



ASSESSING SCIENCE EDUCATION UNDERGRADUATES' KNOWLEDGE ON CLIMATE CHANGE EDUCATION FOR ENHANCING SUSTAINABLE DEVELOPMENT IN NIGERIA

An Official Journal of the Faculty of Education Alex Ekwueme Federal University, Ndufu-alike, Ikwo, Ebonyi State Nigeria.

Dr. David Agwu Udu

Department of Science Education, Faculty of Education
Alex Ekwueme Federal University, Ndufu-Alike, Ebonyi State, Nigeria
Email: daviduduagwu@gmail.com

Abstract

Climate change refers to any significant change in the measures of climate lasting for an extended period of time. It is one of the most important environmental, social and economic challenges facing the world today. Climate change education is the study of causes, effects and control measures of climate change. Sustainable development on the other hand is a pattern of economic growth in which resources are used to meet human needs while preserving the environment so that these needs can be met for generations to come. This study therefore, assessed male and female science education undergraduates' knowledge of climate change education for enhancing sustainable development in Nigeria. The study adopted descriptive survey design. The population was 763 science education undergraduates in Ebonyi State. The sample was 178 undergraduates (81 males and 97 females) drawn from the population through simple random sampling procedure. A researcher-made structured questionnaire titled "Undergraduates' Climate Change and Sustainable Development Questionnaire (UCCSDQ)" was used in data collection. Data obtained were analyzed qualitatively and quantitatively. Findings of the study revealed that most of the undergraduates have good knowledge of climate change education. It also found that controlling the effects of climate change enhances sustainable development in Nigeria. The study further found no significant difference in the male and female undergraduates' perceptions on climate change education for enhancing sustainable development. The study recommended among others that climate change and sustainable development education should be structured and embedded into Nigerian Universities system for greater students' awareness and understanding.

Keywords

climate, climate change, climate change education, science education, sustainable development, undergraduates

Introduction

Climate is broadly defined as the long-term statistics or characteristics of weather that are determined over time. These can be any characteristics, ranging from the average expected weather patterns to the measure of the variability and likelihood of extreme events (Colose, et al. 2020). According to the World Meteorological Organisation, (WMO, 2021), climate is also the average weather in a given area over a longer period of time. It can be described with information on the average temperature in different seasons, rainfall, and sunshine for a period of over

30 years. Weather is the state of the atmosphere, its temperature, humidity, wind, rainfall, etc., over hours to weeks. Weather is influenced by the climate system. The climate system is the highly complex global system consisting of 5 major components: the atmosphere, the oceans, the cryosphere (snow and ice), the land surface, the biosphere, and the interactions between them (Charron, 2016). In addition, Colose, et al. (2020) noted that climate, in its broadest sense, is the statistical description of the state of the climate system. And the interactions of the climate system determine not only day-to-day

weather, but also long-term averages; the climate.

On the other hand, climate change is any systematic change in the long-term statistics of the components of climate system such as temperature, precipitation, pressure, or wind sustained over several decades or longer (WMO, 2021). Climate change is also a change in the statistical properties of the climate system that persists for several decades or longer, usually at least 30 years. These statistical properties include averages, variability and extremes. Climate change may be due to natural processes, such as changes in the Sun's radiation, volcanoes or internal variability in the climate system, or due to human influences such as changes in the composition of the atmosphere or land use. Mendelsohn and Williams (2006) added that climate change is an environmental, social and economic challenge on a global scale. Moreover, climate change as seen by the United States Environmental Protection Agency (USEPA, 2014) refers to any significant change in the measures of climate lasting for an extended period of time. Meanwhile, climate change education is the study of causes, effects and control measures of climate change. Climate change education is a big endeavour because it involves the study of the entire planet and everything that affects their survival (Knutson, 2011). Continuing, Knutson noted that the challenges posed by climate change crises constitute major threat to sustainable development.

