTION A: BIODATA

Name of school…………………………………………………………………………..

Class……………………… Sex: Male ( ) Female ( )

Age …………

Section B:

Please take note of the following keys to guide your responses:

Strongly Agree (S.A) Agree (A) Undecided (U) Disagree (D) Strongly Disagree (S.D)

Tick the options appropriate to you

S/N	ITEM	**S.A**	**A**	**U**	**D**	**S.D**
1.	I found the topic of Climate Change interesting.					

2.	I like listening to issues concerning Climate Change on radio and television.					
S/N	ITEM	S.A	A	U	D	S.D
3.	I am concerned about the effects of Climate Change on health.					
4.	I don’t think Climate Change is real.					
5.	I am willing to undertake some measures that will reduce Climate Change.					
6.	I will not study Climate Change related courses in the higher institution.					
7.	Climate Change topic is too difficult for me.					
8.	I will like to work as a Climate Change specialist.					
9.	I will help in propagating measures to reduce Climate Change in my school and community.					
10.	I think Climate Change topic should be taught from junior classes.					
11.	To me, Climate Change should be taught to primary school students too.					
12.	I think Climate Change should be incorporated into other science subjects.					
13.	I am well informed about Climate Change.					
14.	I am not bothered about Climate Change.					
15.	To me, Climate Change poses risks to future generations.					
16.	To me, much awareness on Climate Change should be created for the general public.					
17.	I think Climate Change should be taught better by using weather materials.					
18.	I am interested in discussing the effects of Climate Change with my parents and friends.					
19.	I support the idea of Green Schools.					
20.	I am not interested in getting more information on Climate Change.					
21.	I will encourage the formation of Climate Change clubs in my community.					

APPENDIX C

FACILITY AND DISCRIMINATION INDICES OF CLIMATE CHANGE CONCEPT PERFORMANCE TEST (CCCPT)

S/N	F	D
1	0.34	0.10X
2	0.31	0.20M
3	0.89	0.30
4	0.10	0.00X
5	0.40	0.20 M
6	0.34	0.30
7	0.57	0.40
8	0.34	0.30
9	0.60	0.10X
10	0.34	0.40
11	0.37	0.50
12	0.20	0.20 M
13	0.69	0.60
14	0.51	0.40
15	0.69	0.20 M
16	0.57	0.60
17	0.29	0.30
18	0.74	0.60
19	0.31	0.20 M
20	0.51	0.40
21	0.43	0.50
22	0.31	0.40
23	0.37	0.40
24	0.43	0.40
25	0.37	0.50
26	0.46	0.30
27	0.26	0.40
28	0.80	0.30
29	0.86	0.40
30	0.80	0.30
31	0.57	0.00 X
32	0.69	0.40
33	0.11	0.00 X
34	0.54	0.20 M
35	0.63	0.40
36	0.77	0.30
37	0.49	0.10 X
38	0.74	0.20 M

39	0.77	0.20 M
S/N	F	D
40	0.74	0.00 X
41	0.80	0.40
42	0.31	0.20 M

Source: Researcher's work, (2015).

Items marked M were modified and retained while items X implies the items were discarded.

Where F= Facility index=R/ T D= Discrimination index= R_H- R_L / N_H

R= number of right responses R_H= number of right responses in high group

T= total number of responses R_L= number of right responses in low group

N_H= number of candidates in high or low group.

