

## ASSESSMENT OF SECONDARY SCHOOL SCIENCE TEACHERS AND STUDENTS' CONCEPTUAL KNOWLEDGE OF GLOBAL WARMING IN TARABA STATE, NIGERIA

Obioha Chinomnso Nkechinyere (PhD), Gamnjoh Dennis Deya and Ndong Precilia  
<sup>1, 2, &3</sup> Taraba State University, Jalingo, Nigeria

### Abstract

*The research focused on secondary school science teachers and students' knowledge of global warming in Jalingo education zone of Taraba State, Nigeria. The study employed a survey research design. The study population comprised of 2896 secondary school students and 899 secondary school teachers in Jalingo Education Zone of Taraba State. Kreycie Morgan table of sample determination was used to sample 340 senior secondary school students and 269 secondary school teachers. Thirty four (34) secondary school students were selected from 10 secondary schools each using random stratified technique. Secondary School Students and Teachers' Knowledge on Global Warming Questionnaire (SSTKGQ) was used for the study. The instruments were validated by three experts. Two from Science Education Department and one from Measurement and Evaluation. The instrument was subjected to reliability test using Cronbach Alpha statistics. A reliability index of 0.84 was obtained. Mean and standard deviation were used in answering the research questions while independent sample test was used to test the hypotheses at 0.05 level of significance. Findings revealed that both students and teachers of secondary schools have knowledge about global warming, there is a significant difference in knowledge about global warming among secondary school teachers and Students based on gender. It was recommended that Based on the findings of this study, government should integrate climate education into school curriculum and promote gender responsive climate training for teachers.*

**Keywords:** Science Teachers, students, knowledge, attitude, global warming

### Introduction

Promoting knowledge about global warming should begin at the foundational level through the integration of climate change into school curricula, particularly for science students and teachers to cultivate early awareness, scientific literacy and informed engagement with environmental issues. This is because, global warming is one of the major and most complex problems of the environment in the last three decade plus that has drawn the attention of the media, scientists and the public. Undang and Agus (2017) refers to global warming as the effect of increasing average temperature of the earth and oceans because of the exacerbation of the greenhouse effect. According to Berlie (2018), global warming refers to the increase in the earth's average surface temperature since the industrial revolution primarily due to the emission of greenhouse gases from the burning of fossil fuels and land use change.

The addition of pollutants to the biosphere due to human activities leading to possible economic and climatic consequences potentially caused greenhouse effect. To Gamnjoh (2024), global warming is simply the increase in the average temperature of global surface air and oceans due to natural events and human activities. The term therefore, is used to describe a gradual increase in the average temperature of the earth's atmosphere and its ocean, a change that is believed to be permanently changing the earth's climate. Many people start to debate whether global warming is real or not until finally, the data obtained by climate scientist proved that our earth is warming during over the past of 100 years. Undang and Agus (2017) revealed that the effect of global warming increases day by day. Our knowledge about the dangers, effects, and prevention is important and become a claim for human. The effects have been predicted influence sea levels, beach, agriculture, wild animals, human's health, social and politics. According to Diffenbaugh and Burke (2019) global warming has already slowed economic growth in tropical

regions and intensified drought, wildfires and storms which hinder long- term development. Recent research therefore has identified pathways by which changes in climate change can affect the fundamental building blocks of economic production (Carleton & Hsiang, 2016).

In a cross sectional study by Sabiha, Atilla and Nazihan (2011) on students-teachers conceptions about global warming and changes in their conceptions during pre-service education. An open-ended questionnaire was used to collect the study's data. Participants were 32 first and 37 fifth year biology student teachers. The results showed that both groups had some confusions and concerns about global warming. All of the student teachers were under the impression that ozone layer depletion was the main cause of global warming and they assumed that greenhouse effect was completely an anthropogenic phenomenon rather than a naturally occurring process. In addition, the pre-service education did not seem to have an important effect on student teachers' awareness of global warming.