Sustainable development can be described as a process of improving the range of opportunities that will enable the citizens of any nation to fully achieve their potentials and aspirations over a period of time without compromise to the economic, social and environmental systems (Omole & Ozoji, 2014). According to McKeown (2002), sustainable development basically involves a knowledge base which revolves round three basic concepts of the economy, environment, and society. Sustainable development is concerned with the need to face and

save the future to keep and safeguard the interests of the younger generations. Contributing, Aliyu (2009) noted that climate change would pose a constraint to the developing nations' attainment of poverty reduction and sustainable development as captured under the United Nations Millenium Development Goals.

According to Njoku (2016), sustainable development is a pattern of economic growth in which resources are used to meet human needs while preserving the environment so that these needs can be met for generations to come. Its importance was recognized with the establishment of the United Nations Decade for Education for Sustainable Development (2005-2014). Continuing, Njoku emphasized that Sustainable development was further popularized in the 1992 United Nations Conference on Environment and Development in Rio de Janeiro. The outcome of this conference, Agenda 21, listed a wide range of strategies for realizing sustainable development, pointing out the role of education in Chapter 36, "reorienting education towards sustainable development".

Moreover, the United States Environmental Protection Agency (USEPA, 2014) observed a relationship between sustainable development and climate change. The agency maintained that while climate change influences key natural and human living conditions which are the basis for social and economic development, on the other hand society's priorities on sustainable development influence the emission of greenhouse gases that contributes to climate change and vulnerability (Glavic, 2020). Human activities are responsible for almost all of the increase in greenhouse gases in the atmosphere over the past centuries, which are largely caused by the emission of gases from burning fossil fuels for electricity, heat and transportation (International Panel on Climate Change, IPCC, 2007).

Meanwhile, UNESCO (2017) emphasized that education for sustainable development is crucial for

the development of crosscutting sustainability competencies in learners, as well as enable individuals to contribute to sustainable development by promoting societal, economic, and political change and behavioral transformation. Similarly, Glavic (2020) opined that education for sustainable development encourages different disciplines to enter into dialogue, make connections, share knowledge, and work together on emergent areas. Continuing, Glavic added that education for sustainable development aims to develop students' ability to understand and evaluate connections between big issues, such as inequality, public health, global consumption, biodiversity loss and the limits of natural systems.

The university is the tertiary level of education. It is regarded as a high level center for learning. It is therefore expedient that university students, especially the science education undergraduates should access the knowledge of climate change issues and its relationship to sustainable development. According to Nath (2009), the university undergraduates should acquire the knowledge and understand the concepts and phenomena of climate change. Although climate change issues are scientific, but it is expedient that all humans should be literate in climate change education for enhancing sustainable development. According to Agboola and Emmanuel (2016), science literacy is an understanding of human influence on climate and climatic influence on humans and the society at large. Meanwhile, Agboola and Emmanuel identified some qualities of a climate literate person to include: understands the essential principles of earth's climate system; knows how to assess scientifically credible information about climate; communicates about climate and climate change in a meaningful way; and is able to make informed and responsible decisions with regard to actions that may affect climate. On that note, the science education students and science

educators can be very useful in the impartation of climate literacy through climate change education. Accordingly, Agboola and Emmanuel (2016) emphasized that the University science education teachers/lecturers have a special responsibility of instilling climate change education and general environmental awareness in all the science education undergraduates and graduates either by formal curricula or structured discussion. Nath noted further that the knowledge of climate change is a vital intellectual activity that need to be possessed by all regardless of the educational background or level. According to Marty and Yokochi (2006), as the climate changes, everything else changes, from the natural habitat of wildlife to the culture and sustainability of a region. Marty and Yokochi further identified some effects of climate change to include; rise in sea level, changes in the pattern of rainfall, water scarcity and adverse health effects from warmer temperature. Climate change has a cumulative effect on natural resources and the balance of nature. However, as critical as the effects of climate change are to sustainable development, it is not clear whether science education undergraduates have acquired the knowledge or awareness of climate change and its effect, hence the justification for this study.

This study therefore, assessed the male and female science education undergraduates' level of knowledge of climate change and how it can enhance sustainable development in Nigeria. To achieve the purpose, this study addressed the following research questions with corresponding hypotheses.

