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Development of a Climate Change Anxiety Instrument: What is Your Heartbeat Reading?

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ABSTRACT: *Nigeria is experiencing the reality of climate change more than ever with Sea level rise, coastal and riverine flooding; erosion and desertification as 'clouds of witnesses'. People's perception and experiences appears to be the core issues that will influence their climate change anxiety level, a potent factor behind climate action. The younger generation would have a larger share of this experience and propensity for the worst hit including women. This background necessitated the need for the development of a Climate Change Anxiety Instrument (CCAI) for secondary school students. This research attempts to develop and test a reliable and valid instrument that will assess students' level of anxiety towards the changes that climate change brings to bear on humans and the environment in general. The development phase, patterned alongside Computer Anxiety Scale (CAS) developed by Okebukola and Woda (1993), first involved 50 senior secondary school students and the final phase involved 90 senior secondary school students. Results compared students' learning outcomes using constructivism, pictorial/discussion and traditional techniques. Pedagogy significantly influenced students' climate change anxiety. The Tukey analysis shows pictorial/discussion significant differences among the group on climate change anxiety. Location significantly influenced students' level of climate change anxiety in favour of rural students*.

KEYWORDS: climate change, anxiety instrument**,** critical pedagogy, secondary students; Nigeria, culturo-techno-contextual approach.

INTRODUCTION

A contemporary picture of our planet, the only home of humanity, still reflects her luxuriously beautiful blue colour sustained by the massive Oceans occupying about 70% of the Earth's surface. In contrast to this, the state of the world's natural environment is increasingly fragile and is faced with massive, and in some cases, irreversible environmental degradation and species loss. The reality of climate change consequences has plagued our beautiful blue planet, the only home of humanity, significantly now than ever. The 1990s witnessed the adverse effects of climate change being depicted with pictures in scientific literature, students' texts, mainstream and social media of biodiversity under threat, such as Polar Bear on a floating ice sheet on the Ocean; evidently showing loss of glaciers as well as habitat of Polar biodiversity. In retrospect, this narrative has obviously changed as witnessed during the decade 2010-2019 with climate change consequences being depicted with pictures showing tragic climate disasters (Ahove, 2019) affecting thousands and sometimes tens of thousands of humans in a

community, region or country. In so many instances several properties, lives and nature are lost. These incidents are better described as global human climate crisis, as we are now confronted with an existential challenge built on a scientific prediction in view of the present concentration of Greenhouse Gases in the atmosphere, glaciers and the Ocean. Scientist around the world reported vast storage of caps of frozen carbon dioxide and methane scattered under the seafloor across the planet, these hidden climate time bombs called hydrates. But with rising temperatures of the Ocean, as a result of increase in atmospheric temperature, temperatures around these frozen caps have increased slightly thus these GHGs have greater potential of escaping. Scientists had also warned that if we continue to emit Greenhouse Gases (GHGs) at the present concentration climate change may become a doomsday's reality on planet earth.

Climate change over the years appears to be popularly known in the environmental science community as the most important global challenges confronting humanity (Intergovernmental Panel on Climate Change [IPCC], 2014; 2018. This dynamic phenomenon is unfolding itself on a global scale, affecting the entire global population obviously unfairly with significant negative effects on ecosystems, economies, communities and thus became an existential challenge. This is in favour of the major polluters in the developed economies relative to most developing nations, which aligns with the World Bank's (2002) forecast that developing nations will suffer the most as a result of more exposure to climate change due to less adaptive capacities and weak economy. At the same time, developed countries have contributed disproportionately to the increase in the total concentration of greenhouse gases (GHGs), both in absolute and per capita terms. The climate crisis has been more severe in Africa, home to most of the poorest nations in the world. This climate crisis has been more devastating in Africa because technological change has been slowest in Africa and the domestic economies are dependent very seriously on climate-sensitive livelihood activities (Bele, Sonwa & Tiani, 2014; see Okorie & Ijah, 2020).

