



ROLES OF TECHNOLOGY IN COMBATING CLIMATE CHANGE CHALLENGES AFFECTING STUDENTS' PERFORMANCE IN MATHEMATICS

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Abstract

The study examined the roles of technology in combating climate change challenges affecting students' performance in mathematics. Descriptive survey research design was employed. Three research questions and one hypothesis guided the study. A population of 154 (31 male and 123 female) mathematics teachers in Onitsha Education Zone of Anambra State was used for the study. A validated structured 30-Item questionnaire having three sections titled "Questionnaire on How Technology Combats Climate Change Challenges in Mathematics (QHTCCCCCM)", "Questionnaire on Technological Tools Use in Combating Climate Change Challenges in Mathematics(QTTUCCCCM)" and "Questionnaire On Extent of Technological Tool Usage in Combating Climate Change Challenges (QETTUCCCC)" was used. The questionnaire has reliability index of 0.77 as determined using Cronbach Alpha method. The mean score, standard deviation and percentage were used to answer the research questions while t-test was used to test for the hypothesis at 0.05 level of significant. The result showed that technological tools such as radio, computer, tablet, smart phone, television, video conferencing, notepad, e-book, projector and microphone can be used in combating climate change challenges that affect students' performance in mathematics. Mathematics teachers often use computer and smart phone but rarely use radio, television, video conferencing, notepad, e-book, projector, microphone in teaching mathematics. Findings also showed that technology creates forum mathematics interactive, fosters individualized and programmed learning, helps in sharing mathematics ideas globally and enhances online mathematics examinations. Male and female mathematics teachers have no significant difference in their mean responses. It was recommended among others that technology should be used in the school and at home.

Keywords

Technology, Mathematics, Climate change, and Performance

Introduction

The atmosphere is influenced by oceans, ice masses, land surfaces, vegetation, reflecting radiant energy back into the atmosphere, water, heat and the horizontal movement of air across the land surface (Jackson, 2021). Nigeria as a nation experience these variation in the earth's global climate over time called climate change. Climate change

according to Ogunniran (2018) is referred to as change which is directly and indirectly attributed to human anthropogenic activities that alters the composition of the global atmosphere. Climate change is a change in the statistical distribution of weather elements and which is sustained for up to a decade or more (Nwankwo&Unachukwu, 2012). United Nations Framework Convention on Climate

Change (2006) defines it as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere. Jackson, (2021) posited that climate change are caused by unbalance weather condition, threatening of the planet's ecosystems, humankind and global economy, increase in the amount of energy to the earth's atmosphere over time as the star ages, periodic changes in earth's orbit and axial tilt with respect to the Sun, fossil-fuel combustion, carbon dioxide, methane, and water vapour, absorb infrared radiation emitted from Earth's surface, elevation of the continental masses and the bathymetry of the oceans, deforestation, cultivation, livestock ranching, industrial production, and human activities.

Climate change in Nigeria is evident from temperature increase, rainfall variability (increasing rainfall in coastal areas and decline in rainfall in the continental areas), drought, desertification, rising sea levels, erosions, floods, thunderstorms, lightnings, bush fires, landslides, radiation, and loss of biodiversity (Olaniyi, Olutimehin & Funmilayo, 2019). Findings by Agwu and Okhimamhe, (2009) revealed that two South-Eastern communities in Enugwu Nanka in Anambra State and Akama Amankwo Ngwo in Enugu State witnessed the challenges of climate change which resulted to destruction of shelter (both human and animal), arable farmlands, access roads and economic trees by landslides and tornadoes. Njoku (2006) discovered a downward trend in rainy days per annum in the Northern Nigeria with Kaduna having a slight reduction in rain day per annum. National Emergency Management Agency reported that flood and windstorm displaced no fewer than 7290 people and destroyed many farms in Sokoto, Kebbi and Zangara states between April and September 2016 (Daily Post Staff, 2016). The states of Abia, Bauchi, Benue, Jigawa, Kebbi, Kano, Kogi and Zamfara were most affected by the floodwaters which lasted for 48 hours. The situation in Kaduna and Katsina was aggravated by the collapse of earth dams (Mohammed, Shamsuddin, Noraliani & Eun-Sung, 2018).