Adio-Moses and Aladejana (2016) investigated a study on assessment of knowledge and awareness of global warming among inhabitants of industrial areas of an urban community in Nigeria. In this descriptive survey, purposive sampling technique was used to select 200 respondents from among the inhabitants of this area. A questionnaire with reliability co-efficient ( $r$ ) of 0.78 was used for data collection. Two research questions were answered and three hypotheses tested at 0.05 level of significance. Statistical methods such as Chi-square, frequency count, simple percentage and pie chart were used for data analysis. Results showed that only 20% had negative attitude while 81 (40.5%) were indifferent, all the three hypotheses were rejected. Consequently, it was deduced that respondents have significant knowledge of global warming. In recommendation, people's environmental health seeking behaviour should be promoted through multidisciplinary and interdisciplinary research and the development of inclusive environmental health and safety intervention strategies.

In a study by Undang and Agus (2017) on teachers and students knowledge about global warming in a smoke area of Indonesia. The data was retrieved through objective tests on 230 teachers and 573 junior and senior high school students in Lampung Province as one of the most potential black smoke disaster area in Indonesia. Data were collected and analyzed using two Way ANOVA, and Tukey multiple comparison to understand the relationship of global warming knowledge towards gender, teachers' identity, students' educational level. The results showed that students and teachers knowledge about global warming are very low. The students' knowledge is higher than the teachers. For students, it was found that an educational level hold the important factors of students' global warming knowledge, in which secondary school students has better knowledge and experiences relative to the primary students. There is no difference in students' knowledge of global warming caused by gender.

Hestness et al (2018) investigated pre-service science teachers and high school students' conceptual understanding of global warming in Maryland, USA. The study found notable misconceptions in both groups but teachers demonstrated a high level of scientific reasoning. Another similar study by Shepardson et al (2018) through structured interviews and surveys, the study compared U.S high school students and teachers understanding of global warming, causes and effects. The study concluded that although teachers possessed more factual knowledge, students often had a stronger emotional engagement with the issue.

Boon (2019) examined the climate change knowledge and attitudes of secondary school teachers and students in Australia. Findings of the study revealed that while teachers had slightly more accurate scientific knowledge, students were often more concerned and motivated about climate action. Putri (2019) assessed scientific literacy on global warming among 112 secondary school students in Bandung, Indonesian. Findings revealed that male students outperformed females in interpreting scientific data and understanding environmental concepts. Another similar study by Eze (2020) on climate change awareness and pro-environmental behavior among students

and teachers. It was found that males demonstrated higher awareness levels and a greater willingness to act environmentally.

Lee et al (2020) in a comparative study explored U.S middle and high school science teachers and students knowledge about global warming. Findings showed that while most teachers understood the human causes of climate change, many lacked depth in explaining mechanisms and students mirrored these gaps. In another similar study by Karyono and Suryani (2021) on climate literacy among secondary school students and their teachers. Finding revealed that teachers had higher overall knowledge scores but students showed more awareness of recent climate activism and sustainability. Ugwu et al (2021) explored teachers' knowledge and attitudes toward climate change in Enugu State. Results of the study showed that male teachers had significantly higher knowledge levels and more favorable attitudes compared to female teachers.

### **Statement of the Problem**

Due to the rapid increase in migration from rural areas to urban centers, industrialization, consumption of the earth's resources, human activities, rapid destruction of the natural environment, and the preference for fossil fuels in energy production, the ecological balance of the world is deteriorating leading to a rapid increase in environmental problems. Eventually, these environmental problems have become problems that pose a serious threat to the lives of human beings. One of these environmental problems is global warming (Darçın, Bozkurt & Hamalosmanolu, & Köse, 2006, in Sabiha, Atilla & Nazihan, 2011). However, students have misconception about global warming. Due to the lack of education on global warming and the fact that it is an abstract concept, environmental education becomes more important. In solving environmental problems, social awareness is created by people gaining positive environmental awareness and attitudes, and thus solutions to environmental problems can be produced. Providing environmental education to children at an early age, which ensures the formation and development of environmental awareness, is a critical period for them to develop concern, interest, awareness, and knowledge about the natural world. This study therefore addressed the question, what is the assessment of secondary school science teachers' and students' conceptual knowledge and attitude to global warming in Jalingo Education Zone of Taraba State, Nigeria?