Today many African nations are groaning under the weight of the consequences of climate change: bedevilled with drought and desertification (Felix-Ezeh, 2014); erosion, coastal flooding, challenges of water demand and supply as well as unpredictable rainfall pattern (Ojo, 2012); leading to poor agricultural yield with very poor coping capacity often resulting to outcry for aids from the developed economies. In contrast to this, the developed economies appears to be building very strong systems for mitigating the adverse effects of climate change and citizens have acquired relatively better adaptive skills through climate change adaptation education (Kerry, Pruneau, Blain, Barbier, Mallet, Vichnevetski,…Langis (2012); Pruneau, Kerry, Blain, Vichnevetski, Deguire, Barbier,… Lang 2013). Research in climate change adaptation education has been one of the major platforms for this success story from the developed nations. This stressed the significance of community based climate change education (Okorie & Ijah, 2020) as an avenue for a better comprehension of the environment, and the key to this is in the emergence of a contemporary research in climate change education with a view to enhance climate change adaptation skills among citizenry especially the younger generation for sustainable development in Nigeria.

The impact of climate change due to global warming has continued to generate the interest of educational and business institutions, individuals and the global community in general in search of short and long term solutions. Reports by the United Nations Intergovernmental Panel on

Climate Change (IPCC, 2018) indicate that the continued increase in the level of greenhouse gasses (GHGs) in earth's atmosphere has effectively trap heat within the earth leading to the warming of our beautiful blue planet. Climate change due to global warming is an issue with scientific, environmental, economic development, and political dimensions the nexus of which must be considered in the navigation for a solution.

Anxiety and Climate Change Education

Manzanal, Barreiro & Jimenez (1999) and Yount & Horton (1992) mentioned that emotional traits play a strong influence on human behaviour. This implies that emotions could stimulate learning outcomes and behavioural change, this is particularly true if the subject or concept in question is of interest to the learner and conversely a reverse learning experience could emerge if the concept is not of interest or beneficial to the learner. Anxiety or worry about the challenges of climate change is a major societal problem often perceived as something only negative. Thus worry could shift focus of the learner thus hinder and impede learning new concepts or ideas about climate change outside the current knowledge of the learner. The new knowledge has the potential of replacing the concepts that have promoted the worry and shake learners out of old behavioural patterns. In contrast to this argument, Ojala (2016) made reference to several emerging empirical studies and that new theories on emotions have identified anxiety and worry as essential preconditions for social deliberation and critical thinking. To be climate worried is to stimulate the desire to search for more information about the problem. Asides from its role in motivating intellectual discussions, researchers have argued on worry as a rational response to vital values and activities that are threatened by climate change. The argument encouraged that this issue should be discussed in learning situations, which is a trusted technique that could help people do something realistic about the problem (see Ojala, 2016).

In furtherance to this discussion, anxiety has been described as a trait that keeps people from doing what they are doing at the moment, activates their cognitive system, makes them more focused on the outside world and more reflective. This was described as a motivation needed by people to think critically (Ojala, 2013). Thus a spice of worry may be essential for critical thinking in order to solve societal challenges such as climate change. The rational question to ask in view of these arguments is that, do people have the tendency to take action not on the basis of information but on emotional attachment concerning climate change? Researchers as well as climate change educators may have to consider the cognitive component as well as the affective component as combinations to provide the action which drives actions for or against climate change education.

One of the challenges that come with climate change is disruption and to imagine, expect its realisation in your community or perhaps an individualistic experience often lead to feelings of unease and anxiety. Anxiety has the propensity to disrupt learning in a climate change education setting (Ojala, 2016). Climate change anxiety is relevant in the assessment of emotional awareness about climate change. Climate change educators must be aware that this problem in itself is related to emotions of worry and anxiety. This worry often is a blend of feelings of guilt, fear and helplessness. Ojala (2016) postulated that climate change is anxiety-provoking, because it touches and threatens the sources that fundamentally influence our existence. Thus the climate crisis is a major existential threat to the future survival of humanity

and application of appropriate climate education techniques is an indication for a potent antidote.

