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Effects of Field Trip and Inquiry Methods on the Teaching and Learning of Global Warming in Chemistry

[1]Beatrice Arisa Bayim, [2]Hope Amba Neji

[1]Academic Doctor, Department of Integrated Science, School of Secondary Education Science Programmes, Cross River State College of Education, Akamkpa-Nigeria

[2]Academic Doctor, Department of Physical Science Education, University of Calabar, Calabar, Nigeria

Corresponding Author's E-mail: beatybayim@gmail.com

***Abstract* - Global warming is the long term heating of Earth's surface caused as a result of natural or human activities primarily burning of fossil fuel, bush burning, logging, and other anthropogenic processes as a result of population increase, which result in increased emission of greenhouse gases such as, Carbon (iv) Oxide, Nitrous oxide, Chlorofluorocarbons, Ozone, Methane, Sulphur oxide and so on. Teaching and learning of global warming in secondary school is still very unpopular. This study adopted a quasi-experimental design. This study explore field trip and inquiry methods to teach global warming to 300 Chemistry students drawn from 10 schools in Boki and Etung Local Government Areas in Central Educational zone of Cross River State (150 students from each area of study) by criterion reference sampling technique. The choice of these Local Government Areas is based on the fact that activities that can result in global warming are high in these areas. The students were selected by simple balloting with replacement from a population of 3000 senior secondary (SSII) Chemistry students in the area of study. The instrument used was a 20 item achievement test tagged Global Warming Achievement Test (GWAT).The reliability of the instrument which was tested with Cronbach Alpha gave a reliability of 0.68 which indicates that the test was reliable. Students from Boki L.G.A were taught using the field trip method, while those from Etung L.G.A were tutored using Inquiry method. The methods of instruction were carried mainly in the forest where activities of logging were prevalent for two weeks for each group simultaneously with the help of Research Assistants. At the end of the teaching session, a twenty (20) item achievement test, Global Warming Achievement Test (GWAT) was given as post-test for one hour. The scripts were collected and marked over 100%. The results were analysed using Analysis of covariance (ANCOVA). The findings indicated no significant relationship between the achievement scores of students taught with field trip and those taught without field trip. The findings also showed no significant relationship between achievement scores of students taught with inquiry method and those taught without inquiry method. The findings however indicated no significant interaction effects between male and female students when taught using the teaching approaches. The study recommended among others, that hands-on and practical teaching strategies to be introduced in the curriculum for effective teaching and learning of global warming.**

Keywords: Global warming, Climate change, Greenhouse gases, Field Trip method, Inquiry method.

I. Introduction

Global warming is the long term heating of Earth's surface observed since the pre-industrial period (that is between 1850 and 1900). This heating is due to human activities, primarily fossil fuel burning which increases heat-trapping greenhouse gases levels in Earth's atmosphere (Botkin and Keller, 2000). Global warming is a natural or human induced increase in the average global temperature of the Earth's surface. It is determined by four main factors: the amount of sunlight Earth's receives, the amount of sunlight Earth's reflects retention of heat by the atmosphere and evaporation and condensation of water vapour (Broecker, 1997). Sunlight that reaches the earths warms both the atmosphere and the surface. Earth's atmospheric systems then reradiate heat as infrared radiation which warms the surface of the Earth. There are gases that are emitted as a result of anthropogenic processes. These are greenhouse gases. There are: Carbon (vi) Oxide, Nitrous oxide, Chlorofluorocarbons, Ozone, Methane, Sulphur oxide and so on. These gases re-emit radiation and thus cause heat in the atmosphere. The Earth absorbed some of this heat and some are reflected back from the Earth's surface which is absorbed by the atmosphere. As a result of this absorption and reflection, the average temperature above the Earth's surface is higher than it would be if there was no atmosphere. This results in what is called greenhouse effects. This effect has increased in recent times due to population increase and increase in activities of man, thus the resultant effect is caused by emission of gases mostly Carbon (iv) Oxide which causes global warming.

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With Nigerian increase population, the country is most vulnerable to experience severe heat, drought, flood and other harsh temperature conditions caused by emission of these gases which result in global warming. To address this extremity, there is an urgent need for the adaptive capacity of communities through adequate science education on the concept in order to enable citizens to make informed decisions in the context of the science education in general and chemistry in particular. Global warming education can be one of the essential components that can help reduce the rate of heat that brings about global warming and problem associated with it. If students learn about climate change and global warming, they can transfer knowledge into homes, communities, professional spheres as they enter the work force.