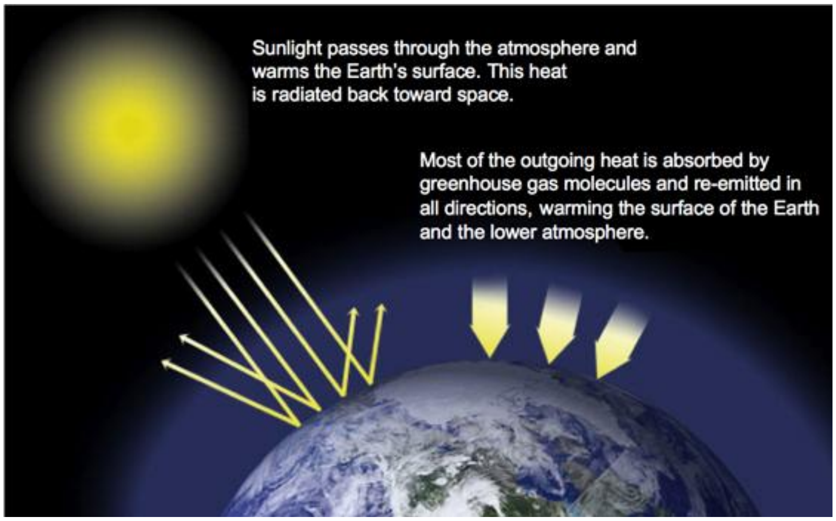
APPENDIX D
LESSON PLAN FOR EXPERIMENTAL GROUP

Week	One
Class	SS 2
Duration	80 minutes
Sex	Males and Females
Average age	16-17 years
Subject	Geography
Topic	Defination of Climate Change concept.
Behavioural Objectives	By the end of the lesson, the students should be able to: 1. Define weather and climate 2. define Climate Change 3. differentiate between climate and climate change. 4. explain the phenomenon of climate change- what drives changes in Climate, and the greenhouse effect.
Previous Knowledge	The students have been taught the concept of weather and climate in their SS 1 class.
Instructional Materials	The field, pictures/diagrams.
Introduction	Teacher introduces the lesson by asking the students some questions based on their previous knowledge, example: What is weather? What is climate? Mention the elements of weather and climate.
Presentation	The lesson is presented in sequence following these steps/activities:
Activity I	Teacher introduces the topic to the students.
Activity II	Students observe the condition of the atmosphere on the field at that particular time and comment on it. The teacher will further interacts with the students and explains the features observed as the weather. The teacher asks the students about the current season and what was experienced before and for how long it lasted. The teacher relate this to climate which is a condition that extend over a long period.
Activity III	The students in groups of five ponders over the climate experienced from 2012 up till date and discusses among themselves the differences/changes in the temperature and rainfall within these years. The teacher further interacts with the students and explains the changes observed as climate change. She further defines climate change for the student as variations in atmospheric

process longer than 30 years . It can also be defined as climate fluctuations of a global nature including effects from human activities and natural causes.

Activity IV The students in group of five again interacts among themselves and ponders over what they had observed so as to tell the difference between climate and climate change. After the interaction among the students, the groups collectively interacts with the teacher and highlights out their findings.

Activity V The students observe a video clip and chart demonstrating the redistribution of energy on the earth surface. Afterwards, they interacts and discusses among themselves .The students also visits an agricultural site with a greenhouse and they observes the phenomenon of the greenhouse effect after which they interact among themselves and with the teacher too. The teacher further explains the changes taking place within the atmosphere, starting from the solar radiation, the sun being the main source of energy to the earth. The teacher further define the greenhouse effect to corroborate what was observed by the students.



A layer of greenhouse gases- acts as a thermal blanket for the earth
Source: NASA, 20I5

Agricultural greenhouse
Source: Nairaland Forum, 2015

Evaluation — Teacher asks the students some questions based on what was taught and what was observed by them, example:

- What does a sunny or rainy day implies?
- What is climate change?
- What is the difference between climate and climate change?
- What happens in a greenhouse?

Conclusion — Teacher concludes the lesson by summarizing the lesson and emphasizes more on the difficult areas observed during evaluation. She then allows the students to form their note based on what was taught and observed by them.

Week	Two
Class	SS 2
Duration	80 minutes
Sex	Males and Females
Average age	16-17 years
Subject	Geography
Topic	Factors of Climate Change- natural factors.

Behavioural Objectives

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

1. Define natural factors of climate change.
2. mention and explains natural factors.
3 explain how the natural factors causes Climate Change.

Previous Knowledge

The students were taught the definition of climate change, weather and climate, and what drives changes in the atmosphere and greenhouse effects in their previous lesson.

Instructional Materials

The field, pictures, charts showing the anthropogenic and natural factors of climate change and greenhouse gases.

Introduction

The teacher introduces the lesson by asking the students some questions based on their previous knowledge, example:

- Differentiate between climate and climate change.
- What is the major source of energy on earth?
- What is greenhouse effect?

