



GSJ: Volume 9, Issue 7, July 2021, Online: ISSN 2320-9186
www.globalscientificjournal.com

**INTEGRATING CLIMATE CHANGE CONCEPTS INTO QUANTITATIVE
SUBJECTS IN NIGERIAN SECONDARY SCIENCE CURRICULUM**

BY

Daniel Buba Mshelia, Department of biology F. C. E (T) Gombe,

Justina T. Diblong, Department of biology F. C. E. (T) Gombe

Angela Peter, Department of biology F. C. E. (T) Gombe

Usman Adamu Dukku, Department of biology F. C. T (T) Gombe

ABSTRACT

This paper tries to identify climate change and the emerging issues as well as the realities associated with it as part of sustainable development goals (SDGs) expected to be achieved by 2030 globally. It also emphasised the need for proper awareness and sensitization through enlightening students about climate change. It mentioned how climate change could be lifted into school curricular especially through the assistance of the quantitative subjects which uses data for planning, forecasting and correct inferences from data obtained. The paper suggest the use of climate into the curricular of quantitative subjects will bridge the gap of knowledge and awareness between the curriculum learnt in the secondary school and those intended to be learnt later in tertiary institutions. Also the knowledge acquired by the students can be spread and applied in the larger society by the students while relations and neighbours learn from them, since school is smaller part of the society. The paper also recommended that curriculum planners should consciously integrate climate change themes and concepts in secondary school curriculum for science and quantitative subjects using both the horizontal and vertical organisation of curriculum content and learning experiences. Further, real life climate change issues and problems should be used as examples to guide the teaching and learning of climate change concepts in quantitative subjects.

Keywords: Sustainability, emission, cardiovascular, expediency ,indispensability

INTRODUCTION

As a result of the changing world around us as evident in the context noticeable by local and global changes in our weather and climate. The increasing atmospheric temperature has generally resulted in an increase in water holding capacity of the atmosphere which has led to change in precipitation pattern and increase in atmospheric moisture Devkota, Maraseni and Cockfield, (2014). The manifestation of climate change that is variation in the mean state of the climate persisting over a long time.

It has been scientifically known that there exists imbalance variation in the climate pattern at each point in the world. These changes are said to involve climate variables such as sea level rise, frequency of cyclones, rainfall amount and distribution, concentration of methane in the atmosphere, the time it takes for an ocean circulation to complete one cycle etc. In order to make this meaningful according to Bhaskar (2015), the averaging period is assumed to be approximately 30 years; this duration encompasses most of the known cycles of variability. In recent decades, changes in climate has had effects on natural and human systems world wide. Every country of the world is today feeling the effect of climate change as well as all the economic, social and environmental problems associated with it. The world is being threatened by the consequences of climate change such as flood, heat waves and drought which in turn threatens the existence of man. Numerous terrestrial, freshwater and marine species have shifted from their original geographical ranges, seasonal activities, migrating patterns, abundance and species interactions in response to ongoing climate change (IPCC, 2014) While some species are being threatened by extinction. Climate changes have been associated with ill health such as asthma, allergic diseases, respiratory diseases and cardiovascular diseases (Jang, 2011). Food production may also be threatened arising from flooding or drought which are impacts of change. Climate change is actually a threat to sustainable development, social and natural systems. These climate changes impacts are due largely to increase in anthropogenic greenhouse gas emissions (IPCC, 2014). Anthropogenic greenhouse gas- carbon dioxide (CO₂), Methane (CH₄) and Nitrous oxide (N₂O) emission has tremendously increased since the pre – industrial driven era driven largely by economic and population growth. Accumulation of this emission has shown increase of 40%, 150% and 20% respectively in recent decades. These emissions have been found to be largely due to human activities from energy sector, industrial sector, transport sector, building sector and agriculture and forest land uses.