The climate change challenges resulted to death, respiratory diseases, infectious diseases, malaria, skin ailments, heat stroke, loss of forest resources, loss of portable water, shortage of

medicinal plants, loss of roads/road tracks, low food production, heat-related mortality, dehydration, malnutrition, damage to public health infrastructures, migration of both man and animals among others (Idowu, Ayoola, Opele & Ikenwe, 2011; Nwankwo & Unachukwu, 2012). This is also evidenced from the finding of Etuonovbe (2007) climate change cause high temperature level, emissions from fossil fuel combustion causes ozone depletion, deforestation, flooding, poor adaptation capacity, physical habitat destruction, lack of early warning system, resource conflicts, and environmentally-induced migration.

Due to negative effect of climate change, Nigerian government came up with policies, strategies and plans like National Action to Combat Desertification, National Policy on Drought and Desertification, Greenwall Initiative and Presidential Initiative on Afforestation, Forest Policy initiative, Climate Change Policy Response Strategy (CCPRS) and National Adaptation Strategy and Plan of Action for Climate Change Nigeria (NASPA-CCN) (Federal Ministry Of Environment Abuja, Nigeria Special Climate Change Unit, 2010). Despite these attempts to combat the climate change challenges unfortunately the issues still persist especially where it concerns destruction and closure of education and school environment. In order to combat the climate change challenges facing education in the country, Wainwright, (2009) admitted that understanding climate change requires the development of scientific research programs that will cut across fields of study in atmospheric science, oceanography, hydrology, geology, ecology, and environmental science. It is not gainsaying that these fields have relationship with mathematics. Ekpenyong (2020) posited that mathematics is the path way towards the development of science, technology and provision of solutions to global issues. The implication is that with the use of mathematics, accurate information about the economic situation of the nation will be delivered; action on climate mitigation and adaptation will be taken, skills and pedagogical support in studying the climate conditions will be promoted.

Mathematics is defined as a fundamental part of human thought that provides an effective way of building mental discipline and encourages logical

reasoning Park, Brombacher & Brocardo (2021). Finding by Anakpua, Eze and Emefo (2020) showed that mathematics helps in predicting change in temperature, weather forecast, dictation of excess heat, high - wind and excess carbon in the atmosphere, measuring and estimating heat waves, determining the expansion of water sea level and understanding social issues. Studies have shown that most failures and substandard performance in Mathematics were attributed to insecurity in the learning environment (Zin, Zaman & Noah, 2002). Ogunniran (2018) expressed that schools that are exposed to global climate changes due to greenhouse effect, high temperature, acidic rain, flooding, pests, diseases, pandemics, fire out breaks, earthquakes, floods and landslides make life difficult to live among the students. The result of Reuters (2020) showed that the outbreak of covid-19 led to loss of lives and properties, school closure, disrupt of school programmes and increase in students' dropout rate.

Resorting to only face to face method of teaching and learning of mathematics even in the time of climate change will not enable the mathematics teachers to achieve the expected objectives needed in mathematics activities. The need to include the use of technology in teaching and learning of mathematics to meet up with the changes and uncertainties in the global world is paramount. This may be the reason Ekanem (2015) opined that education in the 21st century places emphasis on the use of tools and technologies in training, assessing learning and for students' interaction within and outside the classroom environment for proper understanding and prospects.

Technology is defined by Aditiawan (2003) as the class of knowledge about specific product or production technique. Technology refers to methods, systems, and devices used for practical purposes to gain scientific knowledge. Finding by Johnson, Jacovina, Russell, and Soto (2016) showed that technology has significant role in climate monitoring, data dissemination, tracking the progress of hurricanes and typhoons using weather satellites, tracking the progress of tornadoes, thunderstorms effluent from volcanoes and forest fires, collecting and processing weather data, communication systems and traffic control. Result by GeSI SMART (2008) showed that technologies

introduce more efficient equipment and networks in reducing emissions, and help both developed and developing countries in using ICT-based systems to monitor weather and the environment worldwide in order to adapt to the negative effects of climate change. This study collaborates with the Vygotsky's model where students will have access to the highest-quality of mathematics instructional programs through technology to get to the Zone of Proximal Development (ZPD). Which means the use of technology will enable the mathematics teacher know the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers.