Presentation

The lesson is presented in sequence as follows:

Activity I

Teacher introduces the topic to the students.

Activity II

The students on the field, observes the environment and points out the things that are human in nature and those that are natural, after which they define human and natural factors in order to differentiate between them.

Activity III

Students observes a chart showing the natural and anthropogenic factors of climate change, after which they points out those that are natural in nature. They also observe how the factors influence or cause climate change from a video clip. The factors are :

- Volcanic eruption
- Continental drift
- Ocean currents
- Earth’s tilt
- Deforestation
- Using of electricity
- Transportation

- Agriculture
- Mining
- Manufacturing.

Activity IV — Students also in groups interact among themselves to explain what was observed from the video clips.

Activity V — Students and teacher interact among themselves to further explain the topic.

Evaluation — Teacher asks the students some questions based on what was observed by them and what they learnt from the field work, for example:

- Differentiate between natural and anthropogenic factors.
- Mention the natural factors of climate change.
- Explain how the natural factors causes Climate Change.

Conclusion — The teacher concludes the lesson by summarizing the lesson and emphasizes more on the difficult areas observed during evaluation. She then allows the students to form their note based on what was taught and observed by them.

Week	Three
Class	SS 2
Duration	80 minutes
Sex	Males and Females
Average age	16-17 years
Subject	Geography
Topic	Human (Anthropogenic) factors of Climate Change
Behavioural Objectives	By the end of the lesson , the students should be able to: 1. Define anthropogenic factors. 2. mention the anthropogenic factors of Climate Change. 3. explain how the anthropogenic factors causes Climate Change.
Previous Knowledge	The students learnt the natural factors of Climate Change and how they trigger Climate Change in their previous lesson.
Instructional Material	Field, charts, video clips
Introduction	Teacher introduces the lesson by asking the students some questions based on their previous lesson, examples: - Mention the natural factors of Climate Change. - Explain how the natural factors causes Climate Change.
Presentation	The lesson is presented in sequence as follows:
Activity I	Teacher introduces the lesson to the students.
Activity II	Students on the field, observes the environment and points out the things that are human in nature, after which they define human factors.
Activity III	Students observes a chart showing the natural and anthropogenic factors of climate change, after which they points out those that are human in nature. They observe some human factors pointed out from the chart on the field (the environment).They also observe how the factors influence or cause climate change a video clip. The factors are : - Volcanic eruption - Continental drift - Ocean currents - Earth's tilt - Deforestation - Using of electricity - Transportation - Agriculture - Mining - Manufacturing.

Activity IV	Students also in groups interact among themselves to explain what was observed from the video clips.
Activity V	Students and teacher interact among themselves to further explain the topic.
Evaluation	Teacher asks the students some questions based on what was observed by them and what they learnt from the field work, for example: - Mention the anthropogenic factors of climate change. - Explain how the anthropogenic factors causes Climate Change. - Mention the anthropogenic factors that were observed from the field.
Conclusion	The teacher concludes the lesson by summarizing the lesson and emphasizes more on the difficult areas observed during evaluation. She then allows the students to form their note based on what was taught and observed by them.

Week	Four
Class	SS 2
Duration	80 minutes
Sex	Males and Females
Average age	16-17 years
Subject	Geography
Topic	Greenhouse gases and their sources.
Behavioural Objectives	By the end of the lesson, the students should be able to: 1. Define greenhouse gases. 2. mention the greenhouse gases in order of their abundance. 3. state the sources of greenhouse gases.
Previous Knowledge	The students learnt the anthropogenic factors of Climate Change and how they trigger Climate Change in their previous lesson.
Instructional Material	Field, charts, video clips
Introduction	Teacher introduces the lesson by asking the students some questions based on their previous lesson, examples: - Mention the anthropogenic factors of Climate Change. - Explain how the anthropogenic factors causes Climate Change.
Presentation	The lesson is presented in sequence as follows:
Activity I	Teacher introduces the topic to the students.
Activity II	The students observes the list of the greenhouse gases on a chart and their sources in order of their abundance as follows: - Water vapour - evaporation from water bodies as a result of high temperature - Carbon dioxide -through burning of fossil fuels from activities like manufacturing, transportation, generation of electricity, deforestation, burning of trees and vegetation. - Methane - raising of livestock, mining of petroleum and coal, farming practices such as application of fertilizer, burning fossil fuels from manufacturing processes - Nitrous oxide – through soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, and nitric acid production. - Chloroflourocarbons (CFCs) - leaking coolants from leaky refrigerators, freezers and air conditioners in cars and homes, some industrial and manufacturing processes like producing computer chips.

