



### TEACHERS INCLUSION OF CLIMATE CHANGE CONCEPTS IN THE TEACHING OF MATHEMATICS FOR SUSTAINABLE DEVELOPMENT

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#### Abstract

Climate Change is one of the heated issues in the world today. This issue needs to be translated to the upcoming generation through the school system. The various subjects in the school system are the vehicles through which this could be achieved. It is on this regard that the study examines the level of inclusion of climate change concepts in the teaching of mathematics for sustainable development in Yenagoa Local Government Area of Bayelsa State. Three objectives, research questions and hypotheses guided the study. Descriptive survey design was used for the study. The study population comprised two hundred and thirty-six (236) teachers teaching mathematics in Yenagoa Local Government Area of Bayelsa State for the 2019/2020 academic session. The sample constituted of 236 teachers and the census sampling technique was used for the study. The instrument used for data collection was a questionnaire on the Inclusion of Climate Change Concepts in Teaching Mathematics (ICCCTM). The Cronbach coefficient alpha formula was used to determine the reliability of the instruments, while the validity was ascertained by experts. Data collected were analysed using mean, standard deviation, chi-squared analysis and independent t-test analysis at 0.05 level of significance. The findings indicated that teachers seldom include climate change concept in the teaching of mathematics. The findings of the study also indicated that there was no significant difference between the responses of male and female teachers and that of urban and rural teachers. It was concluded that mathematics teachers should cite climate change in relevant mathematics concepts.

#### Keywords

Teachers Gender, Location, Climate Change.

#### Introduction

Climate change is one of the pressing issues of the world today. It is the term used for the shift in worldwide weather phenomena associated with an increase in global average temperatures. According to the Intergovernmental Panel on Climate Change (IPCC) (2008), Climate change refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties that persists for an extended period of time which could be decades or longer. It is any change in climate over time, whether due to natural variability or as a result of human activity. The United Nations Framework

Convention on Climate Change (UNFCCC) defined climate change as a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and natural climate variability observed over comparable time periods in addition.

The Earth's climate is changing, and the scientific consensus is not only that human activities have contributed to it significantly but the change is far more rapid and dangerous than thought earlier (IPCC 2008). Climate change is causing critical global environmental changes that is the warming temperature of the earth's surface and the oceans, changes in the global water cycle, declining

glaciers and snowpack. It has caused sea level to rise, ocean acidification, greater variability, such as with “wetter wets”, “drier dries” and “hotter hots” more frequent and severe extreme heat events more severe droughts (Pryor, 2017). Pryor (2017) also stated that there are more intense precipitation, such as severe rains, winter storms and hurricanes, higher average temperatures and longer frost-free seasons, longer wildfire seasons and worse wildfires. Loss of snowpack and earlier spring runoff, recurrent coastal flooding with high tides and storm surges, more frequent and severe floods has been seen due to intense precipitation and spring snowmelt. These are the results of human activities due to industrialisation and others

These human activities thought in most cases are for the development of the human society. These developments are achieved through technological advancements. Some of the technologies used today have caused a lot of effects on the environment and have undermine the sustainability of our society. The society today therefore, needs measures that would lead to the sustainable development of her. Sustainable development is the process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are compatible in such a way that they enhance current and future potential to meet human needs and aspirations.

The notion of sustainable development reflects concerns relating to the impact of development on the present generation, but it also requires ensuring that future communities have access to resources that will allow them to survive and prosper. Long-term sustainability is critical to the success of extermination of the effects of climate change through various processes such as social learning strategies, technological strategies educational strategies, conservative strategies, agricultural strategies, campaign talking points strategies and social norm strategies.

The secondary school system is ideal for transfer of scientific information on global climate change issues. The teacher in this sector can do it through the process of teaching and learning in the school. The teacher can disseminate the meaning, causes, effects of climate change and how this can be ameliorated through the subjects they teach. A teacher is an expert who is capable of imparting knowledge that will help learners to build, identify and to acquire skills that will be used to face the

challenges in life (Senge, 2000). Mathematics is among the various subjects taught by the teacher in the school system. It spans through basic 1 to 9 and senior secondary school 1 to 3 due to its importance.

Mathematics as an important subject is applied in various disciplines of human endeavour. A degree of mathematics is applied in all aspects of climate change which indicates that a range of thematic areas could be relevant for mathematics classrooms (Steffensen, Hansen & Hauge, 2016). The concepts in mathematics could be used to buttress climate change, effects and how its effects could be ameliorated. According to Barwell (2010), mathematics can be used in three aspect of climate change which are description, prediction and communication. Description involves among others measurement of temperature, rainfall and sea level which result to data collection and the statistical analysis of these data.