Studies reviewed have shown the roles of technology in climate monitoring, tracking of the progress of hurricanes, typhoons, tornadoes, volcanoes, forest fires. Collection, processing and communication of weather data as regards climate change are not left out of the roles of technology. No existing literatures have considered reviewing the role of technology in covering mathematics curriculum irrespective of locations and time and improve students' performance in mathematics even in the mist of climate change challenges. Therefore this study examined the roles of technology in combating climate change challenges affecting students' performance in mathematics.

Statement of the Problems

The worrying situation of school closure as a result of climate change challenges like erosion, dust, flooding, heavy rainfall, carbon dioxide (CO₂), destruction of homes and school properties by heavy wind, increase in pests, diseases and deaths have disrupted teaching and learning and seriously affect the students performance in school subjects especially mathematics. This situation has caused loss of lives and properties, fear, anxiety, tension and lack of curriculum coverage. Some mathematics teachers have experienced difficulty in achieving mathematics objectives due to closure of schools for months or years which resulted to students' poor performance in mathematics. In this 21st century, there is need for mathematic teachers to use scientific methods and technologies in teaching

mathematic in to meet up with the changes and uncertainties in the global world. Therefore this study sought to investigate the roles of technology in combating climate change challenges affecting students' performance in mathematics.

Purpose of the study

The purpose of the study is to examine the roles of technology in combating climate change challenges affecting students' performance in mathematics

Specifically, the study examined

1. How technology combats climate change challenges affecting students' performance in mathematics.
2. The technological tools that can be use in combating climate change challenges that affect students' performance in mathematics.
3. The extent of technological tools usage by mathematics teachers to combat climate change challenges that affect students' performance in mathematics.

Research Questions

1. How does technology combats climate change challenges affecting students' performance in mathematics?
2. What are the technological tools that can be use in combating climate change challenges that affect students' performance in mathematics?
3. To what extent do mathematics teachers use technological tools to combat climate change challenges that affect students' performance in mathematics?

Hypothesis

H₀: There is no significant difference between the mean response of male and female mathematics teachers on how technology combats climate change challenges that affect students' performance in mathematics.

Methods and Materials

Design of the Study

This study employed descriptive survey design in examining the roles of technology in combating climate change challenges affecting students' performance in mathematics. According to Akuezilo and Agu (2003), descriptive research design describes and interprets the conditions, relationships that exist, opinions that are held,

processes that are going on and trends that are developing in research study.

Area of the Study

The study was carried out on the roles of technology in combating climate change challenges affecting students' performance in mathematics. The technological tools and the extent of technological tools usage by mathematics teachers to combat climate change challenges that affect students' performance in mathematics were involved in the study. Mathematics teachers in Onitsha Education Zone of Anambra State were involved in the study because the teachers experience the effect of climate change, have direct contact with the school environment and students.

Population of the Study

A population of 154 (31 male and 123 female) mathematics teachers in Onitsha Education Zone of Anambra State was used for the study (Quality Assurance Unit Post Primary School Service Commission Awka, 2020).

Sample and sampling Technique

There was no sampling due to manageable size of the number of mathematics teachers in Onitsha Education Zone of Anambra State.

Instrument for Data Collection

A 30-Item questionnaire items which has three sections titled "Questionnaire on How Technology Combats Climate Change Challenges in Mathematics (QHTCCCCM)", "Questionnaire on Technological Tools Use in Combating Climate Change Challenges in Mathematics (QTTUCCCCM)" and "Questionnaire On Extent of Technological Tool Usage in Combat Climate Change Challenges (QETTUCCCC)" was used. Questionnaires in section 1 and 2 were designed on 4- point likert scale of strongly agree having 4 points, agree 3 points, disagree 2 points and strongly disagree 1 point while questionnaire in section 3 was designed on very often, often, occasionally and rarely response pattern.