Activity III Students observe the sources of greenhouse gases on the field (farmlands, roads and market areas) and from video clips.

Activity IV Students also in groups interact among themselves to explain what was observed from the video clips and the field.

Activity V Students and teacher interact among themselves to further explain the topic.

Evaluation Teacher asks the students some questions based on what was observed by them and what they learnt from the field work, for example:

- What are greenhouse gases?
- Mention the greenhouse gases in their order of abundance.
- Mention the various sources of the greenhouse gases.

Conclusion The teacher concludes the lesson by summarizing the lesson and emphasizes more on the difficult areas observed during evaluation. She then allows the students to form their note based on what was taught and observed by them.

Week	Five
Class	SS 2
Duration	80 minutes
Sex	Males and Females
Average age	16-17 years
Subject	Geography
Topic	Impacts of climate change
Behavioural Objectives	By the end of the lesson, the students should be able to: 1. Mention the general impacts of climate change on a world scale. 2. State and explains the impacts of climate change observed in their area. 3. mention other impacts of climate change prominent in other parts of the Country.
Previous knowledge	The students were taught the greenhouse gases and their sources in their previous lesson.
Instructional Materials	The field, pictures, video clips of the impacts of climate change.
Introduction	The teacher introduces the lesson by asking the students some questions based on their previous knowledge, example: - What are greenhouse gases? - Mention the greenhouse gases and their sources.
Presentation	The teacher presents the lesson in sequence following these steps:
Activity I	Teacher introduces the topic to the students.
Activity II	Students observe a list of the impacts of climate change on a world scale from a chart and video clip as follows: - Increase in average temperatures - Extreme weather events such as heat waves, rainstorms, hurricanes, wildfires, flooding, droughts. - Rising sea level - Spread of diseases - Bad air, allergy and asthma - Ecosystem shifts and species die-off - Ocean acidification - Diminished food and water supplies
Activity III	Students in groups observes their environment to point out and discuss the impacts of climate change that are prominent in their environment.
Activity IV	Students also observes the video clips/pictures of the impacts of climate change to point out the impacts of climate change prominent to other parts of

the country (Nigeria) and the world.

Activity V Students and teacher interacts among themselves to further explain the topic.

Evaluation The teacher asks the students some questions based on what was observed by them and what they learnt. For example:

- Mention the general impacts of climate change
- What are the impacts of climate change observed in your environment?
- What are the impacts of climate change prominent to southern part of the country and the polar regions?

Conclusion The teacher concludes the lesson by summarizing the lesson and emphasizing more on the difficult areas observed during evaluation. She then allows the students to form their note based on what was taught and observed by them.

Week	Six
Class	SS 2
Duration	80 minutes
Sex	Males and Females
Average age	16-17 years
Subject	Geography
Topic	Solutions/ Remedies in reducing climate change
Behavioural Objectives	By the end of the lesson, the students should be able to: 1. Mention the general ways by which climate change can be remediated. 2. State the ways climate change can be remediated at schools. 3. mention the ways climate change can be remediated at homes.
Previous Lesson.	The students were taught the impacts of climate change in their previous lesson.
Instructional Materials	The field, pictures/charts and video clips.
Introduction	The teacher introduces the lesson by asking the students some questions based on their previous knowledge, example: - What are the impacts of climate change? - Mention the impacts of climate change prominent to the northern and southern parts of Nigeria.
Presentation	The lesson is presented in sequence as follows:
Activity I	Teacher introduces the topic to the students
Activity II	The students observes from the chart the ways by which climate change can be reduced as follows: - Investing in clean energy such as solar and wind energy. - Good driving and good car maintainance - Switching to walking - Riding on bicycles - Using of energy-efficient products - Planting of trees to serve as carbon sinks - Introducing the Green School Design approach - Saving of energy - Recycling of rubbish/ using recyclable products.
Activity III	The students observe their school environment (field) and discusses among themselves in groups the solutions/remedies that will be appropriate to combat climate change in the school environment.
Activity IV	Students will also observe their homes and other residential buildings (field) around and also discusses among themselves the ways by which climate

change can be remediated at home.

