Eurasian Journal of Science and Environmental Education
2024, 4(1), 1-12
ISSN 2672-863X (Online)
https://www.ejsee.com/

Research Article

OPEN ACCESS

Predicting affective and cognitive learning outcomes: A quantitative analysis using climate change vectors

Usani Joseph Ofem [1]*, Esther Chidirem Nworgwugwu [1], Sylvia Victor Ovat [1], Pualina Mbua Anake [1], Nnyenkpa Ntui Anyin [1], Maryrose Ify Udeh [1], Roseline Anyiopi Undie [1]

[1] Alex Ekwueme Federal University, Ndufu-Alike, Ikwo, NIGERIA
[2] University of Calabar, Calabar, NIGERIA
***Corresponding Author:** ofemoracle@gmail.com

Citation: Ofem, U. J., Nworgwugwu, E. C., Ovat, S. V., Anake, P. M., Anyin, N. N., Udeh, M. I., & Undie, R. A. (2024). Predicting affective and cognitive learning outcomes: A quantitative analysis using climate change vectors. *Eurasian Journal of Science and Environmental Education*, 4(1), 1-12. https://doi.org/10.30935/ejsee/14405

ABSTRACT

Recent changes in the atmospheric conditions have exerted a lot of pressure on the surface of the earth causing attitudinal change, fear of survival as well as pattern of living. Schools are not out of these influences from the changes in climatic conditions. These study, therefore. examines the nexus between climate change vectors such as classroom temperature variation, persistent drought, severe flood occurrence on class attendance, class participation and academic performance among secondary school students. The study adopted an ex post facto research design, and a total of 1,881 were used for data collection. Two research instruments, the climate change variation scale and class attendance, class participation, and academic performance scale were used for data collection. The instrument was validated using factor analysis to assess the dimensionality of the items as well as obtain factors using component analysis and varimax rotation. To assess principal the mode fitness and acceptability, the confirmatory factor analysis (CFA) was carried out using the maximum likelihood estimation method, and the factor loadings from exploratory factor analysis and CFA were not too different. The collected data were analyzed using the simple and multilinear regression techniques. The results showed that relatively, persistent, severe flooding and classroom temperature variation contributes significantly to class participation, class attendance, and academic performance among students. Similarly, the variables; severe flood, drought and classroom temperature when compositely examined contributes to the variation in class attendance, class participation and academic performance among students. Implications and recommendations of the study were stated.

Keywords: severe flood, severe drought, classsroom temperature variation, learning outcome, structural equation model and confirmatory model

Received: 11 Nov. 2023 ◆ Accepted: 08 Feb. 2024

INTRODUCTION

The issues of academic performance, class attendance, and participation in classroom activities are always a matter of concern to educators, teachers, parents, and all those who are interested in the education of the child. The overall performance of the child is a function of the interaction of the cognitive, affective, and psychomotor abilities of the learner, according to Shi and Qu (2021). Hence, when the learner is not displaying competence cognitively, behaviorally, and skillfully, it becomes worrisome to the parents and those who are interested in the educational wellbeing of the learner. According to Alberto et al. (2021), the issue of how climatic factors have become an issue in the decision of the child to learn and acquire certain skills and competence needed for effective engagement in the affairs of society is not well understood.

Climate change is a global condition that is threatening many components of society. The effect of climate change on man's activities cannot be overlooked, as there is evidence to show that man has been regulated by the sudden devastating effect. In fact, there are variations in weather that tends to limit students participation in class, dropout from school, school absenteeism among others (Hyndman, 2017). Kumar (2021) lamented that the situation in the classroom today does not permit even the teacher to spend considerable time in the class due to high temperature leading to hot classrooms, flooding, distorting students, and teacher plans to be in school, draft that causes hunger, and a whole lot of other variations in society occasion by the emission of greenhouse gases. In early 2022, there were cases of flooding in the Niger Delta Region of Nigeria, where buildings were swallowed by floods, hoses collapsed, and gulf vehicles were packed along gullies. Wit (2011) reported in a memo on 'preparing for a change in climate that the activities of man and other natural disasters that have taken place in society have led to a rising level of carbon dioxide and other gases in the atmosphere, which has warmed the earth, which has caused a rise in sea level fires and droughts, as well as melting snow and ice, extreme storms and rainfalls, and floods. Thus, scientists have made several projections that as this trend continues, it will pose a significant effect on the way we live, the food we eat, the clothes we wear, our health status, the efficiency of agricultural lands, and other human activities that may pose a threat to our economy, educational, social, and quality of life. What has not been fully comprehended is the direct effect of these climate change vectors on the educational outcome of the learner in terms of class attendance, class participation, and academic performance in selected subjects, and it is against this backdrop that this study was carried out. The specific objectives of the study are, as follows:

1. Examine the relative contribution of classroom temperature variation, persistent drought, severe flood occurrence on class attendance, class participation and academic performance among secondary school students.
2. Examine the composite contribution of classroom temperature variation, persistent drought, severe flood occurrence on class attendance, class participation and academic performance among secondary school students.

LITERATURE REVIEW

The term climate change is often considered by scientists to encompass different variables like rainfall, increased temperature, flooding, drought, famine, humidity, wind, among others, and is known to be detrimental to human health (Kumar & Imam, 2013; Xu & Lamarque, 2018). These seasonal attributes of the climates either make the life of man comfortable or reduce the quality of wellbeing. However, these variations are not similar in all areas, according to their tropical definitions and zones. While some areas may be cold, others may be hot. Similarly, while some areas are experiencing steady and persistent rainfall, others are experiencing serious drought, but in all, there is a devastating effect of these variations on the activities of man (Sambo, 2010). Therefore, the climate change effect has existed for a long time, but its effect was more obvious in the 20th century. According to Davis (2009), it is evident now that given the accumulated activities of man and nature over time, especially from the industrial revolution till date, “the rising levels of GHG emissions caused an approximate 24.0% increase in the re-radiation of heat back towards the earth’s surface, which therefore increased global average temperatures by approximately 0.4 °C–a rate unparalleled in the last ten thousand years” (p. 121).

Studies on climate change and educational outcomes have focused on temperature, drought, famine, rainfall, and humidity, among others (Ma et al., 2020; Maione et al., 2016; Sun et al., 2019). Scholars have agreed that climate change dynamics have a serious effect on the learning outcomes of the students (Jamila et al., 2018; Phan, 2021). That is, where the environmental condition is not favorable, occasioned by a rise in classroom temperature, it may impede the learner’s mental state and functioning, thereby reducing their thinking ability,, lack of attention to details, and making them disinterested in what is happening round them. More so, students with acute illnesses like asthmatic conduction who may not survive dust and harsh winds may develop sickness and, if care is not taken, may die. In senior secondary education in Nigeria. For example, where academic activities are tedious and rigorous, involving plenty of subjects to read, assignments to carry out, and family chores to be performed by the learner, variations in the weather can affect their performance. Thus, Anderson (2011) and Hyndman (2017) asserted that the net effect of climatic change is expressed in the score of the learner in terms of academic performance as well as students’ disposition to school, school absenteeism, and relationships with others.

In a related study on seasonal weather variation and the academic performance of students by Dariya et al. (2021), The findings showed that seasonal weather variations affected the performance of 180 (58.3%) of the students, while only 41.7% were not affected. The review of literature will further be carried out according to the sub-variables of the study for proper comprehension of scholars’ views on the impact of these climate change agents on the educational system.