Mathematical concepts such as mathematical modelling, non-linear systems and stochastic processes are used for predictions and communication of climate change. These involve the production and consumption of information about climate change in the form of written texts, graphs, charts and diagrams. Steffensen, Hansen and Hauge (2016) examined climate change in mathematics classrooms. An online survey was carried out to get a first impression of what teachers do in classrooms, and why, in relation to climate change and mathematics education. The survey response was mainly qualitative in nature. It was concluded that collectively, teachers have ideas on how to use climate change in classrooms.

Abtahi, Götze, Steffensen, Hauge, and Barwell (2018) examined Teaching Climate Change in Mathematics Classrooms: An Ethical Responsibility. They investigated how issues of climate change incorporated into the teaching and learning of mathematics can be understood as a moral and ethical act. They found that including climate change in mathematics classrooms can be (and is) viewed as an ethical responsibility of mathematics teachers, in their day-to-day practice but their decision about this issue are complex.

Mathematics as a subject is taught both by both male and female teachers in the secondary school. The inclusion of the concepts of climate change in the teaching of the subject may vary as male and female teachers may view it in different perspectives. Ambe-Uva, Iwuchukwu and Jibrin (2008) cited in Nnenna and Adukwu. (2018) defined gender as a social meaning associated with being a

male or a female, including the construction of identities, expectations, behaviours and power relationships that are derived from social interactions. The different societal roles and responsibilities of men and women may present different opportunities for incorporating different initiatives into teaching and learning of mathematics. Gender influence of teachers could be related to differences in teaching styles. Therefore, it is necessary to understand these distinctions in respect of male and female teachers' responses towards the inclusion of climate change concepts in the teaching of mathematics.

Ahiatrogah (2017) examined gender dimension in the development of effective teaching skills among distance education students. A longitudinal developmental research design was used for the study. Data was collected using the Teaching Practice Assessment Form. Result revealed that a statistically significant difference existed between the teaching skills acquired by male and female distance education students.

A lot of variables may inhibit or hinder effective subject delivery of the teacher. Among them is the teacher' school location. The school location variable where the teacher resides could be urban or rural. One of crucial factors in terms of the school location variable is the distribution of resources. Urban location has high population density, contains high variety and beauty place views including better and more resources for educational purposes while rural location is characterized by low population density containing low variety and isolated place views including poor and less resources for educational purposes. Dash and Barman (2016). investigated the level of teaching effectiveness of secondary school teachers in the district of Purba Medinipur, West Bengal. The descriptive Survey method was used for the study. The result revealed that there was significant difference among the secondary school teachers regarding their level of teaching effectiveness on the basis of school location.

### Statement of the Problem

Climate change as an emerging factor is the effect of human activities on climate. These activities of man have caused a lot of changes in the environment some of which are warming temperature of the earth's surface and the oceans, changes in the global water cycle, declining glaciers and snow pack, sea level rise, high level flooding in cities and ocean acidification. These effects have

caused man and other living things great suffering. These effects need to be ameliorated through the teaching of mathematics so as to make the environment and its resources available for future generation. Do teachers include climate change concepts in the teaching of mathematics for sustainable development?

### Purpose of the Study

The purpose of this study is to determine teachers' inclusion of climate change concepts in the teaching of mathematics for sustainable development. Specifically, the study sought to:

1. investigate teachers' inclusion of climate change concept in the teaching of mathematics for sustainable development.
2. examine male and female teachers' inclusion of climate change concept in the teaching of mathematics for sustainable development.
3. assess teachers' inclusion of climate change concept in the teaching of mathematics for sustainable development based on location

### Research Questions

The following questions were posed to guide the study.

1. What is the response of teachers on the inclusion of climate change concept in the teaching of mathematics for sustainable development?
2. What is the difference between the responses of male and female teachers on the inclusion of climate change concept in the teaching of mathematics for sustainable development?
3. What difference exist between the responses of teachers on the inclusion of climate change concept in the teaching of mathematics for sustainable development based on location?

### Hypotheses

The following hypotheses were tested at .05 level of significance.

1. There is no significant difference in the responses of teachers on the inclusion of climate change concept in the teaching of mathematics for sustainable development.
2. There is no significant difference between the responses of male and female teachers on the inclusion of climate change concept in the teaching of mathematics for sustainable development.
3. There is no significant difference between the responses of teachers on the inclusion of climate change concept in the teaching of mathematics for sustainable development based on location.