Activity V Students and teacher interacts among themselves to further explain the topic.

Evaluation The teacher asks the students some questions based on what was observed by them, example:

- What are the general solutions/remedies to climate change?
- Mention the solutions/remedies of climate change that can be adopted in the school environment.
- How can climate change be remediated at home?

Conclusion The teacher concludes the lesson by summarizing the lesson and emphasizing more on the difficult areas observed during evaluation. She then allows the students to form their note based on what was taught and observed by them.

APPENDIX E

LESSON PLAN FOR CONTROL GROUP

Week	One
Class	SS 2
Duration	80 minutes
Sex	Males and Females
Average age	16-17 years
Subject	Geography
Topic	Defination of Climate Change concept.
Behavioural Objectives	By the end of the lesson, the students should be able to: 1. Define weather and climate 2. define Climate Change 3. differentiate between climate and climate change. 4. explain the phenomenon of climate change- what drives changes in Climate.
Previous Knowledge	The students have been taught the concept of weather and climate in their SS 1 class.
Instructional Materials	chalk, chalkboard and charts
Introduction	The teacher introduces the lesson by asking the students some questions based on their previous knowledge, example: What is weather? What is climate? Mention the elements of weather and climate.
Presentation	The teacher presents the lesson in sequence following these steps:
Step I	The teacher defines weather for the student as the atmospheric condition of a place at a particular time, example- a sunny day, a rainy day , cloudy day. students and explains the features observed as the weather. The teacher further defines climate as the average weather condition of a place over a long period of time like 35 years.
Step II	The teacher defines and explain climate change as variations in atmospheric process longer than 30 years . It can also be defined as climate fluctuations of a global nature, including effects from human activities and natural causes.

Step III — The teacher differentiates between climate and climate change. Climate is the average weather condition of an area over a period of a time while climate change is the fluctuations in the climate of an area as a result of natural and human causes. As such climate change produces some effects on the earth' surface especially on the existing climate.

Step IV — What drives changes in the climate: The teacher briefly explains the changes taking place within the atmosphere, starting from the solar radiation, the sun being the main source of energy to the earth. The teacher display a chart showing the redistribution of energy on the earth surface. The teacher also explains the greenhouse effect using a chart too. She defines the greenhouse effect as the rise in temperature on earth as certain gases in the atmosphere traps energy thereby keeping the earth warm. She compares the greenhouse effects to the greenhouse (made of glass) used to plant some crops.

Evaluation — The teacher asks the students some questions based on what was taught and what was observed by them, example:

- What is the difference between climate and climate change?
- What happens to temperature within the greenhouse?
- What happens to the earth if there is no greenhouse effect phenomenon?

Conclusion — The teacher concludes the lesson by summarizing the lesson and emphasizes more on the difficult areas observed during evaluation. She then allows the students to copy the chalkboard summary.

Week	Two
Class	SS 2
Duration	80 minutes
Sex	Males and Females
Average age	16-17 years
Subject	Geography
Topic	Factors of Climate Change concept- natural and human (anthropogenic) Factors, greenhouse gases and their sources
Behavioural Objectives	By the end of the lesson, the students should be able to: 1. Define natural and anthropogenic factors of climate change. 2. mention and explains natural factors.
Previous Knowledge	The students were taught the definition of climate change, weather and climate, and what drives changes in the atmosphere and greenhouse effects in their previous lesson.
Instructional Materials	Chalk and chalkboard
Introduction	The teacher introduces the lesson by asking the students some questions based on their previous knowledge, example: - Differentiate between climate and climate change. - What is the major source of energy on earth? - What is greenhouse effect?
Presentation	The teacher presents the lesson in sequence following these steps:
Step I	The teacher defines and explain what natural and anthropogenic factors of climate change means. Natural factors are those caused by nature while anthropogenic are those caused by man. She then gives examples of things that are natural.
Step II	The teacher highlights out the natural factors of climate change on the chalkboard: - volcanic eruption - Continental drift - Ocean currents - Earth's tilt
Step III	Teacher explains how each of the natural factors trigger off Climate Chang
Evaluation	The teacher asks the students some questions based on what was taught example: - What are natural factors of Climate Change? - Explain how the natural factors causes climate change.