R1. What are the male and female undergraduates' responses on their knowledge of climate change?

Ho1. There is no statistically significant difference in the male and female undergraduates' responses on their knowledge of climate change.

R2. What are the male and female

undergraduates' responses on their knowledge of climate change education for enhancing sustainable development?

Ho2. There is no statistically significant difference in the male and female undergraduates' responses on their knowledge of climate change education for enhancing sustainable development.

Method and Materials

The design of the study was a descriptive survey. The population comprised of all science education undergraduates in Alex Ekwueme Federal University, Ndufu, Alike, Ebonyi State. The sample was 178 (81 males and 97 females) science education undergraduates selected from the University through simple random sampling technique. The instrument for data collection was a researcher-made structured questionnaire titled "Undergraduates' Climate Change and Sustainable Development Questionnaire (UCCSDQ)" with a five-point Likert rating scale of Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), and Strongly Disagree (SD), weighted as follows; 5, 4, 3, 2, and 1 accordingly for the research questions. The instrument was validated by three experts in Science Education. The questionnaire comprised of two parts. Part 1 sought information on the bio-data of

the respondents, while part 2 contained two clusters/sections A and B, with twenty (20) items on climate change education for enhancing sustainable development. Cronbach Alpha was used to determine the internal consistency of the items by conducting a pilot study with a sample of thirty science education undergraduates randomly selected from another University outside the study area. The reliability indices obtained were 0.86 and 0.84 for the two clusters of the instrument, with an overall reliability index of 0.83. This was considered high enough for the study. All the 178 copies of the questionnaire were distributed to the respondents by the researcher, through the help of the course representatives of the different levels. All the questionnaires were returned giving a 100% return rate.

Results

The results are presented in tables according to the research questions and hypotheses.

Research Question 1: What are the male and female undergraduates' responses on knowledge of climate change?

Table 1: Mean and Standard Deviation of Male and Female Science Education Undergraduates Responses on Knowledge of Climate Change

Group Statistics						
S/N	Items	Gender	N	Mean	SD	Decision
1	The climate is dynamic and always changing through natural cycle.	Male	81	3.68	1.19	A
		Female	97	3.59	1.28	A
2	Climate change refers to a measurable increase in the average temperature of earth's atmosphere.	Male	81	3.58	1.20	A
		Female	97	3.47	1.28	A
3	Change in weather condition over an extended period of time is climate.	Male	81	3.52	1.37	A
		Female	97	3.52	1.33	A
4	Climate change manifests in diverse ways in the world.	Male	81	3.27	1.34	A
		Female	97	3.22	1.37	A
5	Climate change is currently an immediate and urgent concern.	Male	81	3.42	1.32	A
		Female	97	3.37	1.36	A
6	Climate change is affecting our environment directly or indirectly.	Male	81	3.56	1.31	A
		Female	97	3.42	1.39	A
7	I am sure that climate change is really happening within my environment.	Male	81	3.20	1.44	A
		Female	97	3.26	1.39	A
8	I am familiar with the term "Green House Effect"	Male	80	3.44	1.21	A
		Female	97	3.36	1.29	A
9	I am familiar the term "Global Warming"	Male	81	3.28	1.28	A
		Female	97	3.24	1.31	A
10	I will like to know more about climate change.	Male	81	4.04	1.17	A
		Female	97	3.92	1.23	A
Overall Total		Male	81	3.50	1.25	A
		Female	97	3.44	1.30	A

From Table 1, the male and female science education undergraduates' responses on knowledge of climate change have overall mean score of 3.50 with a standard deviation of 1.25 for the males and 3.44 with standard deviation of 1.30. The table also shows that the mean responses of the undergraduates in all the 10 items were higher than the benchmark of 3.0. This implies that the science education undergraduates have good knowledge of climate change. Meanwhile, there is a slight difference of 0.06 in the mean responses of the male and female undergraduates. However, the table did not show whether the observed slight difference was statistically significant or not. To ascertain the significance or otherwise, the result was subjected to

inferential testing of hypothesis 1 as hereunder shown in table 2. Meanwhile, the standard deviation of the female science education undergraduates was 1.30, which was slightly higher than 1.25 obtained by their male counterparts. The lower standard deviation shows that the male undergraduates' responses were more clustered around the mean than that of their female counterparts.