Studies on Persistence Drought

A body of consolidated research has noted that the changes in climate pose an extreme risk with the rise in global average warming (Coates et al., 2014; Kreft et al., 2014; Marengo, 2009). The researchers further noted that the variability in temperature occasioned by dangerous emissions from the ozone layer could amplify the shocks that will be experienced across the globe. Hallegatte et al. (2007) further observed that this shock can have both short-term and long-term effects on the educational outcome of the learner, especially in areas that are vulnerable to these harsh environmental conditions. For example, in areas that experience drought, the tendency for children to drop out of school is very high. Masih et al. (2014) noted that in countries in East Africa like Ethiopia, Kenya, and Somali, among others, most families are confronted with the challenges of feeding their children appropriately, not to mention getting finances that will facilitate the payment of their children’s school charges. In a similar report, Marengo (2009) noted that more than 21 million people in drought-prone areas in northern Nigeria are currently in a dilemma occasioned by increased mortality of their livestock, scarcity of water for farming, limited food supply, malnourishment, as well as parched lands. This situation has increased hunger, and children cannot study effectively on an empty stomach, and parents have no option but to sacrifice the education of their children for survival first.

Different scholars have identified that scarcity of water does not just affect the performance of the learner or engagement in school activities, but also affects the health of the learner (Deschênes & Moretti, 2009; Rocha & Soares, 2015; Zivin & Shrader, 2016; Zivin et al., 2018). It should be kept in mind that the learner needs to be healthy to be in the class, and research has shown that where there is drought, there is a high rate of cardiovascular stress, respiratory diseases, and cerebrovascular diseases (Deschênes & Moretti, 2009). The scarcity of water propels families to utilize water whenever they see it, and this in most cases leads to water-borne diseases that trigger sickness such as cholera, diarrhea, typhoid, and malaria, which, of course, have claimed so many lives for both parents and children. Therefore, if persistent drought cases increase, Souza et al. (2013) noted that it could reduce school attendance, participation in class, and cognitive task performance.

Evidence abounds from the literature that persistent drought negatively impacts the educational outcome of the learner (Danyelle & Gustavo, 2007; Blanton et al., 2010; Hayati et al., 2010; Hoddinott & Kinsey, 2001; Maccini & Yang, 2009). Studies on drought shock and school performance in Brazilian rural schools found that persistent drought increases hospitalization among learners. Similarly, that drought increases the probability of dropping out of school and poor academic performance among students. Ardyn and Christopher's (2020) study on the impact of a severe drought on education: more schooling but less learning found that drought increases children's shock, leading to a decrease in income and access to food. This inversely affects household decisions on resource allocation for schooling as well as exposing the child to stress and uncertainty. The researchers also reported that a severe drought affects the probability of students' advancement in school, a decline in academic performance in mathematics, low school attendance, and leadership attitude.

Gitau (2013) study found that drought negatively impacts the learning outcomes of students, as 33.0% of the students are often absent from school due to drought severity, 17.0% of students exhibit truancy, 21.0% drop out of school, and 17.0% of the students perform poorly in school due to the severity of droughts in Kenya. Similarly, Isaac's (2014) study also found that drought-related factors affect pupils' participation in school due to the reduced source of income of parents whose businesses depended heavily on water. Similarly, findings exist that drought-related matters affect the learners' tendencies to continue in school, perform maximally as anticipated, participate in school activities, and develop the right skills, especially in developing countries, where agriculture is the mainstay of their economies (Amogne & Tessema, 2017; Doherty & Clayton, 2011; Nkeiruka, 2014).

However, Jensen (2000) noted that there is no direct relationship between drought and the academic outcome of the learner. That drought as a variable is mediated by many other factors, such as self-discipline and academic optimism, among others. When these psychological factors are put in place, these occurrences may not have the same effect as often reported. It is therefore necessary to find out the contribution of this variable to school outcomes in terms of class attendance, participation, and academic performance.

Studies on Severe Flood

Flooding is one of the direct effects that is experienced in Cross River State as one of the aftermaths of climate change, resulting in severe rainfall over time. Students that are living in food-related areas are vulnerable to social, psychological, and educational losses (Mudavanhu, 2014; Kumar & Raghav, 2018; Vranda & Sekar, 2011). The damages caused by floods over the country, especially within this period when there are climate changes, have affected the normal lives of the people even after the flood may have taken place. Floods have the tendency to bring down schools, limit the chances of school attendance, provoke psychological fear, destroy lives and properties, cause disruption in children's learning in school, and cause other problems like loss of contact hours, suspension of school activities, students loss of interest in school, and high rates of absenteeism that may interrupt the delivery of educational services as well as limit the quality of education that students receive (Chaudhary & Tamsini, 2017; Mudavanhu, 2014; Abbasi & Shaukat, 2013). The effect of flooding in most cases is that too much rainfall destroys aquatic life, limits the income of those who hold tenaciously to agriculture, causes water pollution, and increases the rate of waterborne diseases like cholera, diarrhea, and many other communicable diseases (Daimary, 2022).

Over time, scholars have carried out studies on the direct and indirect effects of flooding on the learning outcomes of learners. Phuloma (2020) study looked at how floods affected students during the COVID-19 pandemic. The findings of the study revealed that flooding brings problems such as ill health and psychological imbalances as a result of damaged homes, leading to the inability of parents to provide the basic needs of the students, such as food, shelter, and security, among others. Mudavanhu (2015) and Gibbs et al. (2019) collaborated on the findings that when disasters like floods take place, they affect students, especially secondary school students, whose consumption is largely autonomous. disrupts their ability to go to school as well as their performance in school. Other researchers have stated that flooding has a potential effect on the ability of the learner to be comfortable in the environment given the fact that most of the areas are often left with traces of dirt in the school environment, dropouts from school in some areas, absenteeism from schools, closure of schools for a while, destruction of important libraries in schools, death of some teachers and students in schools that may be badly affected by the flood, damage to school roads, and increased cost of returning to school when houses are covered and hose properties destroyed (Cadag et al., 2017; Kundzewicz et al., 2014; Lumbroso, 2020;).

Studies on Classroom Temperature Variation

Classrooms are expected to be ventilated, cool, and provide comfort to the learners. That is, there are supposed to be thermal comforts in the classroom to aid teaching and learning. Thermal comforts, according to the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE, 2017), are the 'condition of mind that expresses satisfaction with the thermal environment'. It is the most important indoor quality that permits students the opportunity to stay calm, induce concentration, and pay attention to details in the class (Munonye & Ji, 2017).

Researchers over the years have been concerned with the effect of temperature variations on students' performance in schools (Munonye, 2020). It has been stated that exposure to high temperatures in class increases respiratory and cardiovascular issues that lead to hospitalization and even death (Anderson et al., 2013). Most students do not find it easy to remain in the class, nor does the teacher spend the required number of minutes explaining the content of the unit of instruction to the learners. In fact, Jiang (2018) noted that the indoor attributes of the class in terms of thermal comfort are vital for the students health, attention to details and content assimilation, and, inversely, academic performance. Therefore, it may be necessary that the use of artificial air conditioning may help to cushion the effect of high temperatures occasioned by a continuous global increase in the surface temperature.

Elbayoumi et al.'s (2015) study was on the assessment of ventilation and thermal comfort of NV classrooms in the Gaza Strip climate. The findings of the study revealed that there was a seasonal variation in the perceived indoor environment that influences the thermal comforts of the occupants. Similarly, in a study of human responses to the seasonal variations of the indoor thermal environment in China by Liu et al. (2017), thermal comforts differ as monitored in schools due to seasonal variations. In America, Haverinen-Shaughnessy and Shaughnessy (2015) studied classroom ventilation and temperature on test scores among students. The result showed that a significant correlation exists between the rate of ventilation and the score in mathematics and that when outliers in six classrooms were filtered to improve the ventilation rate, the performance was higher. Mendell and Heath (2005), Satish et al. (2012), and Sundell (2011) reported that when the ventilation in the class is low, especially in regions, where there is a high temperature, the students are exposed to indoor pollutants, which may affect the respiratory systems of the learners as well as lead to complicated health challenges that will affect their academic activities. Similarly, in America, most studies have reported that the average ventilation rate recommended by the American Society of Heating, Refrigerating, and Air Conditioning, which is 7.1 1/s, often leads to maximum class achievement (ANSI/ASHRAE, 2004).