IPCC (2014) predicted that by 2100, due to climate change, warming is likely to exceed 2^oC above pre – industrial levels, global mean sea level may rise by 0.95m, leading to high risks

such as storm surges, food and water insecurity, extreme weather events, loss of ecosystem and other severe and irreversible impacts globally if appropriate mitigation efforts are not put in place. The existence and sustainability of present and future generation of man is therefore at risk. The urgency expected in the tackling of climate change issues by nations of the world may have informed the inclusion goals 2, and 11 to 15 – which are all related to climate change – in Sustainable Development Goals (SDGs) agreed upon by leaders of the nations of the world. These goals which are expected to be achieved by 2030 are:

2. Zero hunger

11. Sustainable cities and communities

12. Responsible consumption and production

13. Climate action

14. Life below water

15. Life above water

Necessity for climate change education

Science Technology Engineering and Mathematics Education has many benefits for the society which include making our environment likeable and ensuring a better life for the current and future generation. Education will for a long time remain vital vehicles for stimulating, generating and disseminating information to enhance public awareness most especially on contemporary environmental issues. This no doubt necessitates effective education curriculum on climate change. In this regard, the United Nations (UN) championed the global efforts to increase awareness on environmental education around the world prompting the UN Conference on Human Environment held in Stockholm, Sweden in 1972 to declare that environmental education be a vital tool in addressing global environmental problems, as well as in the preservation and improvement of the world's environment. In fact, in 2012, the United Nations Children and Education Fund (UNICEF) actually restated her support for the empowerment of children with climate change information (UNICEF,2012). The expediency and indispensability of climate change education, especially its integration into the secondary school curricular has been further stressed by Dyster (2013) when he declared that Education is the most powerful tool to engage young people in the debate, prepare them for working with the green economy, and give the definitive science and facts about the biggest issue facing young people;. This shows that adequate and timely education especially at the formative school levels play a very significant role, not only in producing educators on climate change but solution providers to the myriad problems associated with the effects of climate change of climate change in our society today. This is more pertinent since the world today has become an information and knowledge driven system, for which

the infusion of a curriculum on climate change especially in the formative level of education that is, in the secondary school is the way to go.

Integrating climate change in Secondary School Curriculum

The changing climate is a challenge for both current and future generation, just as its impacts are increasing the vulnerability of societies around the world (Devkota, 2014). Adequate knowledge and awareness of the contemporary global challenges posed by climate change and global warming has obviously become inevitable. Integrating climate change in secondary school curriculum is thus required to drive the efforts for enhanced awareness on the characteristics and effect of climate change on the people and the environment.

According to Nzewi (2012), climate change is part of emerging global curricular issues, and incorporating these issues into the curriculum is premised on the belief in the transformative power of widespread, systematic education to improve lives and communities both locally and globally.

In study in Ghana, Boakye (2015) sought to find out the extent of integration of climate change into science curricula of pre – tertiary schools in Ghana so that if there was a need for improvement, this could be done to promote effective climate change education in Ghana.

Pre – tertiary schools were involved in the study because, in Ghana, the purpose of the lower primary science curriculum was to provide a strong foundation for further study of science at the upper primary level and beyond, (Ministry of Education, 2012). The study revealed that although climate change was not integrated into the curricula of lower and upper primary.

There were topics in both the curricula that lent themselves to climate change. In summary, the content analysis revealed that climate change was non – existent in the curricula of the lower primary, Grades 1to3, upper primary, Grades 4to6, but was present in the Junior High School (JHS) and Senior High School (SHS) curricular. At both the JHS and SHS levels for instance, the proportion of climate change integrated into both curricular were the same, 2%. The 2% climate change content of both the SHS and JHS leaves much to desire considering the fact that there were potential topics in the curriculum that could have been related to it to reinforce learning.

Comparing a similar study carried out in Kenya, Boakye (2015) noted that although the teaching and learning of climate change starts in the primary school (Cherry, 2011; Republic of Kenya, 2012), only 0.53% of the total secondary school curriculum were found to address directly or indirectly climate change issues in Kenya. This figure is rather appalling when compared with Ghana with 2% (Boakye, 2015), most especially when the finding is juxtaposed with UNICEF declaration for the support for the empowerment of children with climate change information (UNICEF, 2015).

In Nigeria, curriculum at secondary school level is aimed at preparing learners for further education and also preparing them for a useful living within the society (FGN, 2014). The pattern of curriculum designed for the secondary school has core subjects as well as other category of subjects. Core subjects specified by the FGN (2014) are meant to develop the total child. Duru (2011) identified the essence of core subjects as to bring about integration, address the needs of the learners, and promote active learning. The secondary school curriculum does not have environmental education yet as school a subject, except few associated concepts integrated during the teaching of sciences. The important and relevant knowledge, skills and values that are needed to be learnt about climate change are not treated by teachers in an integrated manner.