Global warming and climate change are often used interchangeably. However, they are not the same. Global warming is a long-term change in the average temperature of the earth. While climate change is the average weather of a particular locality.

Global warming is caused by the accumulation of gases in the atmosphere. The gases are carbon (iv) oxide, methane nitrous oxide, chlorofluorocarbon (CFCS), when the earth's atmosphere is heating up due to increasing amounts of carbon (iv) oxide and other gases resulting from human activities.

This heating of the earth's atmosphere is commonly referred to as the greenhouse effect. This means that the earth's atmosphere is likened to a glass sides and roof which is often used by agriculturists to trap the sun's warmth for the rearing of plants. The green-house trap some of the heat which is being radiated back from the earth into space to create greenhouse effect. The heat trapping is predicted to increase global temperature and would have considerable impact on the environment and society. The atmosphere acts as a greenhouse for the earth, letting through incoming the light but shutting in heat. An increased amount of certain gases like carbon (iv) oxide, cfcs, water vapour methane, nitrous oxide, increases the atmospheric ability to block heat which leads to warmer temperatures and climate changes.

Gases which cause global warming emanate by the action of man and animals. Activities of animals include; actions of micro- organisms on death of plants and animals. The physical activities of humans include; burning of fossil fuel and farming, burning of fuel to create electricity or power our cars causes the release of carbon (iv) oxide into the atmosphere. Other activities of man that bring about release of CO_2 into the atmosphere are; deforestation and tree-clearing, urban and infrastructural development and so on. Plants and trees play important roles in regulating the climate because they absorbed CO_2 from the air and release oxygen back into it. When vegetation is removed or burnt, the stored Carbon is released back to the atmosphere as CO_2 thus contributing to global warming. Observations regarding global warming have substantiated the theory that it is indeed a human enhanced greenhouse effect that is causing the planet to heat up and this is very worrisome. Houghton et al (1996) stated that global warming is caused by emission of greenhouse gases which raise the temperature to over 1.0-3.5^{o}C.

(Brears, 2024) noted that despite the urgent need for climate change and global warming education only about 47% of 100 natural curriculum frameworks reviewed made referenced to climate change and global warming in the curriculum. There were indications that only few countries that were vulnerable to climate change and global warming consider the concept as important to teach. Teaching global warming in school has been very difficult as there had not been any specific methods of teaching that would reduce the consequences of global warming, since activities that bring about global warming pandemic are still ongoing. Effective teaching strategies as suggested by Brears (2024) are hands-on activities, were students are allowed to employ and understand the concept as they interact with the environment. This study seeks to employ methods that could be used to teach the concept so that students would understand the consequences, causes, and effects of global warming in order to be able to check what happens in the larger Community.

II. Literature Review

Climate change and global warming are components of National Research Council (NRC, 1996 in Shepardson *et al*, 2009). Most science textbook talked about climate change and global warming. This however, may have little to do with students understanding of the concepts (Shepherdson, Nuogi, Choi, and Charuombat, 2009).

In a study by (Sherpardson *et al*, 2009) students believed that air pollution causes global warming and climate change. Forms of air pollution were identified and acid rain and dust (Pruneau *et al*, 2001), harmful and unnatural gas (Gowda *et al*, 1997) and their air pollution (Anderson and Wallin, 2000). Some considered Ozone depletion as a cause of global warming and climate change. The common idea is that Ozone holes allow solar energy or ultraviolet radiation to reach the earth causing global warming and climate change (Osterlind, 2005). Still some students believed that climate change and global warming are changed by increase in solar radiation or because the earth gets close to the sun (Prunear, *et al*, 2003).Global warming occurs when Carbon (iv) Oxide and other air pollutants collect in the atmosphere and absorb sunlight and solar radiation that have bounced off the earth's

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surface. This radiation normally escape this space, but the pollutants can last for years to centuries in the atmosphere, trap the heat and cause the planet to get hotter. These heat trapping gases especially Carbon (iv) Oxide, Methane, Nitrous Oxide, Water vapour, and Fluorinated gases are known as greenhouse gases.

A lot of occurrences have taken place naturally that result in global warming; such as burning of fossil fuels like coal, oil, gasoline, natural gas and deforestation. In the United States, the largest source of greenhouse gases is transportation 29%, followed by electricity production, 28%, and industrial activities, 22% (www.nrdc.org). Climate change keeps rising. Scientists tell us that we need to reduce global carbon emission by as much as 40% by 2030. For this to happen, the global community must take immediate concrete steps to decarbonize electricity generation by equitably transitioning from fossil fuel based production to renewable energy sources like wind and solar to electrify our cars and trucks and to maximize energy efficiency in our buildings, appliances and industries.