But Ivan et al. (2021) further posited that although many studies have shown that environmental factors affect classroom performance, what is not clearly understood is how variations in temperature impact students decisions to study and perform as anticipated. While most studies have been carried out using these variables, extensive studies have not been made in Nigeria, where there are thermal variations across zones, to find out whether these climate changes have any impact on the learning outcomes of students in Nigeria. It is not to the knowledge of the researchers if studies exist in Nigeria that have looked at climate change dynamics and learning outcomes among students. Otherwise, this might be the first study conducted in Nigeria that attempts to model a correlation between climate change factors and class attendance, class participation, and academic performance.

Current Study

The studies that have been examined sparingly look at climate change and other factors of the learner that are not cognitively oriented. Previous studies have focused on effects of severe flooding, classroom temperature, and persistent drought on academic performance. Few or no studies have looked at the effect of these environmental vectors on multiple outcomes of the school activities of the learner. More so, theoretical positions have mainly been used to explain the impact of climate change vectors, as identified here, on academic outputs. Similarly, studies that have been carried out have utilized instruments whose degree of validity is hard to ascertain. The researchers do not intend to discredit existing instruments or studies but rather dedicate time to developing instruments that will be used to measure these climate change factors and utilize them in order to provide empirical evidence on the effect of these factors on learners' activities and outcomes in school for policymaking and critical decision-making in the educational sector. The study is germane in that empirical evidence will be provided to help policymakers make crucial decisions that will facilitate management of climate change that is inevitable in these areas.

METHODOLOGY

The study was quantitatively inclined with an ex post facto research design. It was conducted in the South Geopolitical Zone in Nigeria with six states (Akwa Ibom, Bayelsa, Cross River State, Delta, Edo State, and Rivers State). The area is a coastal zone that is prone to environmental changes occasioned by tremendous flooding, drought, and temperature variation due to its closeness to coastal regions, exploration of oil, activities of deforestation, and being vulnerable to harsh climate scenarios. The study population is 18,562 students in senior secondary schools in the study area. The sampling technique used was stratified and cluster sampling to select a total of 1,881 students for the study. The descriptive statistics of the respondents are presented in **Table 1**.

Table 1. Demographic characteristics of population

Variables	Sub-category	Frequency (n)	Percentage (%)
State	Cross River State	211	11.22
	Akwa Ibom State	312	15.59
	Bayelsa State	344	18.29
	Rivers State	402	21.27
	Delta State	291	15.47
	Edo State	321	7.06
Total		1,881	100
Gender	Male	982	52.21
	Female	899	47.79
Total		1,881	100
Age	Below 12 years	656	34.87
	13-20 years	773	41.10
	Above 20 years	452	24.03
Total		1,881	100
Location	Urban	801	42.58
	Rural	1,080	57.42
Total		1,881	100

Instrumentation

The instrument used for this study was a questionnaire titled climate change variation scale (CCVS) and class attendance, class participation, and academic performance scale (CACPAPS). CCVS was made up of 18 items, with each sub-variable having six items used in measuring it. For example, persistent drought, which occurs because of a shortage of water because of a lack of rainfall, was measured with six terms (n=6). Sample items include: "I have not seen rain for the past 1 month"; "my community depends on only tap water"; "most times, my community lacks good water to drink"; "there is no problem with water in the community"; and "grass has been grassing faster due to enough rainfall" among others. A severe flood, which is the opposite of a drought, is measured with six items (n=6). Sample items include: "Students have stopped going to school because of excessive water in the community"; "most of the school buildings have been taken by water"; "students do not have access to school as the roads are blocked with water"; and "teachers and students are afraid of going to school because of the damages caused by water in the school promises" among others. Similarly, for classroom temperature, which measured the degree of hotness or coldness found in the class at every time, it was measured with six items (n=6). Sample items include: "Most teachers do not stay in the class for long because of the heat they experience"; "students do not feel comfortable while receiving instruction in class"; "most times, our classes are so hot that everybody loses concentration in class"; "sometimes, students stay outside the class to learn"; and "our classes do not have enough ventilation during school hours" among others. The items were structured on a five-point Likert response option of very strongly agree (VSA), strongly agree (SA), agree (A), strongly disagree (SD), and very strongly disagree (VSD).

CACPAPS was measured using 12 items. Scale is made up of class participation, class attendance, and academic performance. Class participation, which is the ability of the learner to interact, answer, and ask questions in the class, was measured using six items (n=6). Sample items include: "I ensure that I take part in group activities in the class"; "I ask questions, where I do not understand"; "I do not allow myself to stay distracted from what is done in the class by my teacher"; and "sometimes I ensure that I answer questions asked by the teachers, among others". Class attendance, which is measured by the frequency of students coming to school and staying in the class to learn, is measured with six items (n=6). Sample items include: "I am always present in class"; "I hardly stay away from school", "I only attend class when I like"; and "sometimes, I prefer to stay at home than going to school" among others. Items were structured on a five-point Likert response option of VSA, SA, A, SD, and VSD. Students' academic performance was measured using average performance of students on core subjects offered by students as obtained from the data base of each state ministry of education in the six states that constitute the regions.

Validation

The validation of the instrument was done by six experts from three professional areas at universities. The researchers selected professors of standing repute who are knowledgeable in climate change dynamics and the outcome of students' progress in school. Thus, two experts were selected from curriculum and instruction. Two from environmental sciences, and two from measurement and evaluation. Each of the experts was to assess the items in the instrument and determine its value in terms of relevance, clarity, and representativeness with a scoring guide. The scores of the assessors were used to determine the item content validity index (I-CVI) and the scale content validity index (S-CVI) as recommended by different scholars (see Yusoff, 2019; Zamanzadeh et al., 2015). For CCVS, I-CVI for persistent drought ranged from 0.79 to 0.88; for severe flood occurrence, it ranged from 0.77 to 0.89; and for classroom temperature, it ranged from 0.90 to 0.92. Similarly, S-CVI ranged from 0.90 to 0.97. The average proportion of items considered relevant for the three scales is 0.90. This implies that, on aggregate, 90.0% of the validators considered that the items in CCVS were relevant, clear, and representative for the study. This range of values obtained was sufficient to establish content validity for both instruments (see Lynn, 1986; Yusoff, 2019). The approach was adopted for CACPAPS. I-CVIs for class attendance ranged from 0.80 to 0.89, and I-CVI for class participation ranged from 0.80 to 0.94. S-CVI for SCAQ ranged from 0.88-0.94. The average proportion of items considered relevant for the two scales is 0.89. This implies that, on aggregate, 89.0% of the validators considered that the items in CACPAPS were relevant, clear, and representative for the study.

A pilot study was further carried out to determine the reliability and construct validity of the two scales, CCVS and CPCAAPS. The instrument was made up of 30 items, measuring both constructs. Exploratory factor analysis (EFA) was carried out using 400 students who were not part of the main study from secondary schools that were not participating in the study. The copies were distributed, coded, and analyzed for dimensionality checks. The analysis of EFA was done using the principal axis factor with ProMax as the rotation option, and all factors that were less than 0.50 were suppressed. The extraction criteria were that the eigenvalue was greater than one. SPSS and Jamovi were used for the analysis to ascertain the factors and the internal consistencies of the scales using Cronbach's alpha, omega, and composite reliability techniques. The outcome of the results is presented in the subsections in the preceding sections.

Procedure for Data Collection

The data was collected by the researchers from various schools that were used for the study. The goals and benefits of the study were explained to the students in detail. The students were also promised that the data provided would be used only for academic purposes and that the results would be published in reputable journals. Thus, measures for privacy and confidentiality of the data provided by the respondents will be guaranteed. This was to enable the students to understand the purpose of the instruments administered and provide their consent for participation in the study. The students who were willing to participate in the study gave their consent. This is in line with best global research practices and adherence to ethical principles of research. Only 143 students refused to give consent to the study, and they were not in any way required to participate in the study. The questionnaires were administered to 1,738 students, and all instruments administered in various classes were successfully retrieved.