## Research Methods

The design for the study was the descriptive survey design. The population comprised two hundred and thirty-six (236) teachers teaching mathematics in Yenagoa Local Government Area of Bayelsa State for the 2019/2020 academic session. The sample constituted 236 teachers and the census sampling technique was used for the study. The census sampling was used because of small number of teachers. The instrument used for the study was a questionnaire on the Inclusion of Climate Change Concepts in Teaching Mathematics (ICCCTM). ICCCTM had two sections, Sections A and B. Section A was on demographic information of students while section B had ten items on inclusion of climate change concept in the teaching of mathematics with the options Never (N), Seldom (S), Often (O) and Always (A).

The instrument was face validated by one experienced secondary school teacher, one expert in test, measurement and evaluation and one expert in mathematics education. These evaluators were requested to vet the items for clarity of words, plausibility of the appropriateness to the level of the students and adequacy in addressing the objectives and the problems of the study. Their comments and corrections were incorporated into the final form of the instruments. In order to test the reliability of the instruments, the instrument was administered to a sample of 20 teachers in a school not selected for the study but the teachers had similar qualities as those

in the study. The instrument was administered once to each teacher and the Cronbach coefficient alpha formula was used to determine the reliability of the instruments. A reliability of .82 was obtained and the instrument was considered reliable for the study.

The questionnaire was administered to each of the sampled teachers who responded to it. They were collected back immediately after filling and were scored. The questionnaires were scored 4-points for N, 3-points for O, 2-points for S and 1-point for A and the ranges of 3.5 – 4, 2.5 – 3.4, 1.5 – 2.4 and 1 – 1.4 were respectively considered for Always, Often, Seldom and Never in the determination of the mean response. Data collected were analysed using mean, standard deviation, chi-squared analysis and independent t-test analysis at 0.05 level of significance.

## Results

The results are presents based on the research questions and hypotheses.

### Research Question One

What is the response of teachers on the inclusion of climate change concept in the teaching of mathematics for sustainable development?

**Table 1**

Mean Responses of Teachers on Inclusion of Climate Change Concept in Teaching Mathematics.

Item No	Description	N	.	Decision
1	I ask students to collect data on climate change from sources.	236	2.03	Seldom
2	Students are asked to tabulate climate change data in the mathematics classroom.	236	2.07	Seldom
3	I teach students to read graphs on climate change	236	1.92	Seldom
4	Students are asked to compare graphs from different sources on climate change	236	1.88	Seldom
5	Interpretation of climate change graphs or charts are done in the classroom.	236	1.95	Seldom
6	I use climate change concepts in teaching mathematical models.	236	1.69	Seldom
7	Climate Change data are used in teaching mathematical concepts such as average, quadratic equation and functions.	236	1.78	Seldom
8	I go on field trip with students to demonstrate effects of climate change.	236	1.94	Seldom
9	I use animations in the mathematics classroom to demonstrate climate change concepts.	236	1.91	Seldom
10	Student are taught on how to analyse data on climate change for meaningful purposes.	236	2.09	Seldom
	Grand Mean	236	1.93	Seldom

As shown in table, the respondents' responses on all the items were seldom. The grand mean also indicated seldom. It can be inferred from the responses that that teachers seldomly included the concept of climate change in the teaching of mathematics.

**Research Question Two**

What is the difference between the responses

Gender	N	$\bar{X}$	SD
Male	139	1.93	0.37
Female	97	1.92	0.41

As presented in table 2, the mean response of male teachers is 1.93 while that of their female counterparts is 1.92. It can be inferred from the result that though the responses of male and female teachers fell within the range of seldom inclusion but that of male teachers is higher than female teachers.

**Research Question Three**

What difference exist between the responses

Location	N	$\bar{X}$	SD
Urban	152	1.96	0.40
Rural	84	1.87	0.35

As presented in table 2, the mean response of teachers in urban location is 1.96 while those in rural location is 1.87. It can be inferred from the result that though the responses of teachers in urban and rural location fell within the range of seldom inclusion but that of teachers in urban location is higher than those in rural location.

ofmale and female teachers on the inclusion of climate change concept in the teaching of mathematics for sustainable development?

**Table 2**

Meanand Standard Deviation of Male and Female Teachers Responses on Inclusion ofClimate Change Concept in Teaching Mathematics.

of teachers on theinclusion of climate change concept in the teaching of mathematics for sustainable development based on Location?

**Table 3**

Meanand Standard Deviation of Teachers Responses on Inclusion ofClimate Change Concept in Teaching Mathematics Based on Location

**Hypothesis One**

There is no significant difference in the responses of teachers on the inclusion of climate change concept in the teaching of mathematics for sustainable development.