Validation of the Instrument

The instrument was face and content validated by three experts in the Department of Science Education (one lecturer in Measurement and Evaluation and the other two from Mathematics Education) from the University of Nigeria Nsukka. Each of the experts was given a copy of the

questionnaire to check the adequacy and correctness of the questionnaire items. The corrections and suggestions were incorporated into the final draft of the questionnaire.

Reliability of the Instrument

A trail test was conducted using 28 mathematics teachers in Awka zone in Anambra State. Data collected from the trial testing was analysed using Cronbach Alpha and reliability coefficient of 0.77 was obtained.

Method of Data Collection

The researchers sent the questionnaire items to the respondents hand, post, e - mail and whatSapp. Fortunately 154 copies of the questionnaire were returned without misplacement.

Method of Data Analysis

Research questions were answered using descriptive statistics while hypothesis was tested with t -test at 5% level of significance.

Results

Table 1: Mean and standard deviation response rating of male and female mathematics teachers on how technology combat climate change challenges affecting students' performance in mathematics

S/N Item Description	Male Mathematics Teachers N=31			Female Mathematics Teachers N = 123		
	X	SD	Decision	X	SD	Decision
1. Technology is used in teaching Mathematics without physical classroom.	3.00	0.70	Accepted	3.38	0.67	Accepted
2. Technology provide forum for interactive learning during climate change.	2.57	0.98	Accepted	3.27	0.61	Accepted
3. Technology promotes Individualized learning during school closure as a result of climate change.	3.41	0.75	Accepted	3.03	0.65	Accepted
4. Technology fosters programmed learning in mathematics during climate change.	3.15	0.68	accepted	3.09	0.61	Accepted
5. Technology enhances sharing of mathematics ideas globally during climate change.	3.05	0.63	Accepted	3.02	0.65	Accepted
6. Technology provides audio and video mathematics solutions via the internet.	3.03	0.62	Accepted	3.11	0.63	Accepted
7. Technology allows exchange of mathematics ideas among the students from different nationalities.	3.00	0.61	Accepted	2.76	1.03	Accepted
8. Technology helps in	2.60	0.92	Accepted	2.58	1.12	Accepted

planning mathematics events and projects.

9. Technology creates avenue for online mathematics examinations during climate change.	3.14	0.67	Accepted	3.05	0.64	Accepted
10. Technology facilitates group study in mathematics through social media.	2.73	1.02	Accepted	2.69	0.99	Accepted
Grand Mean	2.67	0.76		3.00	0.76	

The data in table 1 shows that both male and female mathematics teachers agreed on all the items with the mean values greater than 2.50. The grand mean of 2.67 and 3.00 indicated that the respondents agreed that all the items were how technology combats climate change challenges affecting students' performance in mathematics.

Table 2: Mean response rating of mathematics teachers on technological tools that can be used in combating climate change challenges affecting students' performance in mathematics

S/N	Item Description	SA	A	D	SD	N	X	Decision
	Radio	62	87	3	2	154	3.36	Accepted
	Computer	94	51	2	7	154	3.51	Accepted
	Tablet	80	67	5	2	154	3.46	Accepted
	Smart phone	93	49	5	7	154	3.48	Accepted
	Television	103	12	21	18	154	3.30	Accepted
	Video conferencing	73	69	3	9	154	3.34	Accepted
	Notepad	72	45	20	17	154	3.12	Accepted
	E-book	54	81	10	9	154	3.17	Accepted
	Projector	54	93	3	4	154	3.28	Accepted
	Microphone	47	78	17	12	154	3.04	Accepted
	Grand Total						3.31	

Strongly Agree (SA), Agree (A) Disagree (D), Strongly Disagree (SD)

The data in table 2 shows that mathematics teachers accepted all the items with the mean values greater than 2.50. The grand mean of 3.31 indicated that the respondents agreed that all the items were the technological tools that can be used in combating climate change challenges affecting students' performance in mathematics.