RESULTS

Exploratory Factor Analysis

The results of EFA for CCVS produced a KMO value of.850 with Bartlett's test of sphericity, $\chi^2(153)=22{,}152.484$, $p<.001$. These values showed that the sample size was adequate for EFA to be carried out. This is an indication that CCVS is a multidimensional construct with different sub-variables. For CPCAAPS, the result of EFA produced a KMO value of .818 with a significant Bartlett's test of sphericity: $\chi^2(66)=4{,}119.140$, $p<.01$. A total of two factors were extracted after preliminary screening of factors that cross-loaded with multiple factors; factors with single loading were deleted from the data set. Two items were deleted from data set due to cross and factor loading less than 0.50. Cumulatively, CCVS accounted for 74.7% of total variance, and CACPAPS accounted for 56.0% of total variance. A summary of factors and their item loadings is shown in **Table 2** and **Table 3**.

Table 2. EFA of CCVS

Factors	Items	M	SD	EFA	CFA
Persistent drought (α=.780)	Item 1	2.7957	.85792	.768	.762
	Item 2	2.5748	.75448	.765	.774
	Item 3	2.6145	.81991	.775	.774
	Item 4	2.6870	.85632	.859	.840
	Item 5	2.7578	.84185	.940	.935
	Item 6	2.6007	.79393	.705	.737
Severe flood occurrence (α=.767)	Item 1	3.2468	.66455	.529	.508
	Item 2	3.2181	.70296	.865	.852
	Item 3	3.1548	.74395	.834	.807
	Item 4	3.2474	.73077	.933	.946
	Item 5	3.1542	.73277	.821	.848
	Item 6	3.2221	.79153	.740	.738
Classroom temperature (α=.871)	Item 1	2.9931	.58178	.689	.685
	Item 2	3.1128	.44366	.733	.748
	Item 3	3.0455	.55519	.811	.807
	Item 4	2.8861	.68517	.756	.735
	Item 5	3.0386	.68137	.581	.598
	Item 6	3.1415	.64346	.682	.667

Note. M: Mean; SD: Standard deviation; $\chi^2(153)=22{,}152.484$; $p<.001$; KMO=.850; & Total variance explained=74.7%

Table 3. EFA of school outcome scale

Factors	Items	M	SD	EFA	CFA
Class attendance (α=.819)	Item 2	2.5224	.70267	.703	.726
	Item 3	2.6536	.80923	.731	.762
	Item 4	2.3510	.55958	.638	.519
	Item 6	2.4994	.73896	.696	.639
Class participation (α=.774)	Item 1	2.4609	.56873	.590	.602
	Item 2	2.9994	.61220	.710	.810
	Item 3	3.3970	.60323	.768	.829
	Item 4	2.8383	.69936	.676	.628
	Item 5	2.6214	.70645	.421	.499
	Item 6	3.0667	.74738	.701	.703

Note. M: Mean; SD: Standard deviation; $\chi^2(66)=4{,}119.140$; $p<.01$; KMO=.818; & Total variance explained=56.0%

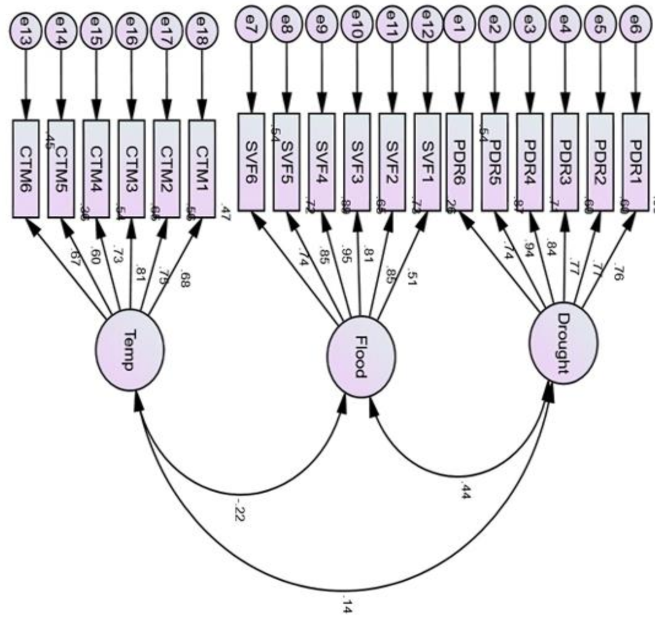

Figure 1. EFA (Source: Field work, 2023)

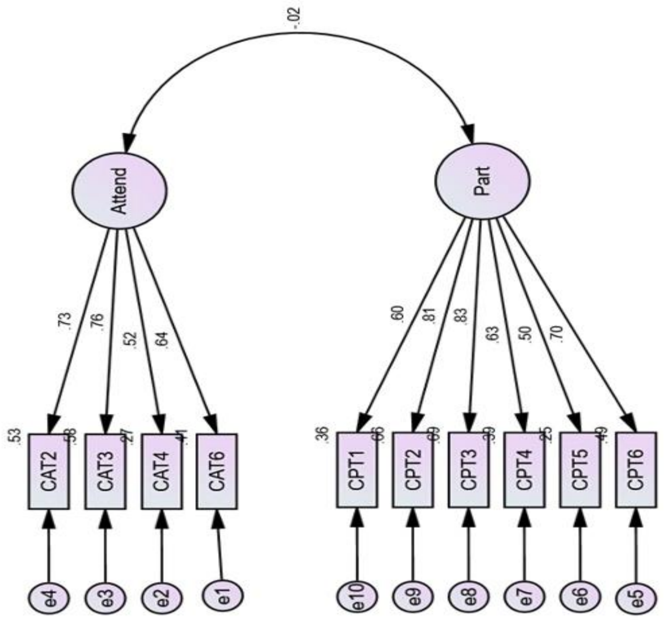

Figure 2. CFA (Source: Field work, 2023)

Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) was carried out using the maximum likelihood estimation statistics. As could be seen in **Table 2**, and **Table 3**, **Figure 1**, and **Figure 2**, there were not many disparities between the factor's loadings of items in EFA and those that are found in CFA. This indicates that the dimensionalities obtained and the factor loadings from EFA are valid measures of the constructs, and the instrument is psychometrically sound. The fit indices of CFA were examined. Each of the fit indices has its strengths and weaknesses. Therefore, it is not advisable that only one fit index be reported. According to Kline (2016), four fit indices such as Chi-square (χ^2), root mean square error of approximation (RMSEA), comparative fit index (CFI), and SRMR can be appropriate to decide whether to accept a CFA model. However, RMSEA is the best measure and is often used as a condition for accepting the model. The result presented in **Table 4** showed that the indices are within the range of values that are used in determining the acceptability of the model.

Research Question One

What is the relative contribution of persistent drought, severe flooding, and classroom temperature to class attendance, class participation, and academic performance among secondary school students?

Table 4. Goodness of fit test of two CFA model

S/N	Fit indices	Threshold	CCVS	CACPAPS
1	χ^2	p>.05	.005	.005
2	AGFI	p≥.90	.900	.954
3	NFI	p≥.90	.918	.923
4	CFI	p≥.90	.923	.907
5	GFI	p≥.90	.911	.955
6	TLI	p≥.90	.909	.990
7	IFI	p≥.90	.954	.912
8	RMSEA	p≥.08	.070	.060

The result of the analysis in **Table 5** showed that variation in class attendance can be explained using the 35.4% contribution of persistent drought (Adj R^2=.354, F=954.345, and p=.000). Thus, there are other variables outside this model that contribute 64.6% to the total variance. The result for persistent drought and class participation showed that Adj R^2=.041, F=75.261*, and p=.000, which implies that the variation in class participation could be explained by the 4.1% contribution of persistent drought. Thus, other variables account for 95.9% of the variance that is not included in the model. For persistent drought and academic performance, the result showed that Adj R^2=.660, F=3378.735*, and p=.000, which implies that the variation in class participation could be explained by the 66.0% contribution of persistent drought.