**Table 4**

Mean Responses of Teachers on Inclusion of Climate Change Concept in Teaching Mathematics.

Description	N	A	O	S	N	df	$\chi^2$	P< .05
I ask students to collect data on climate change from sources.	236	45	26	57	108	27	182.57	.00
Students are asked to tabulate climate change data in the mathematics classroom.	236	34	42	66	94			
I teach students to read graphs on climate change	236	32	20	81	103			
Students are asked to compare graphs from different sources on climate change	236	20	21	105	90			
Interpretation of climate change graphs or charts are done in the classroom.	236	14	37	109	76			
I use climate change concepts in teaching mathematical models.	236	14	20	82	120			
Climate Change data used teaching mathematical concepts such as average, quadratic equation and functions.	236	11	17	118	90			
I go on field trip with students to demonstrate effects of climate change.	236	20	35	68	105			
I use animations in the mathematics classroom to demonstrate climate change concepts.	236	13	25	125	73			
Student are taught on how to analyse data on climate change for meaningful purposes.	236	44	39	47	106			

Table 4 showed that the calculated chi-square value (182.57) and its corresponding calculated probability value ( $P_{cal}$ ) is .00 which is less than the significant level (.05). Therefore, the null hypothesis is rejected. This implies that there exists significant difference in the responses of teachers on the inclusion of climate change concept in the teaching of mathematics for sustainable development.

**Hypothesis Two**

There is no significant difference between the responses of male and female teachers on the

inclusion of climate change concept in the teaching of mathematics for sustainable development.

**Table 5**

Independent t-test Analysis of Male and Female Teachers Responses on Inclusion of Climate Change Concept in Teaching Mathematics.

Gender	N	$\bar{X}$	SD	df	$t_{cal}$	$P_{cal} < .05$
Male	139	1.93	0.37	234	1.75 <sup>NS</sup>	.08
Female	97	1.92	0.41			

NS = Significant at .05 level of significance.

Table 5 showed that the calculated t-value (1.75) and its corresponding calculated probability value ( $P_{cal}$ ) is .08 which is greater than the significant level (.05). Therefore, the null hypothesis is not rejected. This implies that there exists no significant difference between the responses of male and female teachers on the inclusion of climate change concept in the teaching of mathematics for sustainable development.

### Hypothesis Three

There is no significant difference between the responses of teachers on the inclusion of climate change concept in the teaching of mathematics for sustainable development based on location.

**Table 6**

Independent t-test Analysis of Teachers Responses on Inclusion of Climate Change Concept in Teaching Mathematics Based on Location

Location	N	$\bar{X}$	SD	df	$t_{cal}$	$P_{cal} < .05$
Urban	152	1.96	0.40	234	0.34 <sup>NS</sup>	.74
Rural	84	1.87	0.35			

Not = Significant at .05 level of significance.

Table 6 showed that the calculated t-value (0.34) and its corresponding  $P_{cal}$  is .74 which is greater than the significant level (.05). Therefore, the null hypothesis is not rejected. This implies that there exists no significant difference between the responses of teachers on the inclusion of climate change concept in the teaching of mathematics for sustainable development based on location.

### Discussion of Findings

The findings on the responses of teachers on the inclusion of climate change concept in the teaching of mathematics for sustainable development indicated a significant difference. The findings indicated that the proportion of teachers who responded to seldom inclusion of climate change concept were significantly higher than the proportion of teachers who indicated the other options. The findings could be attributed to less sensitisation of teachers on the use of the subject to demonstrate or teach the effect of climate change. The findings of the study could also be attributed to the non-appliance of the teaching of classroom mathematics to societal problems. The finding of the study is in line with that of Steffensen, Hansen and Hauge (2016), who examined Climate Change in Mathematics Classrooms and concluded that collectively, teachers have ideas on how to use climate change in classrooms. The finding of the

study is also in line with that of Abtahi, Götze, et-al (2018), who examined Teaching Climate Change in Mathematics Classrooms and found that including climate change in mathematics classrooms can be viewed as an ethical responsibility of mathematics teachers.

The findings on the responses of male and female teachers on the inclusion of climate change concept in the teaching of mathematics for sustainable development indicated a non-significant difference. The findings indicated that the proportion of male teachers who responded to inclusion of climate change concept though were higher but was not significantly higher than the proportion of their female counterparts. The findings could be attributed to both male and female teachers being less seriously concerned about societal problems. The finding of the study is contrary to that of Ahiatrogah (2017), who found a statistically significant difference existing between the teaching skills acquired by male and female DE students.