Hypothesis 1: There is no statistically significant difference in the male and female undergraduates' responses on their knowledge of climate change.

Table 2: Independent Sample t-test Analysis of the Mean Responses of Male and Female Science Education Undergraduates

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	T	Df	Sig. (2- tailed)	Mean Differ.	Std. Error Differ.	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	.314	.576	.333	176	.739	.064	.192	-.315	.442
Equal variances not assumed			.334	172.37	.739	.064	.191	-.313	.441

Table 2 shows the independent sample t-test conducted on the male and female science education undergraduates' opinions to test the null hypothesis 1. The table shows that Sig. value ($p = .576$) obtained in the Levene's test was greater than .05, which implies that the variances are assumed equal. Furthermore, the results in the equal variances assumed of the table show t-value of .333 and Sig. (2-tailed) value of .739, $p > .05$ at 176 degree of freedom. Therefore, the null hypothesis 1 of no statistically significant difference between the male and female science education undergraduates' responses on their knowledge of climate change was accepted. This implies that the observed slight difference in the mean responses can probably be attributed to sampling error. Specifically, the table shows that the probability that the mean difference observed in table 1 above was due to sampling error and not a real difference between the male and

female undergraduates' opinion was 73.9% which was greater than 5% set for the study. This study, therefore, found no statistically significant difference in the opinions of the male and female science education undergraduates ($t_{(176)} = .333, p = .739 > .05$). This result has shown that the male and female science education undergraduates all had good knowledge of climate change which is needed for enhancing sustainable development.

Research question 2: What are the male and female undergraduates' responses on their knowledge of climate change education for enhancing sustainable development?

Table 3: Mean and Standard Deviation of Male and Female Science Education Undergraduates Responses on Climate Change Education for Sustainable Development

Group Statistics

S/N	Items	Gender	N	Mean	SD	Decision
1	I am familiar with the term sustainable development.	Male	81	3.15	1.34	A
		Female	97	3.24	1.32	A
2	Climate change is a threat to sustainable development.	Male	81	3.12	1.33	A
		Female	97	3.23	1.35	A
3	I have previous experience of sustainable development.	Male	81	2.81	1.29	D
		Female	97	2.94	1.33	D
4	Putting off lights and other electronic gadgets when not in use enhances sustainable development.	Male	81	3.26	1.38	A
		Female	97	3.27	1.38	A
5	Saving of water is a sustainable life style.	Male	81	3.30	1.38	A
		Female	97	3.27	1.38	A
6	Disposing wastes properly enhance sustainable development.	Male	81	3.85	1.28	A
		Female	97	3.70	1.33	A
7	Walking or cycling to school or other places enhances sustainable development.	Male	81	3.02	1.41	A
		Female	97	3.05	1.40	A
8	I am bothered about enhancing sustainable development	Male	80	3.35	1.37	A
		Female	97	3.31	1.38	A
9	Living a positive lifestyle towards the environment enhances sustainable development	Male	81	3.93	1.13	A
		Female	97	3.72	1.24	A
10	Constant education on climate change enhances sustainable development.	Male	81	3.89	1.23	A
		Female	97	3.82	1.22	A
Overall Total		Male	81	3.37	1.27	A
		Female	97	3.35	1.30	A

Table 3 shows the mean with standard deviation of the male and female science education undergraduates on the items presented as climate change education for enhancing sustainable development. The Table shows that the male and female undergraduates agreed to nine (9) of the identified items, but disagreed to one (1). Specifically, they disagreed to item 4, which sought information on their previous experience of sustainable development. Furthermore, the Table shows that the overall mean and standard deviation scores of the male science education undergraduates' opinions on the use of climate change education for enhancing sustainable development were 3.37 and 1.27 respectively, while that of their female counterpart were 3.35 and 1.30

respectively. These results show a slight mean difference of 0.02 between the male and female responses. However, the table did not show whether the observed slight difference was statistically significant. Therefore, the null hypothesis 2 was subjected to independent sample t-test statistics as shown in table 4.