Table 5. Simple linear regression analysis of contribution of persistent flood on class attendance, class participation,& academic performance

Dependent variable	Source of variation	SS	df	MS	F-cal	Significance	Other parameters
Class attendance	Regression	5,026.073	1	5,026.073	954.340*	.000	R=.596[a], R^2=.355, Adj R^2=.354, SD=2.29489, β=.596, & t=30.892
	Residual	9,142.671	1,736	5.267			
	Total	14,168.74	1,737				
Class participation	Regression	575.509	1	575.509	75.261*	.000	R=.204[a], R^2=.042, Adj R^2=.041, SD=2.76530, β=.204, & t=-8.675
	Residual	13,274.98	1,736	7.647			
	Total	13,850.49	1,737				
Academic performance	Regression	14,783.93	1	14,783.93	3378.700*	.000	R=.813[a], R^2=.661, Adj R^2=.660, SD=2.09179, β=.813, & t=58.127
	Residual	7,596.015	1,736	4.376			
	Total	22,379.95	1,737				

Note.*Significant at .05 level; SS: Sum of squares; df: Degrees of freedom; MS: Mean square; & SD: Standard deviation

Table 6. Simple linear regression analysis of contribution of severe flood on class attendance, class participation, & academic performance

Dependent variable	Source of variation	SS	df	MS	F-cal	Significance	Other parameters
Class attendance	Regression	285.227	1	285.227	35.665*	.000[b]	R=.142[a], R^2=.020, Adj R^2=.020, SD=2.82797, β=.596, & t=30.892
	Residual	13,883.517	1,736	7.997			
	Total	14,168.744	1,737				
Class participation	Regression	288.609	1	288.609	36.944*	.000[b]	R=.144[a], R^2=.021, Adj R^2=.021, SD=2.79502, β=.144, & t= -6.078
	Residual	13,561.886	1,736	7.812			
	Total	13,850.495	1,737				
Academic performance	Regression	13,906.774	1	13,906.774	2,849.240*	.000[b]	R=.788[a], R^2=.661, Adj R^2=.661, SD=2.20927, β=.788, & t=53.378
	Residual	8,473.180	1,736	4.881			
	Total	22,379.954	1,737				

Note.*Significant at .05 level; SS: Sum of squares; df: Degrees of freedom; MS: Mean square; & SD: Standard deviation

Table 7. Simple linear regression analysis of contribution of classroom temperature variation on class attendance, class participation, & academic performance

Dependent variable	Source of variation	SS	df	MS	F-cal	Significance	Other parameters
Class attendance	Regression	294.079	1	294.079	36.795*	.000[b]	R=.144[a], R^2=.049, Adj. R^2=.049, SD=2.82707, β=.144, & t=6.066
	Residual	13,874.665	1,736	7.992			
	Total	14,168.744	1,737				
Class participation	Regression	679.513	1	679.513	89.563*	.000[b]	R=.221[a], R^2=.021, Adj R^2=.021, SD=2.75445, β=.221, & t= -9.464
	Residual	13,170.982	1,736	7.587			
	Total	13,850.495	1,737				
Academic performance	Regression	3,441.178	1	3441.178	315.431*	.000[b]	R=.392[a] R^2=.154, Adj R^2=.153, SD=3.30294, β=.392, & t=17.760
	Residual	18,938.776	1,736	10.909			
	Total	22,379.954	1,737				

Note.*Significant at .05 level; SS: Sum of squares; df: Degrees of freedom; MS: Mean square; & SD: Standard deviation

Thus, other variables account for 34.0% of the variance that is not included in the model. A cursory look at the analysis of variance (ANOVA) values p=.000 is less than p=.05 for the three-criterion variable and persistent flood. This implies that persistent drought contributes significantly to class participation, class attendance, and academic performance among students.

The result of the analysis in **Table 6** showed that variation in class attendance can be explained using the 2.0% contribution of severe flooding (Adj R^2=.020, F=35.665, and p=.000). Thus, there are other variables outside this model that contribute 98.0% to total variance. The result for severe flood and class participation showed that Adj R^2=.021, F=36.944*, and p=.000, which implies that the variation in class participation could be explained by the 2.1% contribution of severe flood. Thus, other variables account for 97.9% of the variance that is not included in the model. For severe flood and academic performance, the result showed that Adj R^2=.661, F=2849.244*, and p=.000, which implies that the variation in class participation could be explained by the 66.1% contribution of severe flood. Thus, other variables account for 33.9% that are not included in the model. A cursory look at ANOVA values p=.000 is less than p=.05 for the three-criterion variable and severe flood. This implies that severe flooding contributes significantly to class participation, class attendance, and academic performance among students.

The result of the analysis in **Table 7** showed that variation in class attendance can be explained using the 4.9% contribution of classroom temperature variation (Adj R^2=.049, F=36.795, and p=.000). Thus, there are other variables outside this model that contribute 95.3% to the total variance. The result for classroom temperature variation and class participation showed that Adj R^2=.021, F=89.563*, and p=.000, which implies that the variation in class participation could be explained by the 2.1% contribution of classroom temperature variation. Thus, other variables account for 97.9% of the variance that is not included in the model. For severe flood and academic performance, the result showed that Adj R^2=.153, F=315.431*, and p=.000, which implies that the variation in class participation could be explained by the 15.3% contribution of classroom temperature variation. Thus, other variables account for 84.7% that are not included in the model. A cursory look at ANOVA values p=.000 is less than p=.05 for the three-criterion variable and classroom temperature variation. This implies that classroom temperature variation contributes significantly to class participation, class attendance, and academic performance among students.

The result for question two as presented in **Table 8** showed that the composite effect of the explanatory variables on class attendance (Adj R^2=.641, F=402.864, and p=.000). This implies that the total variance in the class attendance could be explained by 64.1% of the combined contribution of persistent drought, severe flood and classroom temperature. Similarly, since p=.000 is less than p=.05, this implies that the variables combine contributes to the variation in class attendance. A cursory looks at **Table 8** still revealed that persistent drought is the strongest contributor to class attendance (β=.741 and p<.05), followed by severe flood (β=-.275 and p<.05) and classroom temperature (β=.061 and p<.01).

Similarly, the result in **Table 9** showed the composite effect of the explanatory variables on class participation (Adj R^2=.079, F=50.909, and p=.000). This implies that the total variance in class participation could be explained by 7.9% of the combined contribution of persistent drought, severe flooding, and classroom temperature. Similarly, since p=.000 is less than p=.05, this implies that the variables combined contribute to the variation in class participation. Even though the total variance is small, a cursory look at **Table 9** still revealed that classroom temperature is the strongest contributor to class participation (β=-.197 and p<.05), followed by persistent drought (β=-.151 and p<.05), and severe flood occurrence (β=-.046 and p>.01).