Conclusion	The teacher concludes the lesson by summarizing the lesson and emphasizes more on the difficult areas observed during evaluation. She then allows the students to copy the chalkboard summary.

Week	Three
Class	SS 2
Duration	80 minutes
Sex	Males and Females
Average age	16-17 years
Subject	Geography
Topic	Human (Anthropogenic) factors of Climate Change
Behavioural Objectives	By the end of the lesson , the students should be able to: 1. Define anthropogenic factors. 2. mention the anthropogenic factors of Climate Change. 3. explain how the anthropogenic factors causes Climate Change.
Previous Knowledge	The students learnt the natural factors of Climate Change and how they trigger Climate Change in their previous lesson.
Instructional Material	Chalk and chalkboard
Introduction	Teacher introduces the lesson by asking the students some questions based on their previous lesson, examples: - Mention the natural factors of Climate Change. - Explain how the natural factors causes Climate Change.
Presentation	Teacher presents the lesson in sequence as follows:
Step I	Teacher defines anthropogenic factors as factors that are human-induced. Examples of human-induced things are also mentioned by the teacher.
Step II	Teacher highlights out anthropogenic factors of Climate Change on the chalkboard: - Deforestation - Using of electricity - Transportation - Agriculture - Mining - Manufacturing.
Step III	Teacher explains how each of the anthropogenic factors causes or trigger off Climate Change.
Evaluation	Teacher asks the students some questions based on what was taught, for example: - Mention the anthropogenic factors of climate change. - Explain how the anthropogenic factors causes Climate Change.

Conclusion	The teacher concludes the lesson by summarizing the lesson and emphasizes more on the difficult areas observed during evaluation. She then allows the students to copy the chalkboard summary.

Week	Four
Class	SS 2
Duration	80 minutes
Sex	Males and Females
Average age	16-17 years
Subject	Geography
Topic	Greenhouse gases and their sources.
Behavioural Objectives	By the end of the lesson, the students should be able to: 1. Define greenhouse gases. 2. mention the greenhouse gases in order of their abundance. 3. state the sources of greenhouse gases.
Previous Knowledge	The students learnt the anthropogenic factors of Climate Change and how they trigger Climate Change in their previous lesson.
Instructional Material	Chalk and chalkboard
Introduction	Teacher introduces the lesson by asking the students some questions based on their previous lesson, examples: - Mention the anthropogenic factors of Climate Change. - Explain how the anthropogenic factors causes Climate Change.
Presentation	Teacher presents the lesson in sequence as follows:
Step I	Teacher defines greenhouse gases as gases that exist in the atmosphere which helps to trap heat and re-radiates it back to the earth surface. They are also called heat-trapping gases.
Step II	Teacher highlights out the greenhouse gases on the chalkboard and their sources in order of their abundance as follows: - Water vapour - evaporation from water bodies as a result of high temperature - Carbon dioxide -through burning of fossil fuels from activities like manufacturing, transportation, generation of electricity, deforestation, burning of trees and vegetation. - Methane - raising of livestock, mining of petroleum and coal, farming practices such as application of fertilizer, burning fossil fuels from manufacturing processes - Nitrous oxide – through soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, and nitric acid production. - Chloroflourocarbons (CFCs) - leaking coolants from leaky refrigerators, freezers and air conditioners in cars and homes, some industrial and manufacturing processes like producing computer chips.