Some have even argued against its infusion to the curricula claiming that it will lead to the overloading school curricula (Smith, 2013) such that it will be too much for the students to carry. On the contrary, the needs of learners will be incomplete, if they are not also sensitised to what can happen to them in the event of excessive bush burning, emission of fumes i.e. from cooking with firewood, pollution from vehicles and generators. What happens also with noise due to lack of adequate power supply, flood and drought that adversely affected food supply, blocking of water ways with garbage and building, as well as other natural and human – induced disasters.

Adequate awareness and proper sensitization on climate change will enable this young people in secondary school to begin to learn and cultivate the habit of desisting from practices that can be devastating to their health and their environment. For instance, Adedeji, Reuben and Olatoye (2014) like several other authors have written about how temperature rise caused by climate change can in extreme situations (heat) have a direct negative impact on human health. Generally, the nature of health challenge will often vary from place to place, region to region and also from season to season. In other words, the health peculiarities in Nigeria or Africa may not be the same as in Australia or in Europe. It is an appropriate climate change education that will provide the lead in the formulation and implementation of possible policy capable of handling or limiting the health effects of climate change. According to Adedeji, et al. (2014), the possible policy options may include amongst others: Improvement in living conditions, e.g. air conditioning, ventilation; Improvement of preventive/curative health care, e.g. personnel with special educations, vaccination; monitoring/alarm systems and public information/education.

Climate change is affecting the society and as a resource of developing the curriculum, the school cannot shy away from enlightening the students about climate change through the various bodies of knowledge. Education on climate change and other environmental

education issues are not restricted to the classroom alone. There are many ways students can learn about the environment in which they live beyond the classrooms. These could include the school farm, embarking on field trips, visiting national parks, engaging in after school green clubs to mention but few. These programs are the various programs of studies, activities and guidance which the curriculum offers learners. Considering the fact that most of the variations in weather and climate variables are consequences of human activities, proper education of the the students in their formative years in secondary school will inform them and help them make decisions on human activities that can preserve and sustain the environment.

National needs and international trends on global warming necessitates that curriculum should feature global warming. This could be carried out using horizontal and vertical organization of curriculum content and learning experiences. Horizontal in the sense that, in a class, each core subject addresses the issue of climate change. This provides opportunity to establish the relatedness of subjects irrespective of the subject. The vertical organization of learning experiences involves the selection of learning experiences in single subject over time, such that the climate change content and learning experience at a lower class serve as a basic knowledge to learning experiences at the next higher class. This type of learning provides relationship and reinforcement of knowledge in climate change as the learner progresses in school from year to year.

Advocacy for Climate Change Concepts in Science & Quantitative Subjects' Curriculum

Evidences abound in literature to the fact that climate change is science in itself (Tomasevic, 2013; Fries-Gaither, 2010; Smith, 2013). According to Boakye (2015), in the U.S. curriculum, climate change forms part of the science curriculum (Tomasevic, 2013), in Ethiopia, it is integrated into the Biology curriculum (Dalelo, 2012), some of the sciences topics that have been used in climate change lesson are energy (Climate Change Live, 2013; Fries-Gaither, 2010), photosynthesis (Mr. Green Lesson plan, 2010), and the forest (Job Corps Lesson plan, 2008; Kindlmannova & Semerakova, 2010). In the current curriculum being used in Nigeria, 38.9% of the concepts covered in the Junior Secondary School Basic Science address climate change issues while at the Senior Secondary, less than 10% of the concepts of the quantitative subjects address climate change issues.

The multidisciplinary/interdisciplinary approach has been found to blend integrative science, technology, engineering, and mathematics to teach climate change. The approach motivated the students and engaged them in meaningful problems within their communities ((Roehrig, Campbell, Dalbotten, & Varma 2012; Samper, 2010). The conclusion drawn from the

approach was that there is the need for new approaches to science teaching and learning that can promote the kind of skills and critical thinking needed to address the global and multidisciplinary problems facing our planet (Boakye, 2015; Roehrig, et al; 2012).