### **Purpose of the Study**

The purpose of this study is to assess secondary school science teachers' and students' conceptual knowledge to global warming in Jalingo Education Zone of Taraba State, Nigeria. The specific objectives are:

1. To determine the differences in knowledge about global warming between teachers and secondary school Students in Jalingo Education Zone of Taraba State
2. To determine the differences in knowledge about global warming among secondary school teachers and students based on gender in Jalingo Education Zone of Taraba State

### **Research Questions**

The following research questions guided the study:

1. What is the difference in knowledge about global warming between teachers and secondary school Students in Jalingo Education Zone of Taraba State?
2. What is the differences in knowledge about global warming among secondary school teachers based on gender in Jalingo Education Zone of Taraba State?

### **Methods**

Survey research design was used for the study. The population for the study comprised of 2896 senior secondary school students and 899 secondary school teachers in Jalingo Education Zone of Taraba State, Nigeria making a total of 3795. Kreycie Morgan table of sample determination was

used to sample 340 senior secondary school students and 269 secondary school teachers in all the two local government areas that form the education zone. 34 secondary school students from 10 schools were selected using simple random sampling technique. One instrument: secondary school students and teachers' knowledge on global warming questionnaire (SSTKGQ) was validated by experts from science education department Taraba State University, Jalingo. The questionnaire comprised of 30 items. The questionnaire comprised of two sections. Section "A" contains the bio data of the respondents while section "B" contains the research questions. The researcher used a 4 points likert scale of strongly agree (SA), agree (A), Disagree (D) and strongly disagree (SD) answer. Mean of 2.5 and above is taken as agree while mean below 2.5 is considered as disagree. The decision rule was  $4+3+2+1/4=2.5$ . The instrument was subjected to reliability test using Cronbach Alpha statistics. A reliability index of 0.84 was obtained. The questionnaire was administered by the research assistants adhering to the ethics of research. The researchers used mean and standard deviation in answering the research questions while independent sample test was used to test the hypotheses at 0.05 level of significance. Statistical package for social sciences (SPSS) was used.

## Results

Research question one: What is the difference in knowledge about global warming between teachers and secondary school Students in Jalingo Education Zone of Taraba State?

Table 1: Descriptive Statistics of Differences in Knowledge about Global Warming between teachers and secondary school Students

S/N	Item	Students	Teacher	Remark
		Mean(SD) N= 341	Mean(SD) N= 269	
1.	The concept of global warming is defined as an increase in the temperature of earth's and ocean's surfaces due to the increase in the amount of the greenhouse gases in the atmosphere	3.32 (.47)	3.54 (.50)	Agree
2.	The average temperature increase between 0.4 °C – 0.8 °C is caused by the burning of fossil fuels, land clearing, and agriculture which lead to carbon dioxide and other greenhouse gases release	3.40 (.69)	3.59(.50)	Agree
3.	The gases released by human activities are believed to be the main cause of global warming over the last fifty years	3.37 (.69)	3.31(.74)	Agree
4.	The effects of global warming increases day by day	3.32 (.58)	3.52(.51)	Agree
5.	Global warming is real	3.44 (.50)	3.54(.50)	Agree
6.	Global warming causes a climate change which poses threat to life	3.22 (.59)	3.11 (.59)	Agree
7.	Carbon dioxide, a greenhouse gas produced by animals during respiration , is absorbed by plants during photosynthesis for the production of energy	3.20(.74)	3.85(.53)	Agree
8.	Global warming is caused due to human activities	3.11 (.93)	3.49(.53)	Agree
9.	An important aspect of addressing global warming is to combat climate change and improve livelihoods	2.94(.66)	3.00(.39)	Agree
10.	Burning fossil fuels, cutting down forest and farming livestock are increasingly influencing the climate change and the earth temperature	3.40(.63)	3.52(.73)	Agree
11.	Reducing global warming entails eating more vegetable, reuse, repair and recycling	2.57(.88)	3.00(.86)	Agree
12.	One of the problem of the environment is global warming	3.13(.82)	3.62(.69)	Agree