Step III	Teacher further explains what was highlighted on the chalkboard for better understanding.
Evaluation	Teacher asks the students some questions based on what was taught. For example: - What are greenhouse gases? - Mention the greenhouse gases in their order of abundance. - Mention the various sources of the greenhouse gases.
Conclusion	The teacher concludes the lesson by summarizing the lesson and emphasizes more on the difficult areas observed during evaluation. She then allows the students to copy the chalkboard summary.

Week	Five
Class	SS 2
Duration	80 minutes
Sex	Males and Females
Average age	16-17 years
Subject	Geography
Topic	Impacts of climate change
Behavioural Objectives	By the end of the lesson, the students should be able to: 1. Mention the general impacts of climate change on a world scale. 2. State and explains the impacts of climate change observed in their area. 3. mention other impacts of climate change prominent in other parts of the Country.
Previous knowledge	The students were taught the factors of climate change (natural and human) and sources of greenhouse gases in their previous lesson.
Instructional Materials	Chalk and chalkboard
Introduction	The teacher introduces the lesson by asking the students some questions based on their previous knowledge, example: - Differentiate between natural factors and anthropogenic factors of climate change with examples. - What are the greenhouse gases and their sources?
Presentation	The teacher presents the lesson in sequence following these steps:
Step I	The teacher highlights out and explain the impacts of climate change on the chalkboard as follows: - Increase in average temperatures - Extreme weather events such as heat waves, rainstorms, hurricanes, wildfires, flooding, droughts. - Rising sea level - Spread of diseases - Bad air, allergy and asthma - Ecosystem shifts and species die-off - Ocean acidification - Diminished food and water supplies
Step II	The teacher further states and explain the impacts of climate change prominent to the study region (northern part of Nigeria) such as increase in average temperatures, droughts, spread of diseases, bad air, allergy and asthma diminished food and water supplies.

Step III The teacher will also states and explains the impacts of climate change that are prominent to other parts of Nigeria and the world such as increase in average temperatures, rising sea level, flooding, wildfires, ocean acidification, ecosystem shifts and species die-off.

Evaluation The teacher asks the students some questions based on what was taught example:

- Mention the general impacts of climate change
- What are the impacts of climate change prominent to northern and southern Nigeria?

Conclusion The teacher concludes the lesson by summarizing the lesson and emphasizing more on the difficult areas observed during evaluation. She then allows the students to copy the chalkboard summary.

Week	Six
Class	SS 2
Duration	80 minutes
Sex	Males and Females
Average age	16-17 years
Subject	Geography
Topic	Solutions/ Remedies in reducing climate change
Behavioural Objectives	By the end of the lesson, the students should be able to: 1. Mention the general ways by which climate change can be remediated. 2. State the ways climate change can be remediated at schools. 3. mention the ways climate change can be remediated in homes.

Previous Lesson. The students were taught the impacts of climate change in their previous lesson.

Instructional Materials: Chalk and chalkboard

Introduction: The teacher introduces the lesson by asking the students some questions based on their previous knowledge, example:

- What are the impacts of climate change?
- Mention the impacts of climate change prominent to the northern and southern parts of Nigeria.

Presentation: The teacher presents the lesson in sequence following these steps:

Step 1: The teacher highlights out the ways by which climate change can be reduced on the chalkboard as follows:

- Investing in clean energy such as solar and wind energy.
- Good driving and good car maintainance
- Switching to walking
- Riding on bicycles
- Using of energy-efficient products
- Planting of trees to serve as carbon sinks
- Introducing the Green School Design approach
- Saving of energy
- Recycling of rubbish/ using recyclable products.

Step 2: The teacher mentions and explain the remedies that will be appropriate to combat climate change in the school environment such as using of solar/wind energy, planting of trees, recycling of rubbish, green school approach, riding of bicycles to schools.

Step 3: The teacher will also states and explains the way climate change can be reduced at homes such as using of solar/wind energy, using of energy

-efficient products, saving of energy by switching off appliances when not in use, recycling of rubbish.

Evaluation The teacher asks the students some questions based on what was taught example:

- Mention the solutions/remedies of climate change that can be adopted in the school environment.
- How can climate change be remediated at home?

Conclusion The teacher concludes the lesson by summarizing the lesson and emphasizing more on the difficult areas observed during evaluation. She then allows the students to copy the chalkboard summary.