Table 8. Multiple linear regression analysis of joint contribution of persistent drought, severe flood occurrence, & classroom temperature variation on class attendance

Source of variation	**SS**	**df**	**MS**	**F-cal**	**Significance**	**Other parameters**
Regression	5,819.438	3	1939.813	402.864	.000[b]	R=.641[a], R^2=.441, Adj R^2=.440, SE=2.19432
Residual	8,349.306	1734	4.815			
Total	14,168.744	1737				
Model	**B**	**SE**	**Beta**	**t**	**Sig**	
(Constant)	9.260	.402		23.032*	.000	
Persistent drought	.512	.015	.741	33.115*	.000	
Severe flood	-.165	.013	-.275	-12.401*	.000	
Classroom temperature	.063	.019	.061	3.252*	.001	

Note.*Significant at .05 level; SS: Sum of squares; df: Degrees of freedom; MS: Mean square; & SE: Standard error

Table 9. Multiple linear regression analysis of joint contribution of persistent drought, severe flood occurrence, & classroom temperature variation on class participation

Source of variation	**SS**	**df**	**MS**	**F-cal**	**Significance**	**Other parameters**
Regression	1,121.167	3	373.722	50.909	.000[b]	R=.285[a], R^2=.081, Adj R^2=.079, SE=2.70943
Residual	12,729.328	1,734	7.341			
Total	13,850.495	1,737				
Model	**B**	**SE**	**Beta**	**t**	**Sig**	
(Constant)	20.350	.496		41.002	.000	
Persistent drought	-.103	.019	-.151	-5.396	.000	
Severe flood	-.027	.016	-.046	-1.650	.099	
Classroom temperature	-.204	.024	-.197	-8.470	.000	

Note.*Significant at .05 level; SS: Sum of squares; df: Degrees of freedom; MS: Mean square; & SE: Standard error

Table 10. Multiple linear regression analysis of joint contribution of persistent drought, severe flood occurrence, & classroom temperature variation on academic performance

Source of variation	**SS**	**df**	**MS**	**F-cal**	**Significance**	**Other parameters**
Regression	20,224.087	3	6,741.362	5,422.19*	.000[b]	R=.951[a], R^2=.904, Adj R^2=.904, SE=1.11503
Residual	2,155.867	1,734	1.243			
Total	22,379.954	1,737				
Model	**B**	**SE**	**Beta**	**t**	**Sig**	
(Constant)	6.431	.204		31.477	.000	
Persistent drought	.435	.008	.501	55.371	.000	
Severe flood	.367	.007	.488	54.369	.000	
Classroom temperature	.376	.010	.286	37.947	.000	

Note.*Significant at .05 level; SS: Sum of squares; df: Degrees of freedom; MS: Mean square; & SE: Standard error

The result in **Table 10** showed the composite effect of the explanatory variables on academic performance (Adj R^2=.904, F=5422.19, and p=.000). This implies that the total variance in academic performance could be explained by 7.9% of the combined contribution of persistent drought, severe flooding, and classroom temperature. Similarly, since p=.000 is less than p=.05, this implies that the variables combined contribute to the variation in academic performance.

Even though the total variance is small, a cursory look at **Table 10** still revealed that persistent drought is the strongest contributor to class participation (β=.501 and p<.05), followed by severe flood occurrence (β=.488 and p<.05) and classroom temperature (β=.286 and p<01).

DISCUSSION

The first research question result showed that persistent floods, severe flood occurrences, and classroom temperature relatively contribute to students' class attendance, participation, and academic performance. The explanation of the persistent drought on class participation, attendance, and academic performance could be that where their phenomenon exists, the tendency of the means of livelihood that most rural people depend on for survival is often destroyed, and most students are withdrawn from school, which affects their attendance at class. Those who manage to attend may not do well or participate in the classroom activities due to hunger or other ailments that they may have been susceptible to due to bad water or environmental opportunistic disease. In most cases, parents withdraw their pupils and students from school because of the means of catering for school needs that are no longer available. The findings of the study align with previous findings (ANSI/ASHRAE, 2004; Ivan et al., 2021).

Similarly, the result of a severe flood on class attendance, participation, and academic performance could be explained further by stating that where floods occur, as found in these study areas, most school buildings are often destroyed, leaving the students out of school. In most cases, like what was experienced in Bayelsa because of the Cameroun Dam that was open last year, the students could not access their schools as well as their homes. They were taken to internally displaced camps, where access to school was practically impossible as the tendency to even participate in schools for those who were not deeply affected by the flood was low. In most cases, students in these flood-prone areas are susceptible to different kinds of diseases that may affect them, thereby limiting their chances of active participation in class and, inversely, academic performance. The findings of the study were also in line with other studies that have previously established that severe flooding affects the academic outcome of the learner (Kumar & Raghav, 2018; Mudavanhu, 2014). The findings that classroom temperature contributes to class participation, class attendance, and academic performance could be explained by stating that the classroom condition is a key determinant of what both the teacher and students do in the class. Where the classroom temperature is too high, it could make the teacher and students feel uncomfortable, which will impede academic activities that may affect the learner and teaching process. Most students will be more focused on trying to absorb the heat in the class by fanning themselves, as well as the teacher, who may not want to spend enough time in the class. Most teachers do not even come to school when they become allergic to the cold, which affects their class attendance. In most cases, teachers give notes to students to copy while they may not explain in detail for the students to comprehend. When this happens, there is every likelihood that the students' academic scores will be greatly affected. The findings of the study align with previous findings (Elbayoumi et al., 2015; Liu et al., 2017).

Research question two, which sought to investigate the composite contribution of persistent drought, severe flood, and classroom temperature, showed that all the explanatory variables combined have a significant contribution to each of the criterion variables, such as class attendance, class participation, and academic performance. The explanation for this result could be due to the fact that man's activities are to a great extent influenced by his physical environment. Where there is a severe flood, the tendency for students to go to school and attend classes will be obstructed, as major roads may be blocked as well as classes. More so, the health of the learner and that of the teacher are of the utmost importance. Excessive coldness or hotness in the classroom has the potential to stimulate sickness in the learner, especially for those who are diagnosed with illnesses that may cause them to withdraw from school or lose concentration in the class when the environment is not favorable. These conditions tend to affect the participation of the learner. The findings of the study align with previous findings (Ma et al., 2020; Maione et al., 2016; Sun et al., 2019).

Limitation & Further Research Implication

The study, like any other research study, has some limitations. First, climate change is an environmental factor that affects almost everybody. However, the study was limited to only six states, specifically areas that are often affected by floods, persistent droughts, and hot or cold temperatures, which can also affect students in other areas. Therefore, the utilization of this population may limit the generalization of these findings to a wider scope outside the scope of this study. This does not mean that the study is useless. The study has been able to provide a validated instrument that can be used by other researchers to carry out similar studies. More so, the study is in Nigeria and a geopolitical zone; other zones can replicate these studies, especially in northern Nigeria, where drought, famine, and excessive high temperature variations are common.

CONCLUSIONS

The study examined the relative and composite contributions of the climate change vector to students' class attendance, participation, and academic performance in secondary schools. The findings of the study were germane in that the contribution of drought persistence, severe flooding, and classroom temperature were significant, and the variables combined showed a significant contribution in explaining the total variance in students' attendance, participation in school activities, and academic outcomes in schools. It is imperative that curriculum planners, environmental scientists, and school administrators consider the current variation in the atmospheric condition of the area and develop measures that will combat issues of flooding and variable class temperature. School buildings should not be located, where students and teachers will not be ventilated, thereby distracting the attention of students in class, among others. Similarly, the study will help policymakers ensure that dams are built in strategic areas that facilitate the control of floods capable of destroying school buildings and hindering students from attending school.

Author contributions: All authors were involved in concept, design, collection of data, interpretation, writing, and critically revising the article. All authors approve final version of the article.

Funding: The authors received no financial support for the research and/or authorship of this article.

Ethics declaration: The authors declared that survey research in the behavioral or social sciences that is not experimental incline do not pose a significant threat or risk to the participants; thus, ethical clearance was waived according to the Nigeria Code for Health Research Ethics (https://bit.ly/3pK9ORh). However, in line with best practices, the ethical approval for the survey since it involves human responses was obtained from Directorate of Research and Quality Assurance, University of Calabar, Nigeria (DIR/INST/CAL/004/0675).

Declaration of interest: Authors declare no competing interest.

Data availability: Data generated or analyzed during this study are available from the authors on request.

REFERENCES

Abbasi, S. S., & Shaukat, B. (2013). The effects of 2010 flood on educational institutions and children schooling in Khyber Pukhtoonkhwa: A study of Charsadda and Swat Districts. *International Journal of Environment, Ecology, Family and Urban Studies, 3*(3), 1-12.