13.	Global warming is an artificial increase in the temperature of the earth due to intensified greenhouse effect	2.72(.83)	2.96(.82)	Agree
14.	Too many greenhouse gases increase global temperature	2.48(.96)	2.73(.67)	Disagree/Agree
15.	Global warming is a process that causes the earth to become hotter	2.63(.75)	2.69(.66)	Agree

Table 1 show that the students agreed on 14 items and disagreed on one item while the teachers agreed on all the 15 items. The items which both students and teachers agreed on are: concept of global warming is defined as an increase in the temperature of earth's and ocean's surfaces due to the increase in the amount of the greenhouse gases in the atmosphere (Mean=3.32) for students and (Mean=3.54) for teachers respectively, The average temperature increase between 0.4 °C – 0.8 °C is caused by the burning of fossil fuels, land clearing, and agriculture which lead to carbon dioxide and other greenhouse gases release (Mean=3.40) for students and (Mean=3.59), the gases released by human activities are believed to be the main cause of global warming over the last fifty years (Mean=3.37) for students and (Mean=3.31) for teachers , the effects of global warming increases day by day (Mean=3.32) for teachers and (Mean=3.52) for teachers , global warming is real (Mean=3.44) for teachers and (Mean=3.54) for teachers, global warming causes a climate change which poses threat to life (Mean=3.22) for students and (Mean=3.11) for teachers, carbon dioxide, a greenhouse gas produced by animals during respiration , is absorbed by plants during photosynthesis for the production of energy (Mean=3.20) for students and (Mean=3.85) for teachers, global warming is caused due to human activities (Mean=3.11) for students and (Mean=3.49) for teachers, An important aspect of addressing global warming is to combat climate change and improve livelihoods (Mean=2.94) for students and (Mean=3.00), burning fossil fuels, cutting down forest and farming livestock are increasingly influencing the climate change and the earth temperature (Mean=3.40) for students and (Mean=3.52) for teachers, reducing global warming entails eating more vegetable, reuse, repair and recycling (Mean=2.57) for students and (Mean=3.00) for teachers, one of the problem of the environment is global warming (Mean=3.13) for students and (Mean=3.62) for teachers, global warming is an artificial increase in the temperature of the earth due to intensified greenhouse effect (Mean=2.72) for students and teachers (Mean=2.96) for teachers, global warming is process that causes the earth to become hotter (Mean=2.63) for students and (Mean=2.63). However, students disagreed on one item which is, too many greenhouse gases increase global temperature (Mean=2.48) for students and (Mean=2.73) for teachers respectively.

Research question 2: What is the difference in knowledge about global warming among secondary school teachers and students based on gender in Jalingo Education Zone of Taraba State?

Table 2: Descriptive Statistics of Difference in Knowledge about Global Warming among Secondary School Teachers and Students Based on Gender in Jalingo Education Zone of Taraba State

S/N	Item	Male	Female	Remark
		Mean(SD) N= 344	Mean(SD) N= 266	
1.	The concept of global warming is defined as an increase in the temperature of earth's and ocean's surfaces due to the increase in the amount of the greenhouse gases in the atmosphere	3.32 (.47)	3.53 (.50)	Agree
2.	The average temperature has increased between 0.4 °C-0.8 °C caused by the burning of fossil fuels, land clearing, and agriculture which lead to carbon dioxide and other greenhouse gases released	3.54 (.50)	3.41(.75)	Agree

3.	The gases released by those activities claimed to be the main source of the global warming that has occurred at this last 50 years	3.18 (.75)	3.56(.59)	Agree
4.	The effects of global warming increases day by day	3.39 (.49)	3.45(.64)	Agree
5.	Global warming is real	3.42 (.49)	3.56(.50)	Agree
6.	Global warming causes a climate change which poses threat to life	3.20 (.69)	3.14(.43)	Agree
7.	Greenhouse gas produced by animals during respiration and used by plants during photosynthesis	3.60(.68)	3.34(.77)	Agree
8.	Global warming is caused due to human activities	3.37 (.58)	3.15(1.05)	Agree
9.	One important fact about global warming is to fight climate change and improve livelihoods	3.06(.43)	2.85(.65)	Agree
10.	Burning fossil fuels, cutting down forest and farming livestock are increasingly influencing the climate change and the earth temperature	3.66(.69)	3.18(.56)	Agree
11.	Reducing global warming entails eating more vegetable, reuse, repair and recycling	2.54(.85)	3.04(.89)	Agree
12.	One of the problem of the environment is global warming	3.49 (.89)	3.16(.63)	Agree
13.	Global warming is an artificial increase in the temperature of the earth due to intensified greenhouse effect	2.62(.77)	3.11(.84)	Agree
14.	Too many greenhouse gases increase global temperature	2.54(.83)	2.65(.88)	Agree
15.	Global warming is process that causes the earth to become hotter	2.88(.70)	2.37(.61)	Agree