Table3: Percentage response on the extent of mathematics teachers' usage of technological tools to combat climate change challenges affecting students' performance in mathematics

S/N	Item Description	VO	%VO	O	%O	OC	%OC	R	%R
	Radio	5	3.3	7	4.6	3	2	139	90.3
	Computer	30	19.5	21	13.6	24	15.6	79	51.3

Tablet	12	7.8	17	11	45	29.2	80	52
Smart phone	93	60.4	49	31.8	5	3.3	7	4.5
Television	10	6.5	5	3.3	6	3.9	133	86.4
Video conferencing	-	0	-	0	2	1.3	152	98.7
Notepad	5	3.3	7	4.6	3	2	139	90.3
E-book	-	0	2	1.3	5	3.3	147	95.5
Projector	4	2.6	3	2	17	11	130	84.4
Microphone	17	11.0	28	18.2	9	5.8	100	64.9
	Very Often (VO)	Often(O)	Occasionally (OC)			Rarely®		

Table 3 shows the numbers and percentages of mathematics teachers that use technological tools in combating climate change challenges that affect students' performance in mathematics as follows: 5 (3.3 %) mathematics teachers use radio very often, 7 (4.6%) often, 3 (2%) occasionally and 139 (90.3%) rarely. 30 (19.5%) mathematics teachers use computer very often, 21 (13.6%) often, 24 (15.6%) occasionally and 79(51.3%) rarely. For Tablet, 12 (7.8%) mathematics teachers use tablet very often, 17(11%) often, 45 (29.2%) occasionally and 80 (52%) rarely. For Smart phone, 93 (60.4%) mathematics teachers use smart phone very often, 49 (31.8%) often, 5 (3.3%) occasionally and 7(4.6%) rarely. For Television, 10 (6.5%) mathematics teachers use television very often, 5 (3.3%) often, 6(3.9%) occasionally and 133 (86.4%) rarely. For Video conferencing, 2 (1.3%) mathematics teachers use Video conferencing occasionally and 152 (98.7%) rarely. For Notepad, 5 (3.3%) mathematics teachers use Notepad very often, 7 (4.6%) often, 3(2%) occasionally and 139 (90.3%) rarely. For E-book, 2(1.3%) mathematics teachers use E-book often, 5(3.3%) occasionally and 147(95.5%) rarely. For Projector, 4 (2.6%) mathematics teachers use projector very often, 3(2%) often, 17(11%) occasionally and 130(84.4%) rarely. For Microphone, 17(11%) mathematics teachers use Microphone very often, 28 (18.2%) often, 9(5.8%) occasionally and 100 (64.9%) rarely.

Table 4: t-Test difference of the mean responses of male and female Mathematics teachers on the roles of technology in combating climate change challenges that affect students' performance in mathematics

Mathematics Teachers	N	X	SD	df	t-crit	t-cal	Decision
Male	31	2.67	0.76	152	1.96	-2.06	Ho Upheld
Female	123	3.00	0.76				

The result in table 3 shows that t- crit. value of 1.96 is greater than the t-cal. value of -2.06 at 0.05 level of significance. In other words, the null hypothesis was upheld. The result has shown that there is no significant difference between the mean response of male and female mathematics teachers on the roles of technology in combating climate change challenges that affect students' performance in mathematics.

Discussions

The way technology combat climate change challenges affecting students' performance in mathematics include use of technology to teach mathematics concepts, provision of forum for interactive mathematics learning among the teachers and students, promotion of individualized learning, fostering of programmed learning, sharing of mathematics information and ideas globally, provision of audio and video mathematics solution via the internet, exchange of mathematics ideas among students from different nationalities, planning of mathematics projects and events, creating avenue online mathematics examinations and facilitates mathematics group study as indicated in table 1. This has shown that technology has positively contributed to the ways teachers interact in the classroom, in this 21st century. With the use of technology in teaching, some of the concepts that teachers may not be able to elucidate within a short time, are made possible, because it has the capacity to simplify learning if properly and appropriately applied.