Alberto, A., Yang, J., & Xiaohan, Z. (2021). Too hot or too cold to study? The effect of temperature on student time allocation. *Economics of Education Review, 84*, 102152. https://doi.org/10.1016/j.econedurev.2021.102152

Amogne, A., & Tessema, W. (2017) Effect of El Niño induced drought on students' academic performance: a case study in Borena woreda of South Wollo Zone, Ethiopia. *International Journal of Academic Research in Education and Review. 5*(2), 37-47. http://doi.10.14662/IJARER2017.007

Anderson, A. (2011). *Education must play a part in combating climate change*. Brookings Institute Publishing.

Anderson, G. B., Dominici, F., Wang, Y., McCormack, M. C., Bell, M. L., & Peng, R. D. (2013). Heat-related emergency hospitalizations for respiratory diseases in the medicare population. *American Journal of Respiratory and Critical Care Medicine, 187*, 1098-1103. https://doi.org/10.1164/rccm.201211-1969OC

ANSI/ASHRAE. (2004). *Ventilation for acceptable indoor air quality*. American Society of Heating, Refrigerating and Air-Conditioning Engineers.

Ardyn, N., & Christopher, C. (2020). Impact of a severe drought on education: More schooling but less learning. *SSRN*. https://doi.org/10.2139/ssrn.3601834

ASHRAE. (2017). Standard 55-2017. Thermal environmental conditions for human occupancy. *ASHRAE*. https://www.ashrae.org/technical-resources/bookstore/standard-55-thermal-environmental-conditions-for-human-occupancy

Blanton, E., Ombeki, S., Oluoch, G., Mwaki, A., Wannemuehler, K., & Quick, R. (2010). Evaluation of the role of school children in the promotion of pointof-use water treatment and handwashing in schools and households–Nyanza Province, Western Kenya. *American Journal of Tropical Medicine and Hygiene, 82*, 664-671. https://doi.org/10.4269/ajtmh.2010.09-0422

Cadag, J. R. D., Petal, M., Luna, E., Gaillard, J. C., Pambid, L., & Santos, V. (2017). Hidden disasters: Recurrent flooding impacts on educational continuity in the Philippines. *International Journal of Disaster Risk Reduction, 25*, 72-81. https://doi.org/10.1016/j.ijdrr.2017.07.016

Chaudhary, G., & Timsina, T. P. (2017). Impact of flood on performance of students: The case of secondary school students in Jaleshwor Municipality, Mahottari. *Journal of Advanced Academic Research, 4*(1), 12-26. https://doi.org/10.3126/jaar.v4i1.19515

Coates, L., Haynes, K., O'Brien, J., McAneney, J., & De Oliveira, F. D. (2014). Exploring 167 years of vulnerability: An examination of extreme heat events in Australia 1844-2010. *Environmental Science & Policy, 42*, 33-44. https://doi.org/10.1016/j.envsci.2014.05.003

Daimary, N. (2022). Musa acuminata peel: A bioresource for bio-oil and by-product utilization as a sustainable source of renewable green catalyst for biodiesel production. *Renewable Energy, 187*, 450-462. https://doi.org/10.1016/j.renene.2022.01.054

Danyelle, B., & Gustavo, J. (2007). *Droughts shock and school performance in Brazilians rural schools*. https://www.anpec.org.br/encontro/2018/submissao/files_I/i12-e55436242842b511a056477a2e251c17.pdf

Dariya, H., Abdussalam, A., & Saleh, Y. (2021). Relationship between seasonal weather variation and students' academic performance in Kaduna State University, Nigeria. *Science World Journal, 16*(2), 152-156.

Davis, W. D. (2009). What does green mean? Anthropogenic climate change, geo-engineering and international environmental law. *Georgia Law Review, 43*(3), 901-915. https://doi.org/10.1098/rspa.2019.0255

de Souza, E. C., Coelho, A. B., de Lima, J. E., da Cunha, D.A., & Féres, G. J. (2013). Impactos das mudanças climáticas sobre o bem-estar relacionado à saúde no Brasil [Impacts of climate change on health-related well-being in Brazil]. *Pesquisa e Planejamento Econômico* [*Research and Economic Planning*], *43*, 49-87.

Deschênes, O., & Moretti, E. (2009). Extreme weather events, mortality, and migration. *Review of Economics and Statistics, 91*, 693-713. https://doi.org/10.1162/rest.91.4.659

Doherty, T. J., & Clayton, S. (2011). The psychological impacts of global climate change. *American Psychological Association, 66*(4), 265-276. https://doi.org/10.1037/a0023141

Elbayoumi, M., Ramli, N. Z., Yusof, N. F. F., & Al Madhoun, W. (2015). Seasonal variation in school's indoor air environments and health symptoms among students in an Eastern Mediterranean climate. *Human and Ecological Risk Assessment, 21*, 184-204. https://doi.org/10.1080/10807039.2014.894444

Gibbs, L., Nursey, J., Cook, J., Ireton, G., Alkemade, N., Roberts, M., Gallagher, H. C., Bryant, R., Block, K., Malyneaux, R., & Forbes, D. (2019). Delayed disaster impacts on academic performance of primary school children. *Child Development, 90*(4), 1402-1412. https://doi.org/10.1111/cdev.13200

Gitau, D. (2013). *Impact of drought on primary schools learning in Laikipia West District of Laikipia County, Kenya* [Unpublished master's thesis]. Kenyatta University.

Hallegatte, S., Hourcade, J. C., & Dumas, P. (2007). Why economic dynamics matter in assessing climate change damages: Illustration on extreme events. *Ecological Economics, 62*, 330-340. https://doi.org/10.1016/j.ecolecon.2006.06.006

Haverinen-Shaughnessy, U., & Shaughnessy, R. J. (2015). Effects of classroom ventilation rate and temperature on students' test scores. *PLoS ONE, 10*(8), e0136165. https://doi.org/10.1371/journal.pone.0136165

Hayati, D., Yazdanpanah, M., & Karbalaee, F. (2010). Coping with drought. *Psychology and Developing Societies, 22*(2), 361-383. https://doi.org/10.1177/097133361002200206

Hoddinott, J., & Kinsey, B. (2001). Child growth in the time of drought. *Oxford Bulletin of Economics and Statistics, 63*(4), 409-436. https://doi.org/10.1111/1468-0084.t01-1-00227

Hyndman, B. (2017). Does bad weather affect academic performance. *The Conversation Online Bulletin*. http://www.theconversation.com/does-badweather.html

Isaac, J. (2014). *Drought related factors and academic outcome among students* [Unpublished undergraduate study, University of Calabar, Nigeria].

Ivan, C., Yang, J., & Xiaohan, Z. (2021). Too hot or too cold to study? The effect of temperature on student time allocation. *Economics of Education Review, 84*, 102152. https://doi.org/10.1016/j.econedurev.2021.102152

Jamila, A., Buhari, S., & Iheoma, E. (2018). *The effects of harmattan season in the Federal College of Education, Zaria* [Essay submition]. Federal College of Education, Zaria.

Jensen, R. (2000). Agricultural volatility and investments in children. *American Economic Review, 90*(2), 399-404. https://doi.org/doi.org/10.1257/aer.90.2.399

Jiang, J., Wang, D. J., Liu, Y. F., Xu, Y. C., & Liu, J. P. (2018). A study on pupils' learning performance and thermal comfort of primary schools in China. *Building and Environment, 134*, 102-113. https://doi.org/10.1016/j.buildenv.2018.02.036

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th edn.). The Guilford Press.

Kreft, S., Eckstein, D., Junghans, L., Kerestan, C., & Hagen, U. (2014). *Global climate risk index 2015: Who suffers most from extreme weather events?* Berlim.

Kumar, A. R., & Raghav, A. A. (2018). A case study on the flood situation of Assam State. *International Research Journal of Engineering and Technology, 5*(5), 4192-4194.