As seen in Table 2, male students agreed on all the fifteen (15) items while female students only agreed on fourteen items and disagreed on one (1) item. The students agreed that the concept of global warming is defined as an increase in the temperature of earth's and ocean's surfaces due to the increase in the amount of the greenhouse gases in the atmosphere (mean = 3.32) for male and (mean = 3.53) for female respectively, the average temperature has increased between 0.4 °C-0.8 °C caused by the burning of fossil fuels, land clearing, and agriculture which lead to carbon dioxide and other greenhouse gases released (mean = 3.54) for male and (3.41) for female students, the gases released by those activities claimed to be the main source of the global warming that has occurred at this last 50 years (mean =3.18) for male and (mean = 3.56) for female students, Global warming is real (mean =3.42) for male and (mean = 3.56) for female students, global warming causes a climate change which poses threat to life (mean = 3.20) for male (mean =3.14) for female students, greenhouse gas produced by animals during respiration and used by plants during photosynthesis (mean = 3.60) for male and (mean = 3.34) for female students, global warming is caused due to human activities (mean = 3.37) for male and (mean = 3.15) for female students, one important fact about global warming is to fight climate change and improve livelihoods (mean = 3.06) for male and (mean = 2.85) for female students, burning fossil fuels, cutting down forest and farming livestock are increasingly influencing the climate change and the earth temperature (mean = 3.66) for male and (mean= 3.18) for female students, reducing global warming entails eating more vegetable, reuse, repair and recycling (mean = 2.54) for male and (mean = 3.04) for female students, one of the problem of the environment is global warming (mean = 3.49) for male and (mean = 3.16) for female students, global warming is an artificial increase in the temperature of the earth due to intensified greenhouse effect (mean = 2.62) for male and (mean = 3.11) for female students , too many greenhouse gases increase global temperature (mean = 2.54) for male and (mean= 2.65) for female students, global warming is process that causes the earth to become hotter (mean = 2.88) for male , however female students disagreed on this item (mean = 2.37). Hypotheses one: There is no significant difference in knowledge about global warming between teachers and secondary school Students in Jalingo Education Zone of Taraba State.

Table 3: Independent-Samples t-test of Significant Difference in Knowledge about Global Warming between Teachers and Secondary School Students

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Knowledge	Equal variances assumed	2.452	.118	-7.340	608	.000	-.21407	.02916	-.27135	-.15680
	Equal variances not assumed			-7.272	552.889	.000	-.21407	.02944	-.27190	-.15625

Result of independent-samples t-test in Table 4 shows that there is a significant difference in knowledge about global warming between teachers and secondary school Students in Jalingo Education Zone of Taraba State ( $t(608) = -7.340, p < .001$ ). Thus, the null hypothesis which states that there is no significant difference in knowledge about global warming between teachers and secondary school Students in Jalingo Education Zone of Taraba State is rejected. This implies that secondary school teachers and students differ significantly in their knowledge about global warming. Hypotheses two: There is no significance difference in knowledge about global warming among secondary school teachers and students based on gender in Jalingo Education Zone of Taraba State. Table 4: Independent-Samples t-test of Significant Difference in Knowledge about Global Warming among Secondary School Teachers and Students Based on Gender in Jalingo Education Zone of Taraba State

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Knowledge	Equal variances assumed	27.464	.000	.673	608	.501	.02049	.03045	.03932	.08030
	Equal variances not assumed			.658	515.025	.511	.02049	.03113	.04068	.08165

Result of independent-samples t-test in Table 2 shows that there is no significant difference in knowledge about global warming among secondary school teachers and Students based on gender in Jalingo Education Zone of Taraba State ( $t(515.025) = .511, p < .001$ ). Thus, the null hypothesis which states that there is no significant difference in knowledge about global warming among

secondary school teachers and students based on gender in Jalingo Education Zone of Taraba State is rejected. This implies that secondary school teachers and students knowledge about global warming based on gender in Jalingo Education Zone of Taraba State.