Provision of forum for interactive mathematics learning among the teachers and students as a result of technology usage collaborates with the result of Scharaldi (2020) which showed that integrating technology in the mathematics classroom allows students to interact with people outside of the classroom to broaden their understanding and perspectives. Similar finding was seen in the work of Scharaldi (2020) which showed that technology provides dynamic opportunities for instruction in mathematics and STEM classrooms. This finding supported the result of Ijeoma and Burke (2013) which showed that many students use social media especially Facebook, MySpace, and Twitter during academic classes for sharing and collecting feedbacks. The result of Jahnke (2012) showed that students

increasingly depend on Facebook and Twitter for updates on major global events, sharing and collecting feedback collaborates with the present finding. Findings of this study also conforms with the result of Sutherland, (2011) which showed that students use internet browser to access mathematical information, discussing mathematics homework and explore mathematical problems. The implication of this study is that with technology, mathematics teachers and students can interact and solve mathematics problems, share, send messages and updates in mathematics, post home works, assignments and announce upcoming events in mathematics from different locations without physical classroom and during the climate change.

Findings in table 2 showed that the technological tools use in combating climate change challenges affecting students' performance in mathematics are radio, computer, tablet, smart phone, television, video conferencing, notepad, e-book, projector and microphone. This study conforms to the result of Ifijeh, Iwu-James and Adebayo (2016) which showed that the use of technological tools such as computers, networks, software, internet, wireless, and mobile technologies facilitate teachers, students and administrators in educational programmes. This study is related to the result of Martin (2010) which showed that the widespread adoption of handheld computers, mobile phones, digital cameras, satellite navigation, embedded sensors and other interconnected devices mark the beginning of a shift towards being served by many thousands of computers. The implication of this study is that the use of technological tools such as radio, computer, tablet, smart phone, television, video conferencing, notepad, e-book, projector and microphone will enhance learning experiences in the teaching subjects especially mathematics during climate change challenges.

It is quite unfortunate that most mathematics teachers often use computer and smart phone but rarely use radio, television, video conferencing, notepad, e-book, projector and microphone in combating climate change challenges affecting students' performance in mathematics as indicate in table 3. This may be as a result of lack of the technological tools in the school and at home, ignorance of the usage of the technological tools and lack of fund to purchase those tools. Finding in table

4 shows that there is no significant difference between the mean response of male and female mathematics teachers on the roles of technology in combating climate change challenges that affect students' performance in mathematics. This implies that both male and female mathematics teachers have serious regard for the roles of technology in combating climate change challenges that affect students' performance in mathematics. As such, students, mathematics teachers, school administrators, parents and government should adhere strictly to the use of technology to ensure students' optimum performances in school mathematics even during climate change.

Conclusion

Climate change challenges in Nigeria calls for an urgent attention especially where it affects students' performance in mathematics. Based on the findings of this study, the use of technology has been highly appreciated by mathematics teachers because of the roles it plays in combating climate change challenges affecting students' performance in mathematics which include paving way for interactive mathematics learning, fostering individualized and programmed learning, sharing mathematics information and ideas globally, providing audio and video solutions of mathematics problems, creating avenue for online mathematics examinations and facilitates mathematics group study. Further findings revealed that most mathematics teachers often use computer and smart phone but rarely use radio, television, video conferencing, notepad, e-book, projector and microphone in combating climate change challenges affecting students' performance in mathematics. The implication of this study is that the use of technology should be encouraged and made available in the schools and at home.

Recommendations

Based on the findings of this study, the following recommendations are made

- Climate change concept should be embedded in the mathematics curriculum by the curriculum experts.
- Both mathematics teachers and students should be ICT compliant.
- Mathematics teachers and students should interact and solve mathematics problems by the use of technological tools such as radio,

computer, tablet, smart phone, television, video conferencing, notepad, e-book, projector and microphone.

- The use of technology should be encouraged in the schools and at home by the mathematics teachers, school authority and parents.
- Capacity building workshop/seminar and conferences should be organized for teachers and students on the use of technology by the government..
- Government should foster and implement all the policies initiated to combat climate change challenges.
- Government should make available and subsidize the price of technological tools so that the prices will be affordable for schools, mathematics teachers and students.

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