Global warming has a lot of consequences ranging from; earth's rising temperature is fuelling longer and hotter waves, more frequent droughts, heavier rainfall and more powerful hurricanes. Global warming has ability to turn a category 3 storm into a more dangerous 4 storms. The impact of global warming are felt by extreme heat waves which have caused so much deaths all around the world. Other effects of global warming can be felt in the following ways: The effects of global warming are the environmental social changes caused by human emissions of greenhouse gases. There is a scientific consensus that human activities are the primary drivers. Many impacts of climate change have already been observed including glacial retreat in the timing of seasonal events and changes in agriculture productivity.

- Glacier retract, melting glaciers, early snow melt, and several droughts will cause more dramatic water shortage and increase the risk of wildlife in most continents.
- Rising sea levels will lead to coastal flooding on the eastern seaboard especially.
- Forest, farms and cities will face trouble with some new pests, heat waves, heavy down pours and increase flooding. All these factors will damage agriculture and fishes.
- Disruption of habitats such as coral reefs and alpine meadows would drive many plant and climate species to extinction.
- Health and welfare diseases global warming causes adverse health effect from warmer temperature diseases to hottest desert areas or flood prove areas. Example, aerosolized dust or soil contact disease (Lassa fever) food or water borne diseases, bacterial and protozoa diarrhoea, hepatitis A and E and typhoid fever, respiratory diseases, massive increase in migration in diseases vectors such as mosquitoes, rats, mice, cockroaches etc. allergies asthma and infectious diseases out breaks will become more common due to increased growth of pollen producing rag wood.

Transportation problems; Transportation Networks are vital to any nation's economy safety, communication, and quality of life. In Nigeria for instance, climate change impacts pose significant challenges to her existing and proposed transportation systems. Our existing sea ports and airports at Lagos, Warri, Port Harcourt, Kano and Calabar as well as the proposed rail system in the country, the road network linking all the states in the federation would all be threated if adequate planning is not put in place. Examples exist worldwide where flooding sand storms and other natural disasters have disrupted travel of all types including air, water, rail and freight shipments.

- Political: In a climate where the health and welfare of the general population is at stake, political unrest becomes common.
- Lack of food, drinking and irrigation water availability.

These have caused serious challenges that need to be addressed both in the classroom and in the larger environment.

III. Empirical Review

Scientists agreed that the earth's rising temperatures are fuelling longer and hotter heat waves, more frequent droughts, heavier rainfall and powerful hurricanes (https://doi/.org). Global warming had affected most country of the world. For instance in 2015, scientists concluded that there was lengthy drought in California which intensify the worst shortage of water in the city, while in 2016, National Academies of Science, Engineering and Medicine announced that some extreme weather conditions like heat waves, drought and heavy participation can be comfortably be attributed to climate change and global warming.

Records from (www.inucn.org) show in 2020, there was Atlantic hurricane season including a record breaking 30 tropical storms, 6 major hurricane and 13 hurricanes in all. Only in United State, there was 22 weather and climate disasters that caused at least a billion dollars' worth of damage. While in 2017 was worst heat with tropical storms including Hurricanes in their numbers (Irma, Maria, Catherine) and so on. These led to about $300 billion cost and 3,300 fatality. In recent years, China has taken lead in global warming pollution being about 26% of all CO_2 emission. European Union and Indians comes third and fourth

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respectively. In 2017, Nigeria Green House gas emission per Capita (including land use) was 2.37 tonnes of CO_2 equivalent, far below the global average of 7 tonnes. GHG emissions for Nigeria in 2030 are estimated to be 435 million tonnes representing a 31% increase in total emission between 2018 and 2030 (en.m.wikipedia.org). In 2020, Green House Gases (GHG) emission in Nigeria totalled 126.9 million tonnes with the energy sector accounting for the largest source of GHG emissions (www.iucn.org).