Quantitative subjects are subjects that involve numerical manipulations (Ogunkunle, 2012). These include mathematics, sciences, social sciences and engineering. These subjects are characterized by:

- Frequent use of numerals
- Investigating into the why and how of decision making
- Teaching and learning made by inquiry
- Solve problems using thinking skills
- Using aptitude from the subjects to make significant contributions to mankind.

Using horizontal organization of learning experiences as an example, climate change themes taught in a quantitative subject provide knowledge, skills and attitude which are later transferred in the study of other quantitative subjects at the same level of education where concepts of climate change are treated. The use of vertical organization of learning experience allows for simple task like simple fractions to be taught at lower levels. The knowledge of fractions is then used in solving problems on probability and statistics at higher levels of education which has several applications in climate change. When this is carried out using the various content as specified in the school curricula, students are not only aware of circumstances of climate change, they are also fully equipped on how best to deal with circumstances relating to climate change which Lal (2000) identified as follows:

- Using problem solving skills
- Involve in innovative and creative abilities;
- Acquire technical background and understanding of quantitative subjects;
- Proficiency in analysis, synthesis, modelling and simulation;
- communication skills
- Capacity to learn and keep learning
- Ability for technological assessment, adaptation and transfer
- Capacity to work in interdisciplinary areas.

This again point to the fact that all these characteristics can only be learnt in an integrated manner which is also interdisciplinary in nature. Real life climate change issues and problems could also be used to examples to be solved in teaching and learning concepts in quantitative subjects. This will bring to reality these issues in the students and also help them to apply the knowledge acquired in tackling the issues in their environment outside the classroom and society at large. Also, using real life climate change issues and problems as example to be

solved in the teaching and learning of concepts in quantitative subjects will reduce the tendency to overload the curriculum.

Conclusion and Recommendations

Effectively integration of climate change education into secondary school curricula in Nigeria as its been perused in this paper, will provide the students the opportunities not only to acquire skills for adaptation and mitigation with respect to climate change, but make them knowledgeable enough to be able to take part in debates and decisions on the subject (Boakye, 2015; Dyster, 2013; UNICEF, 2012 and Anderson, 2010). Furthermore, the knowledge of climate change content acquired from the advocated science and quantitative subjects mentioned earlier could provide them the needed foundation in climate education and its applications. It is therefore recommended that:

- Curriculum planners should consciously integrate climate change themes and concept in the secondary school curriculum for science and quantitative subjects using both the horizontal and vertical organization of curriculum contentment and learning experiences.
- Secondary school teachers handling science and quantitative subjects should be trained and retrained through workshops, in-service trainings and seminars on climate change themes and concepts.
- Real life climate change issues and problems should be used as examples to be solved in the teaching and learning of concepts in quantitative subjects
- Effective monitoring should be done to ensure the effective teaching and learning of climate change themes and concepts
- Reaching out in using statistical tools useful in processing and interpreting of graphs and data handling should be intensified.

Many homes in Nigeria have at least one child/wards going through secondary school education in which these quantitative subjects are taught. School curricula developed around climate change will no doubt help to sensitize as well as enhance the awareness of the causes, risks/hazards effects, mitigation/prevention of climate change, global warming and other forms of pollution. Knowledge acquired by the students on these issues will be disseminated and applied in the larger society by the students while relations and neighbours learn from them, since the school is a microcosm of the society. This will not only minimize vulnerability to extreme impact, but will register the awareness and consciousness in students and larger society on these issues. Ultimately, live, the ecosystem and properties would be preserved and sustained while education for all citizens is achieved.

References

Adediji, O., Reuben, O. & Olatoye, O. (2014). Global Climate. *Journal of Geoscience and Environment protection*, 2, 114 – 122.

Anderson, A. (2010). *Combating climate change through quality education*

Bhaskar, G. U. (2015). What is the most appropriate indicator to gauge the impact of climate change? Retrieved March 2017 from

https://www.researchgate.net/profile/Gunturu_Bhaskar.

Boakye, C. (2015). *Climate Change Education: The role of pre – tertiary science curricular in Ghana* Retrieved March 2017 from <https://us.sagepub.com/en-us/nam/open-access-at-sage>.

Cherry, L. (2011). Young voices on climate change: The Paul F- Brandwein 2010 NSTA Lecture. *Journal of Science Education and Technology*, 20(2), 208- 213.