Hypothesis 2: There is no statistically significant difference in the male and female undergraduates' responses on their knowledge of climate change education for enhancing sustainable development.

Table 2: Independent Sample t-test Analysis of the Mean Responses of Male and Female Science Education Undergraduates

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Differ.	Std. Error Differ.	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	.114	.736	.068	176	.946	.013	.194	-.370	.397
Equal variances not assumed			.068	171.63	.946	.013	.194	-.370	.396

Table 4 is the independent sample t-test conducted on the male and female science education undergraduates' responses to test null hypothesis 2. The table shows that Sig. value ($p = .736$) obtained in the Levene's test was greater than .05, which implies that the variances are assumed equal. Furthermore, the results in the equal variances assumed of the table show t-value of .068 and Sig. (2-tailed) value of .946, $p > .05$ at 176 degree of freedom. Therefore, the null hypothesis 2 of no statistically significant difference between the male and female science education undergraduates' responses on the use of climate change education for enhancing sustainable development was accepted. This implies that the observed slight difference in the mean responses can probably be attributed to sampling error. Specifically, the table shows that the probability that the mean difference observed in table 3 was due to sampling error and not a real difference between the male and female undergraduates' opinion was 94.6% which was greater than 5% set for the study. This study, therefore, found no statistically significant difference in the opinions of the male and female science education undergraduates ($t_{(176)} = .068$, $p = .946 > .05$). This result has shown that the male and female science education undergraduates all agreed that climate change education enhances sustainable development.

Discussion of findings

The findings of this study revealed that the science education undergraduates of the university used in the research had good knowledge of climate change. This is very commendable based on the fact that knowledge of climate change is very useful in the impartation of climate literacy through climate change education. This finding agrees with Njoku (2016) who found that the level of awareness of climate change issues among students is high unlike sustainable development, and that the students have some knowledge of Climate change and sustainable development issues and were eager to acquire more skills and knowledge on climate change and sustainable development related issues. Njoku stressed further that the impact of climate change is a general phenomenon, and students should be exposed to the dangers of climate change early enough to help them develop positive attitude towards the environment and reduce the dangers associated with climate change thereby living a

sustainable life style.

Besides, Nath (2009) noted that the university undergraduates should acquire the knowledge and understand the concepts and phenomena of climate change, because the knowledge of climate change is a vital intellectual activity that need to be possessed by all regardless of their educational background or level.

Furthermore, this study also found that climate change education is a vital tool for enhancing sustainable development. This finding is in line with USEPA (2014) that observed a relationship between sustainable development and climate change. That while climate change influences key natural and human living conditions which are the basis for social and economic development, on the other hand society's priorities on sustainable development influence the emission of greenhouse gases that contributes to climate change and vulnerability.

Similarly, Glavic (2020) opined that education for sustainable development encourages different disciplines to enter into dialogue, make connections, share knowledge, and work together on emergent areas. Moreover, Glavic noted that education for sustainable development is aimed at developing students' ability to understand and evaluate connections between big issues, such as inequality, public health, global consumption, biodiversity loss and the limits of natural systems.

It is expected that with climate change education, the science education undergraduates will be able to disseminate the information on the adverse effects of climate change thereby helping to create positive attitudes in the people and enhance sustainable development.

Conclusion and Recommendations

This study has established that the knowledge of climate change will assist science education undergraduates in disseminating vital information needed for enhancing sustainable development in the developing countries such as Nigeria. It is an established fact that having the right information is the key to the achievement of any set objectives. With the knowledge of the causes, effects and other challenges associated with changes in the climate, the people will reduce the spate at which they engage in activities that will lead to increase in climate change. When there is reduction in climate change activities, it will enhance sustainable development.

The researcher therefore recommends that climate change education and sustainable development should be structured and embedded into Nigerian Universities system for greater students' awareness and understanding. The science education undergraduates should always use every available opportunity to teach the masses the causes and effects climate change for enhancing sustainable development.

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