Nigeria according to the United Nations has the highest rate of deforestation in the world, losing 3.7 percent of its forest every year including mangroves forest and other arable lands (www.Usaid.gov). Large and multiple ecological zones have given rise to a wide range of livelihoods, agricultural practices, and commodities, all of which are affected by climate change and shocks. Climatic conditions like rising sea levels have threatened Southern cities such as Lagos and coastal areas, thus increasing vulnerability to flooding and waterborne disease. Drought and reduced rainfall combined with rising air temperatures inhibit the country's hydropower systems, minder, agriculture education of food security, reduction in the production of fish and impacting negatively on health and nutrition. Thus deforestation, energy sector and use change have been seen as the greatest contributors to Nigeria's greenhouse gas emission and global warming (www.Usaid.gov). Nevertheless, teaching and learning this concept in school is still having challenges. (Brears, 2024) suggested eight strategies of teaching climate change and global warming: Lab activities, Movies, Novels, Citizen Science, Research project, Personal experiences, Service projects and School garden. The present study however wants to look at field trip and inquiry methods of teaching global warming.

IV. Teaching and learning global warming

Two methods have been suggested by this study to teach and learn this concept: Inquiry method and Field trip method. Inquiry method signifies the process of acquiring and obtaining information by investigating, often personally and voluntarily by a person that is, eager to know the phenomenon in question. According to (Hiangs, 2005) inquiry includes investigation of a problem, sourcing for knowledge that requires solving of the problem, carrying out critical thinking, making observation and drawing conclusions.

(Shamsudin, Abdullah and Yaamat, 2012) in a study on the strategies of teaching science using an Inquiry- Based Science Education (IBSE) by Novice Chemistry Teachers found that Inquiry-Based teaching strategies employed were able to stimulate excitement among students recommended when learning science. The study however, recommended inquiry based method of teaching.

(Hohloch, Grove and Bretz, 2007) stated that inquiry based method promotes and develops hands-on activities for their science classroom.(Alarcon et al, 2023) in a study on science and Inquiry-Based teaching and learning: a systematic review stated that the use of the inquiry-based instructional approach allows the development of research skills and construction of scientific knowledge. Inquiry based science Education (IBSE) is a form of science education that unlike the traditional model where the teacher provides factors and the students learn them, inquiry science education gives learners the opportunity to explore hands-on to experiment, to ask questions and to develop responses based on reasoning (Chachar, Raza and Mehmood, 2022). IBSE is more of student-centred approach to teaching and also focused on problem solving and asking questions. This study was carried out in Pakistan. They further outlined the benefits of inquiry-based method to include: paving ways for effective learning of science and development of critical thinking.

In an inquiry-based method, the learners

i) Develops their own questions
ii) Collect evidence
iii) Form opinions
iv) Construct explanation
v) Communication logically
vi) Make conclusions

In a study on teaching greenhouse effect with inquiry –based computer simulation: A wise case study by (Cohen and Zimmerman, 2012). The researchers used an inquiry-based technology mediated science curriculum known as the Web-based Inquiry Science Environment (WISE). Students from a suburban, diverse, middle school setting used computer simulation as part of a week-long class lesson on global warming and climate change. From the study, the researchers derived ways that teachers can help students develop deeper understanding of climate science topics. The researchers concluded that pedagogical approaches that allow students to conduct 'extreme testing' and increasing the time for free explorations of the computer simulation should be imbibed. This study was carried out in United State of America. However, little study had been done on inquiry based method of teaching global warming in Nigeria as a whole and Cross River State in particular.

V. Field Trip Method of Teaching

Field trip is a method of instruction that is carried outside the classroom. It is also termed an instructional trip, school excursion, or school journey. Field trip is carried out with an

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intent, in which students interact with the setting, displays and the exhibits to gain an experiential connection with the idea, concept, environment and the subject matter. (Tal and Moral, 2009) described field trip as students experiences outside of the classroom at interactive locations designed for educational purposes. When field trips are well planned they result in positive education outcomes and achievement. Field trip also provides first-hand information and enables students to see things by themselves as the really are.

In a study by (Ehirim *et al*, 2021) on the effectiveness and utilization of field trip as a method of teaching and learning chemistry in senior school students in a council area of Imo state, Nigeria. The findings revealed that field trip is interactive, motivating and provides opportunities for chemistry students to widen their practical knowledge of industrial application of chemistry. Studies by (Egwu and Okigbo, 2001) on the effect of field trip on secondary school students' academic achievement in ecology in Anambra State showed that the use of field trip is more effective in enhancing students' achievement in ecology than conventional lecture method. Another study by (Adejoh *et al*, 2021) on the effect of field trip and discovery methods on secondary school students' achievement in biology in Benue State, Nigeria, the researchers found that field trip and discovery methods enhanced students' achievement in biology. There was no significant difference between male and female students' achievement and retention in biology. The study recommences that these two methods should be adopted in the teaching of biology due to its students' involvement approach. Also study by Njoku and Mgbomo (2021) on Effect of field trip and demonstration methods on the achievement of secondary school students in Biology found that field trip teaching method better enhanced students' achievement in biology than demonstration method. The study also revealed that there is no significant difference in the achievement of male and female students who were taught biology using field trip.