Kumar, P. (2021). Climate change and cities: Challenges ahead. *Frontiers in Sustainable Cities, 3*, 645-613. https://doi.org/10.3389/frsc.2021.645613

Kumar, P., & Imam, B. (2013). Footprints of air pollution and changing environment on the sustainability of built infrastructure. *Science of the Total Environment, 444*, 85-101. https://doi.org/10.1016/j.scitotenv.2012.11.056

Kundzewicz, Z. W., Kanae, S., Seneviratne, S. I., Handmer, J., Nicholls, N., Peduzzi, P., & Mach, K. (2014). Flood risk and climate change: Global and regional perspectives. *Hydrological Science Journal, 59* (1), 1-28. https://doi.org/10.1080/02626667.2013.857411

Liu, H., Wu, Y. X., Li, B. Z., Cheng, Y., & Yao, R. M. (2017). Seasonal variation of thermal sensations in residential buildings in the hot summer and cold winter zone in China. *Energy and Buildings, 140*, 9-18. https://doi.org/10.1016/j.enbuild.2017.01.066

Lumbroso, D. (2020). Flood risk management in Africa. *Journal of Flood Risk Management, 13*(3), e12612. https://doi.org/10.1111/jfr3.12612

Lynn, M. (1986). Determination and quantification of content validity index. *Nursing Research, 35*, 382-386. https://doi.org/10.1097/00006199-198611000-00017

Ma, Q., Qi, Y., Shan, Q., Liu, S., & He, H. (2020). Understanding the knowledge gaps between air pollution controls and health impacts including pathogen epidemic. *Environmental Research, 189*, 109949. https://doi.org/10.1016/j.envres.2020.109949

Maccini, S., & Yang, D. (2009). Under the weather: Health, schooling, and economic consequences of early-life rainfall. *American Economic Review, 99*, 1006-1026. https://doi.org/10.1257/aer.99.3.1006

Maione, M., Fowler, D., Monks, P. S., Reis, S., Rudich, Y., Williams, M. L., et al. (2016). Air quality and climate change: Designing new win-win policies for Europe. *Environmental Science & Policy, 65*, 48-57. https://doi.org/10.1016/j.envsci.2016.03.011

Marengo, J. (2009). *Mudanças climáticas e eventos extremos no Brasil* [*Climate change and extreme events in Brazil*]. http://www.fbds.org.br/cop15/FBDS_MudancasClimaticas.pdf

Masih, I., Maskey, S., Mussa, F. E. F., & Trambauer, P. (2014). A review of droughts on the African continent: A geospatial and long-term perspective. *Hydrology and Earth System Sciences, 18*(9), 3635-3649. https://doi.org/10.5194/hess-18-3635-2014

Mendell, M., & Heath, H. (2005). Do indoor pollutants and thermal conditions in schools influence student performance? A critical review of the literature. *Indoor Air, 15*, 27-52. https://doi.org/10.1111/j.1600-0668.2004.00320.x

Mudavanhu, C. (2014). The impact of flood disasters on child education in Muzarabani District. *Jamba: Journal of Disaster Risk Studies, 6*(1), a138. https://doi.org/10.4102/jamba.v6i1.138

Mudavanhu, C. (2015). The impact of flood disasters on child education in Muzarabani District, Zimbabwe. *Jamba: Journal of Disaster Risk Studies, 6*(1), 138. https://doi.org/10.4102/jamba.v6i1.138

Munonye, C. (2020). The influence of seasonal variation of thermal variables on comfort temperature in schools in a warm and humid climate. *Open Access Library Journal, 7*, e6753. https://doi.org/10.4236/oalib.1106753

Munonye, C., & Ji, Y. C. (2017). Rating the components of indoor environmental quality in students classrooms in warm humid climate of Uli, Nigeria. In *Proceedings of the 13th International Postgraduate Research Conference.*

Nkeiruka, F. (2014). Climate change and implication for senior secondary school financial accounting curriculum development in Nigeria. *Journal of Education and Practice, 5*(26), 153-157.

Phan, T. V. (2021). The effect of the difference in the perception of temperature between sexes on the academic performance of Chapin High School students. *Journal of the South Carolina Academy of Science, 19*(1), 83-94.

Phuloma, D. (2020). Effect of flood on students during COVID-19 pandemic. *International Journal of Management, 11*(12), 436-442. https://doi.org/10.34218/IJM.11.12.2020.040

Rocha, R., & Soares, R. R. (2015). Water scarcity and birth outcomes in the Brazilian semiarid. *Journal of Development Economics, 112*, 72-91. https://doi.org/10.1016/j.jdeveco.2014.10.003

Sambo, M. N. (2010). A paper presented at a round table discussion, at the Second Lagos State Summit on Climate Change, on May 4, 2010. *Daily Sun Newspapers.*

Satish, U., Mendell, M., Shekhar, K., Hotchi, T., Sullivan, D., Streufert, S., & Fisk, W. J. (2012). Is CO_2 an indoor pollutant? Direct effects of low-to-moderate CO_2 concentrations on human decision-making performance. *Environmental Health Perspectives, 120*, 1671-1677. https://doi.org/10.1289/ehp.1104789

Schmuck, H. (2020). *Rural flooding, the Zambezi River in Mozambique.* https://reliefweb.int/report/mozambique/flooding-mozambique

Shi, Y. Q., & Qu, S. W. (2021). Cognition and academic performance: Mediating role of personality characteristics and psychology health. *Frontiers in Psychology, 12*, 774548. https://doi.org/10.3389/fpsyg.2021.774548

Sun, S., Tian, L., Cao, W., Lai, P. C., Wong, P. P. Y., Lee, R. S. Y., Mason, T. G., Kramer, A., & Wong, C.-M. (2019). Urban climate modified short-term association of air pollution with pneumonia mortality in Hong Kong. *Science of the Total Environment, 646*, 618-624. https://doi.org/10.1016/j.scitotenv.2018.07.311

Sundell, J., Levin, H., Nazaroff, W., Cain, W., Fisk, W., Grimsrud, D., Gyntelberg, F., Li, Y., Persily, A. K., Pickering, A. C., Samet, J. M., Spengler, J. D., Taylor, S.T., & Weschler, C. J. (2011). Ventilation rates and health: Multidisciplinary review of the scientific literature. *Indoor Air, 21*, 191-204. https://doi.org/10.1111/j.1600-0668.2010.00703.x

Vranda, N. M., & Sekar, K. (2011). Psychosocial impact of flood on children: A qualitative study. *The Odisha Journal of Psyciatry, 2011*, 29-37.

Wit, S. D. (2011). *Global warning* [Master's thesis, Leiden University].

Xu, Y., & Lamarque, J. F. (2018). Isolating the meteorological impact of 21st century GHG warming on the removal and atmospheric loading of anthropogenic fine particulate matter pollution at global scale. *Earth Future, 6*, 428-440. https://doi.org/10.1002/2017EF000684

Yusoff, M. S. B. (2019). ABC of content validation and content validity index calculation. *Education in Medicine Journal, 11*, 49-54. https://doi.org/10.21315/eimj2019.11.2.6

Zamanzadeh, V., Ghahramanian, A., Rassouli, M., Abbaszadeh, A., Alavi-Majd, H., & Nikanfar, A. (2015). Design and implementation content validity study: Development of an instrument for measuring patient-centered communication. *Journal of Caring Sciences*, *14*(2), 165-178. https://doi.org/10.15171/jcs.2015.017

Zivin, J. G., & Shrader, J. (2016). Temperature extremes, health, and human capital. *The Future of Children, 26*(1), 31-50. https://doi.org/10.1353/foc.2016.0002

Zivin, J. G., Hsiang, S. M., & Neidell, M. (2018). Temperature and human capital in the short and long run. *Journal of the Association of Environmental and Resource Economists, 5*, 77-105. https://doi.org/10.1086/694177

❖❖❖