The findings on the responses of teachers on the inclusion of climate change concept in the teaching of mathematics for sustainable development based on location indicated a non-significant difference. The findings indicated that the proportion of teachers in urban location who responded to inclusion of climate change concept, though were higher but was not significantly higher than the proportion of teachers in rural location. The

findings could be attributed to teachers both in urban and rural location non-application of problem solving and problem base strategies in the teaching of mathematics. The finding of the study is contrary to that of Dash and Barman (2016), who revealed that there was significant difference among the secondary school teachers regarding their level of teaching effectiveness on the basis of school location.

### Conclusion

Based on the findings, it could be concluded that mathematics teachers were not very concerned in the inclusion of climate change concept while teaching mathematics in the classroom. This not being concern was shown by both male and female teachers. No matter the effects of climate change in urban and rural locations the teachers in those locations also were not very concerned in the inclusion of climate change concept while teaching mathematics. Climate change being a very serious situation affecting the global society, need to be considered in everything the teacher is involved in. Therefore, its effects need to be taught by male and female teachers or urban and rural teachers so that students will be involved in activities that reduce its effects globally. The study proves the opportunity of letting teachers be aware that climate change can be introduced in the secondary so that students can come to a better understanding early enough to prevent it.

### Recommendations

The following recommendations are made based on the findings:

1. Teachers should include the concept of climate change when teaching mathematics in the classroom.
2. Male and female teachers including urban and rural teachers should incorporate the problems of the society such as climate change into their teaching mathematics using especially strategies as problem solving and problem-based strategies.
3. Seminars and conferences should be held to train teachers on the inclusion of climate change concept in the teaching of mathematics.

### References

- Abtahi, Y., Götze, P., Steffensen, L., Hauge, K. H. and Barwell, R. (2018). Teaching Climate Change in Mathematics Classrooms: An Ethical Responsibility. Retrieve from [https://www.researchgate.net/publication/335491574\\_TEACHING\\_CLIMATE\\_CHANGE\\_IN\\_MATHEMATICS\\_CLASSROOMS](https://www.researchgate.net/publication/335491574_TEACHING_CLIMATE_CHANGE_IN_MATHEMATICS_CLASSROOMS)
- MS\_AN\_ETHICAL\_RESPONSIBILITY/stats
- Ahiatrogah P. D. (2017). Gender Dimension in the Development of Effective Teaching Skills among University of Cape Coast (Ucc) Distance Education Students. *World Journal of Education* 7(4), 12–23.
- Barwell, R. (2010) Climate change and mathematics education: a critical mathematics education perspective. In Pinto, M. M. F. & Kawasaki, T. F. (Eds.) *Proceedings of 33rd conference of the International Group for the Psychology of Mathematics Education (PME)*, vol. 2, pp. 193-200.
- Dash, U. & Barman, P. (2016). Teaching Effectiveness of Secondary School Teachers in the District of Purba Medinipur, West Bengal. *IOSR Journal Of Humanities and Social Science (IOSR-JHSS)*, 21(7), version vii, 50–63.
- Intergovernmental Panel on Climate Change (IPCC) (2008) *Climate Change 2007 Synthesis Report*. Geneva: IPCC.
- Islahi, F. & Nasreen, No Initial (2013). Who Make Effective Teachers, Men or Women? An Indian Perspective. *Universal Journal of Educational Research* 1(4): 285-293.
- Nnenna, G. E. & Adukwu, B. C. (2018). Influence of Gender and School Location on Senior Secondary School Students' Achievement in Biology Inagbani Education Zone of Enugu State, Nigeria. *Journal of Education and Practice* 9(21), 45–51.
- Pryor, L. (2017). The impacts of climate change on health. A paper presented to the Institute & Faculty of Actuaries in London on the 6<sup>th</sup> of July, 2017.
- Senge, J. (2000). *School that learn*. New York: DoubleDay Publishing Group.
- Steffensen, L., Hansen, R. & Hauge, K. H. (2016). Climate Change in Mathematics Classrooms. 13th International Congress on Mathematical Education Hamburg, 24-31
- Yohe, G.W., Lasco, R. D., Ahmad, Q. K., Arnell, N. W., Cohen, S. J., Hope, C. Janetos, A. C. and Perez, R. T. (2007). Perspectives on climate change and sustainability. *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 811-841.
- Pryor, L. (2017). The impacts of climate change on health. A paper presented to the Institute & Faculty of Actuaries in London on the 6<sup>th</sup> of July, 2017.