The study recommended field trip as the best method of teaching biology. An earlier study by (Ukor and Abdubajar, 2019) on the effects of Field trip Instructional Strategies (FIS) on students' interest and achievement in ecological concepts found that there was no significant influence of gender on student achievement in ecology. This present research wants to examine the effect of field trip and inquiry methods on the teaching and learning global warming in chemistry in schools in Cross River State, Nigeria.

VI. Theoretical Review

Constructivism is a theory in education which says that learners do not acquire knowledge and understand concepts by positively perceiving it but knowledge is acquired by experience and social standards, linking new knowledge with already existing knowledge in that learners construct knowledge rather than just positively taking in information (Nola, Robert and Irzik, 2006). This theory among others has it that learners learn best when they engage in learning experiences themselves rather than being passive and receiving information.

The Psychologists/Educationists behind this theory are Jean Piaget and Lev Vygotsky. The theory models of learning are focused on how learners are creators/constructors of knowledge based on their past experiences. Constructivist believed that in order for learning to occur successfully and meaningfully and lasting, learning must include activities (practice), concept (knowledge) and culture (context). The position of the constructivist is that the transfer of learning occurs through involvement in authentic tasks that are anchored or hinged on meaningful contexts. If learning therefore does not have a real life tight to it, there is little hope for transfer of knowledge to take place.

VII. Cognitive Constructivist

Jean Piaget is a cognitive constructivist. He believes that, learners create their own learning by using their prior knowledge and by using discovery method or other activity based methods. Piaget suggested that learners' cognitive development is not just about acquiring knowledge but rather as the learner learns new information, he needs to construct his own mental models of the world. This present study focuses on this premise. Piaget suggest that problem solving cannot be directly taught. Learners learn problem solving through active participation on their own discoveries. Piaget suggests that teachers should provide challenges to the learner that they would discover on their own. In a constructivist classroom, learners are presented with a problem and are involved in group discussions, partake in collaboration with peers or classmates, activate prior knowledge and construct an inquiry-based essential question based on the problem they will investigate.

Piaget outlined the roles of the teacher in the constructivist classroom to include:

- Effectively monitoring learning
- Show students how to construct knowledge
- Promote collaboration to share multiple perspectives
- Promote self-exploration and inquiry
- Design authentic experiences

Piaget is of the opinion that learning in a constructivist classroom involves:

- Learning should be tied to the real-world

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- Active engagement should be through inquiry
- Support should be through the problem-solving process
- Assessment should be focused on the transfer of knowledge and skills.

Examples of learning in a constructivist classroom. Project-based Learning (PBL) and Work-based learning (WBL) which are based on inquiry learning where the students construct their own essential question to investigate. Learners are presented with a problem, are involved in group discussions, partake in collaboration with peers, activate prior knowledge and construct an inquiry-based essential question based on the problem they will investigate. Facilitators or teachers provide scaffolding, which is a frame work on which students construct knowledge relating to the problem presented. This is the core on which this study wishes to emphasize in order to make the teaching of global warming understandable and appreciated by learners.

Constructivist classroom has the following features; it focus on students questions and interest, it build on what students already know, it focus on what students already know, it focus on interactive learning and it is student-centred, it deals with teachers having dialogue with students to help them construct their own knowledge, it is rooted in negotiation, and students work primarily in groups. Constructivist classroom often has teachers who do small group work, collaborate and interact with activities that are motivating to the teacher and the learners. Teachers should initiate open dialogues about what students need in order to find success (www.wgu.edu).

VIII. Greenhouse Theory

According to the greenhouse theory of climate change, the climate system will be restored to equilibrium by a warming of the surface troposphere system and a cooling of the stratosphere (www.science.org). Although humans and other living beings experience climate locally, we need to look at the global Earth system to gain an understanding of what constitutes climate. This involves understanding how air, land, oceans, snow and ice and all living things contributes to and interact with the global climate (IPCC, 2007). All the parameters of the Earth's climate (wind, rain, cloud, sun, temperature) are the result of energy transfer and transformation within the atmosphere at the earth's surface and in the ocean over time, the earth climate remains largely stable because the energy received is equal to that lost (the energy budget is balanced). Thus the sunlight heating earth (Solar radiance) is on average, 1370 watts per square meter (W/m^2) (World meteorological Organization, 2012).