Climate Change Live. (2013). Lesson plans. Retrieved from <https://climatechangelive.org/index.php?pid=180>.

Dalelo, A. (2012). Loss biodiversity and climate change as presented in biology curricula for Ethiopia schools: Implications for action- oriented environmental education. *International Journal of Environmental and Science Education*, 7, 619- 638.

Devkota, R.P. (2014). Climate Change: Trends and people's perception in Nepal *Journal of Environmental Protection*, 5, 255- 265.

Devkota, R.P., Maraseni, T.N & Cockfield, G. (2014). Perceived Community- Based Flood Adaptation Strategies under Climate Change in Nepal. *International Journal of Global Warming*, 6, 113- 124.

Duru, V.N. (2011). *Curriculum Studies: Concepts, Development and Implementation*. Owerri: Avan Global Publication.

Dyster, A. (2013). *In recent months. climate change education has hit the headlines*.

Retrieved from <https://www.leftfoodforward.org/2013/07/education-is-the-key-to->

addressing-climate change/

- FGN (2014). National Policy on Education (NPE). Lagos: National Education Research Development Council Press.
- Fries- Gaither, J. (2010). Beyond penguins and polar bears. Lesson and activities to build the foundations for climate literacy. Retrieved from <https://beyondpenguins.ehe.osu.edu/issue/climate-change-and-the-polar-regions/lessons-and-activities-to-build-the-foundation-for-climate-literacy>
- IPCC, (2014). *Climate Change 2014: Synthesis Report. Contribution of working I,II, and III to the Fifth Assessment Report of the intergovernmental panel on Climate Change* (Core Writing Team, R.K. Pachauri and L.A Meyer (eds.). Geneva, Switzerland: **IPCC**
- Jang, A. (2011). Climate Change and air pollution. *Journal of Korean Medical Association*, **54(2), 175- 180.**
- Job Corps Lesson Plan. (2008). What does trees have to do with climate change? Retrieved Retrieved from <https://www.fs.usda.gov/internet/FSE/DOCUMENTS/stelprdb5108749.pdf>
- Kindlmannova, J., & Semerakova, B. (2010). Forest and climate change. Teacher's guide and worksheets for students.
- Lal, G.K. (2000). Curriculum design: A general perspective. Retrieved from www.ukt.ac.in/infocell./archive/dirjuly3/curriculum.html.
- Ministry of Education. (2012). National syllabus for natural science (primary 1- 3). Retrieved
- Mr Green Lesson Plan. (2010). Mr Green Lesson plan. Retrieved from https://www.futurestates.tv/uploads/lessons_plans/mr_green_lesson_plan.pdf
- Nzewi, U. M. (2012). Emerging Global Issues in Curriculum Development in U. M. O. Iwobi

& B, Akpan (eds.). Education in Nigeria: From beginning to the future. 219- 234.

Foremost Educational Services Ltd.

Ogunkunle, R. A. (2010). Pedagogical approaches to the learning of quantitative subjects.

Paper presented at the capacity building workshop for core subjects organized by NDDC
May, 2010.

Republic of Kenya (2012). Integrating climate change in education system. National climate
change action plan: Knowledge management and capacity development. 1- 18.

Roehrig, G., Cambell, K., Dalbotten, D., & Varma, K. (2012). CYCLES: A culturally-
relevant approach to climate change education in native communities. *Journal of
Curriculum and Instruction* 6(1), 73- 89.

Semper, R. (2010). Promoting climate literacy through informal science learning
environments. Retrieved from [https://www.prject2061.org./events/meetings/climate
2010/includes/media/presentations/SemperAAASClimateChange.pdf](https://www.prject2061.org./events/meetings/climate
2010/includes/media/presentations/SemperAAASClimateChange.pdf)

Smith, J. (2013). Educating, inspiring and empowering people to engage in solutions to
climate change. Retrieved from [https://www.willstegerfoundation.org/climate_
lesson- blog](https://www.willstegerfoundation.org/climate_
lesson- blog).

Tomasevic, G. (2013). Climate change now included in US curriculum. Retrieved from
<https://rt.com/usa/climate-change-curriculum-school-653/>

United Nations Children's Education Fund. (UNICEF) (2012). Climate change and
environmental education.