### **Discussion of Findings**

This section discusses the findings of the study. The result of the findings showed that both secondary school students and teachers have knowledge of what global warming is. The finding particularly revealed that both teachers and students agreed that concept of global warming is the increase in the temperature of earth's and ocean's surfaces due to the increase in the amount of the greenhouse gases in the atmosphere, the average temperature has increased between 0.4 °C-0.8 °C caused by the burning of fossil fuels, land clearing, and agriculture which lead to carbon dioxide and other greenhouse gases released, The gases released by those activities claimed to be the main source of the global warming that has occurred at this last 50 years, The effects of global warming increases day by day, global warming is real, global warming causes a climate change which poses threat to life, greenhouse gas produced by animals during respiration and used by plants during photosynthesis, global warming is caused due to human activities, one important fact about global warming is to fight climate change and improve livelihoods, burning fossil fuels, cutting down forest and farming livestock are increasingly influencing the climate change and the earth temperature, Reducing global warming entails eating more vegetable, reuse, repair and recycling, one of the problem of the environment is global warming, global warming is an artificial increase in the temperature of the earth due to intensified greenhouse effect , global warming is process that causes the earth to become hotter. However, students disagreed on one item which is, too many greenhouse gases increase global temperature. This therefore implies that there is no difference in knowledge about global warming between teachers and secondary school Students. This study disagrees with the finding of Sabiha, Atila and Nazihan (2011) who found that both groups (teachers and students) had some confusions and concerns about global warming. However, the study agrees with the findings of Adio-Moses and Aladejana (2016), who found that inhabitants of industrial areas (students and teachers inclusive) had knowledge of global warming; Study also agrees with the finding of Undang and Agus (2017), Hestness et al (2018) and Lee et al (2020) all who found that students and teachers have knowledge about global warming.

Result of independent-samples t-test shows that there is a significant difference in knowledge about global warming between teachers and secondary school Students in Jalingo Education Zone of Taraba State. This study collaborates with the findings of Undang and Agus (2017) who found a significant difference in the knowledge of respondent about global warming between teachers and students. The students' had higher knowledge than the teachers. However, it contradict the finding of Hestness et al (2018) who found that teachers demonstrated a high level of scientific reasoning about global warming than students while Shepardson et al (2018) found that teachers possessed more factual knowledge as students often had a stronger emotional engagement with the issue of global warming. This implies that informed teachers can influence students' environmental awareness and concern about global warming. Also, students taught by knowledgeable teachers are better equipped to participate in public discussions and policy debates on climate issue, more likely to become informed and responsible citizens in warming world.

The result of the independent-samples t-test on gender shows that there is no significant difference in knowledge about global warming among secondary school teachers and students. This suggests that gender does not play a significant role in influencing factual knowledge of global warming within the educational context. This implication is that male respondent may have been exposed to curricula, media content and learning opportunities leading to comparable levels of understanding about global warming This study disagrees with the finding of Putri (2019) , Eze (2020) , Ugwu et al (2021) who all found that male teachers had significantly higher knowledge levels and more favorable attitudes compared to female teachers.

## Conclusion and Recommendation

Based on the findings of this study, the researchers conclusively reveals that both secondary school students and teachers possess knowledge about global warming, indicating a shared understanding of the causes, effects and possible solutions to climate change within the school environment. There is statistically significant difference in the knowledge of global warming between male and female secondary school students and teachers in Jalingo Education Zone of Taraba State. This indicates that gender plays a significant role in influencing the level of awareness and understanding of global warning among students and teachers. Based on the findings of this study, government should integrate climate education into school curriculum and promote gender responsive climate training for teachers.

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