To confirm global warming, warming comes from warming of the oceans, rising sea levels, glaciers melting, see ice retreating in the Arctic and diminished snow cover in the Northern Hemisphere. This heat occurs mainly in the absence of trees and constant burning of fossil fuels that bring about increase Carbon (iv) Oxide. In Cross River State, constant logging occurs; this study seeks to find out if field trip and inquiry method of teaching can be used to improve the performance of students when taught global warming and how these methods can be used to teach the concept creatively.

IX. Statement of Problem

Global warming has devastating effects and increase in heat. This does not affect only humans but all aspects of life. It can distort the ecological processes negatively and bring about a total shut down in all affairs of the system. Most students have misunderstanding about greenhouse effects and global warming, while some do not know about it (Anderson and Wallin, 2000, Pruneau *et al*, 2001). Teachers as well as students have misunderstanding between global warming and climate change. According to (Pruneau *et al*, 2001, 2003), students see the consequences of global warming as causing skin cancers, higher temperatures and other attending problems. Others do not see any immediate or future impact on society or humans (Prunear *et al*, 2001). Some students also believed that global warming and climate change cannot be stopped or that the resolution to the problem is limiting Carbon (iv) Oxide emissions, without considering the societal consequences of fossil fuel use (Anderson and Wallin, 2000).

Students in the first world countries believed that planting of trees and using renewable energy would prevent or resolve global warming and climate change (Kilnic *et al*, 2008). In Nigeria the story is different, where students, mainly youths and the general public participate in engaging in activities that will bring about global warming like falling down of trees, burning of fossil fuel, and general logging for economy, personal and financial gains. In the same vain, most students do not consider Carbon (iv) Oxide, methane, water vapour and nitrous oxides as greenhouse gases and gases that can bring about global warming. Activities that emit these gases are in the increase in our immediate and wider environment. This study is aimed at devising strategies to teaching global warming so that students would understand the effects, causes and consequences of this pandemic in the environment.

X. Purpose of the Study

This study is geared towards looking at how global warming can be taught in chemistry classroom creatively. The study will also investigate:

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1. The performance of students in chemistry classroom when taught global warming using Field trip and Inquiry methods.
2. The performance of male and female students when taught global warming.
3. How school location influences the performance of students when taught global warming.

Significance of the study

- The study is aimed at helping teachers and students teach and learn the concept of global warming creatively. Thus assisting teachers and students understand the concept as concrete and not abstract.
- The study would help students develop constructivist spirit of learning.
- The study would add knowledge to the existing knowledge on the concept.
- The study would educate the general public on causes, effects and consequences of global warming.

Research question

1. What are the mean achievement scores of chemistry students taught field trip and those taught without field trip?
2. What is the mean achievement scores of chemistry students taught with inquiry method and those taught without inquiry method?
3. What is the interaction effect of gender and the instructional approach?

Hypotheses

1. There is no significant relationship between the mean achievement scores of chemistry students taught using field trip and those taught without field method.
2. There is no significant relationship between the mean achievements scores of chemistry taught using inquiry and those taught without inquiry method.
3. There is no significant relationship between the interaction effect of gender and the instructional approach.

XI. Method

The method used to collect data was field trip and inquiry method. The design for this study was quasi-experimental design. The design is chosen for this study as data was obtained from the scores students got from the test written and the knowledge obtained during the teaching session. This design is appropriate for this study as it sought to gather data from students of what they know about global warming and how they have been taught global warming. The data gathering took two (2) months. The population of the study was made up of all senior secondary school (2) Chemistry students from schools in Boki and Etung L.G. Areas of Cross River State. The population is about Three Thousand (3000) senior secondary two Chemistry students out of which 300 students were selected by simple balloting with replacement. Purposive random sampling was used to select schools that were used for the study. The criteria used were; schools with at least 30 SS 11 chemistry students, schools whose Chemistry teachers holds at least B.Sc (Ed) Chemistry or its equivalent, schools located in Boki and Etung Local Government Areas. Five (5) schools were selected from Boki L.G.A and five (5) schools were selected from Etung L.G.A. Thirty (30) students were selected from each school by simple random sampling with replacement. Thirty (30) questions were given to Lecturers in the department of Chemistry, geography and Test and Management to ascertain their validity. Questions that were too difficult or outside the scope were dropped, reducing the questions to Twenty (20). The twenty questions were first given to 20 students from school in Ogoja L.G.A to ascertain the reliability of the instrument.

The reliability was measure using Cronbach Alpha reliability which gave a reliability of 0.68 showing that the test is reliable. The students were given the Twenty (20) item questions on global warming (pre-test). Five (5) Research Assistants were trained to monitor each group. The students selected were distributed into two groups; A and B based on the school location. Five (5) Schools from Boki L.G.A were taught using field trip method, while 5 schools in Etung L.G.A were taught using inquiry method. The teaching and field trip went on for four weeks. The field trip was carried out by students visiting different sites where logging is prevalence and occurs continuously. The students used different Thermometers at different sites to determine the amount of heat and temperature rise from each site (see fig 1). Students also carry out inquiry by visiting different sites where logging is prevalent and measuring the temperatures at different sites. The exercise was carried out in four weeks. The results were plotted temperature against number of weeks (see fig 2).

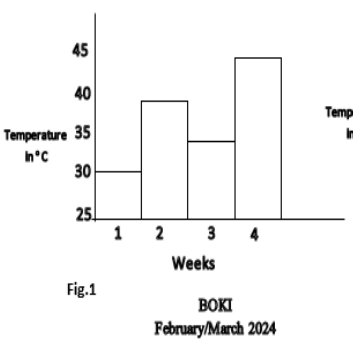

Fig.1

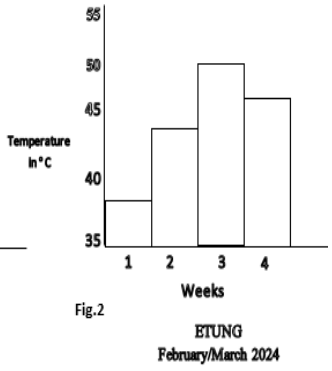

Fig.2

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The concept of global warming was taught to the students in the two groups both in the forest and the classroom for four weeks (twice a week). At the end of the teaching session the Twenty (20) achievement test Tagged, Global Warming Achievement Test (GWAT), post-test, was given to all the 300 students. The test lasted for one (1) hour. The scripts were collected and marked over 100%. The results were analysed using Analysis of Covariance (ANCOVA). The results were presented in Tables based on the hypotheses.

XII. Results and Discussion

Data analysis/ findings:

Null hypothesis one (H_0: 1)

There is no significant relationship between the mean achievement scores of chemistry students taught global warming using field trip method and those taught without field trip method.

Field trip is the independent variable while mean achievement scores of students is the dependent variables, both are continues variables.

Analysis of covariate (ANCOVA) was used to test the null hypothesis as shown in table.

Table I: Summary data of ANCOVA of students taught with trip methods and those taught without field trip methods

Source	Type III sum of square	D.F	Mean square	F	Sig
Correlated model	185.766	2	92.883	.615	.541
Intercept	45800.002	1	45800.002	303.331	.000
Pretest	2.353	1	2.353	.016	.901
Method	161.782	1	181.782	1.204	.273
Error	44844.077	297	150.990		
Total	808439.250	300			
Corrected total	45029.543	299			

R -square=.004(adjusted) R square = .003)

Table 1 showed the computed F- value (1.204) is less than the critical F- value of (3.63) at .05 level of significant for 2 and 297 degree of freedom for a two tailed test. This implies that the null hypothesis of no significance relationship between the mean achievement scores of chemistry students taught using field trip and those taught without field trip is upheld. Thus there is significant relationship between the mean achievement scores of students taught with field trip method and those taught without field trip method. Therefore the F- value calculated is not statistically significant. This study is in contrast with findings of studies by (Ehirim *et al*, 2021), (Ewer and Okigbo, 2001) and (Adejoh *et al*, 2021) who on their different studies on the effect of field trip method in different science subjects discovered a positive relationship between this method and achievement of students.

Hypothesis two (H_0: 2)

There is no significant relationship between the mean achievement scores of chemistry students taught using inquiry method and those taught without inquiry method Analysis of covariance (ANCOVA) was used to test the null hypothesis as shown in table II.

Table II: Summary data of ANCOVA of students taught with inquiry method and those taught without Inquiry method

Source	Type III sum of square	D.F	Mean square	F	Sig
PRETEST	.648	1	.648	.004	.947
METHOD	122.643	1	132.643	.893	.345
Error	44102.063	297	148.494		
Total	809918.000	300			
Corrected total	44236.880	299			

R square=.003(adjusted) R square= .004)

Table 2: Showed the computed F- value (.893) is less than the critical F- value of (3.63) at .05 level of significant for 2 and 297 degree of freedom for a two tailed test. This implies that the null hypothesis of no significant relationship between the mean achievement scores of chemistry students taught using inquiry method and those taught without inquiry method is not rejected but retained. Therefore the F- value calculated is not statistically significant. The findings of this study is not in line with the findings of (Shamsudin, Abdullah and Yaamat, 2012) in a study on the strategies of Teaching Science using and Inquiry- Based Science Education (IBSE) by Novice Chemistry Teachers where they found that inquiry-Based teaching strategies employed were able to stimulate excitement among students and thus recommended inquiry based method of teaching.

Again this study is in contrast with the study of (Hohloch, Grove and Bretz, 2007) who stated that inquiry based method promotes and develops hands-on activities for their science classroom, while also (Alarcon et al, 2023) supported that the use of the inquiry-based instructional approach allows the development of research skills and construction of scientific knowledge. However, this study support the findings of (Chachar, Raza and Mehmood, 2022) who emphasized that inquiry based science education (IBSE) is more of student-centred approach to teaching and also focused on problem solving and asking questions as students carried out experiment on their own taking measurement of different temperatures in the forest and obtaining knowledge as this is done, thus paving ways for effective learning of science and development of critical thinking.

In an inquiry-based method, the learners not only score higher in test but also,

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i) Develops their own questions
ii) Collect evidence
iii) Form opinions
iv) Construct explanation
v) Communication logically
vi) Make conclusions

These are found in the experimental sets up in fig 1 and 2.

Hypothesis three (H_0: 3)

There is no significant relationship between the interaction effect of gender and the instructional approach.

Table III: Summary data of ANCOVA of interaction effect of gender and the instructional approach

Source	Type III sum of square	D.F	Mean square	F	Sig
Correlated model	253.865	4	63.466	.426	.790
Intercept	45008.448	1	46008.448	301.878	.000
PRETEST	2.100	1	2.100	.014	.905
GENDER	9.993	1	9.993	.067	.796
METHOD	174.681	1	.280	1.172	.280
Method* Gender	116.096	1	116.096	.778	.378
Error	43983.015	295	149.095		
Total	809918.00	300			
Corrected total	44236.880	299			

R -square=.039 (adjusted) R square= .026)

From the table 3 above the calculated F-value of .778 is less than the critical F-value of 3.86 at 0.05 level of significant for 4 and 295 degree of freedom for a two - tailed achievement test. It implies that the null hypothesis of no significant interaction effect between gender and instruction approach on chemistry students' achievement scores was not significant. Thus the null hypothesis is retained. This is in line with the study of (Adejoh *et al*, 2021) on the effect of field trip and discovery methods where they found no significant difference between male and female students' achievement and retention in biology. Also study by (Njoku and Mgbomo, 2021) on Effect of field trip and demonstration methods on the achievement of secondary school students in Biology that there was no significant difference in the achievement of male and female students who were taught biology using field trip.

An earlier study by (Ukor and Abdubajar, 2019) on the effects of Field trip Instructional Strategies (FIS) on students' interest and achievement in ecological concepts found that there was no significant influence of gender on student achievement in ecology. Thus this study also on the effect of field trip and inquiry method on teaching global warming in chemistry shows no significant difference in the achievement scores of students in the instructional approaches. Thus male and female students perceive concepts the same when given equal opportunities.

Recommendations

1. Global warming should be taught as a practical topic.
2. Male and female students should be given equal opportunity in the classroom.
3. Teachers should be given in-service training on how to teach new concepts in the curriculum.
4. Teaching of global warming should be included and emphasized in senior secondary chemistry curriculum.
5. Other hands-on methods of teaching global warming should be explored.
6. Organising of climate change and global warming debates among students and pupils so as to wider their knowledge on the concept.
7. Encouraging and advising students on the habit of planting trees and reduction of cutting trees and bush burning.
8. Organizing seminars and workshops on effects of global warming.

XIII. Conclusion

Teaching and learning Global warming is very important given its attendant effects in the atmosphere and the entire environment. Various diseases, flood, drought, heat, and so on that are now prevalent are traceable to global warming and climate change. Effective teaching methods that involve hands-on activities where students are allowed to interact with the environment such as, lab activities, citizen science, service project, and personal experiences with the indigenous people on how to minimize global warming should be introduced in the secondary school curriculum. If students are exposed to teaching and learning global warming early in life, there will be better understanding of its effects and consequences as well as better ways to control the causes of global warming before it becomes a pandemic.

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