Pedagogic Influence

In a constructivist class the discussion process involves questions not just only from the teacher's side but among learners. Questions and answers are at a higher thinking pedestal and interactions are not just between students and teacher, but revolve among the students. Furthermore, the constructivist approach does not require students' or teacher's demonstration rather students construct, gain or use knowledge about the matter in question. The potential benefit of the use of questioning in a constructivist class may be corroborated with the prediction of Yount & Horton (1992), that learners 'with higher level of cognitive reasoning' has the propensity of utilising the acquired environmental knowledge 'in a subsequent attitude decision'. In line with this prediction, Singseewo (2011) believes that critical thinking creates more opportunities for students to be able to analyse, criticise and acquire knowledge to effectively handle environmental problems that they may be experiencing in future. One of such problems is climate change that every youth in the nations of the world will have to deal with in the future and it is important that they are prepared now and especially by the older generation on how to deal with the challenges of climate effects. The implication of this prediction is that the use of constructivism in learning about climate change among students will result in meaningful learning which would aid students to take favourable actions as a consequence of their positive attitude.

The rationale for the use of constructivism in this study stems from the realisation that during the process of construction of knowledge, students share ideas by questioning which is an alternative to meaningful learning and in consonance with Shodell's (1995) view that questions emerge from critical thinking which is opposed to fact-demanding questions, a feature found in a teacher centred classroom.

The reason for the use of the pictorial flavour in the discussion method is based on Ausubel's cognitive theory which stresses the relevance of meaningful learning and Novak's principle of visualisation of concepts. This study spiced the pictorial/discussion technique with the use of a Multimedia Projector (MMP). MMP appears to be finding its way currently into the secondary school system of Lagos State with 45 of the 55 schools visited in the preliminary study possessing MMP (Ahove, 2015). This is another reason for the introduction of the MMP into the study.The lecture mode of teaching has always been referred to as the traditional teaching style, possibly as a result of its wide acceptability, advantages and easy usage. Teaching climate change in a traditional lecture-style classroom has a strong propensity to accomplish several educational objectives. The reason for the use of the traditional technique is to serve as control in relation to the other two methods.

Justification and Objectives for a Climate Change Anxiety Instrument

The impact of climate change has gone beyond negatively affecting the flora and fauna when mainstream media and environmental text shows the picture of Polar Bear on Ice Sheet depicting loss of Glaciers (Miller & Spoolman, 2008) as well as habitat loss of fauna in the North Pole and consequently endangering the lives of these endangered species, as evidence of climate change. Poverty catalyses an environment for people to be more vulnerable to

environmental shocks and stressors (Stephane, Marianne & Edward 2018) such as the consequences of climate change. This situation is prevalent in Africa (World Bank, 2002) and Nigeria is not exempted as Bele, Sonwa & Tiani (2014) mentioned that technological change is slowest in Africa and the domestic economies is dependent most heavily on climate-sensitive livelihood activities which will further compound climate crisis and its aftermath of anxiety. Apparently, about 15 years ago, the mainstream and especially the social media were often washed, like never before, with life pictures of the devastating consequences of climate change on human life, homes and livelihood especially in Sub-Saharan Africa. This has stimulated climate anxiety. Anxiety dosage may be an essential determinant to stimulate critical thinking to solve issues related to climate crisis or negative emotions of fear. The two sides of the divide will to a very large extent influence learning outcomes and behavioural changes.

The purpose of this study is to develop an instrument to measure anxiety dosage, which may be an indication to predict an individual's ability to handle climate crisis as well as favourable or unfavourable climate change action. This is the first justification for this study. The existence of climate anxiety in the emotions of the learners created the necessity for the climate educator to seek for appropriate learning techniques that will help overcome strong negative climate anxiety and translate such into a dosage that will enhance learning outcomes in favour of climate change. This is the second rationale for this research.

This paper seeks to achieve two major objectives, first is to develop a reliable Climate Change Anxiety Instrument (CCAI), the relevance of the instrument, just like the stethoscope, after the development is to be deployed to measure the level of anxiety exhibited by individuals especially youths in secondary schools. Secondly, to assess the influence of pedagogy on students' anxiety towards climate change, as a technique to ameliorate climate crisis panic among African youths. The later objective leads to two important questions for investigation. Will method of instruction significantly influence students' anxiety towards climate change? Will there be a significant difference between urban and rural students' learning outcomes?

METHODOLOGY

Study Design

The research designs deployed in this study are of two fold, first is the survey in the development of CCAI which was in three phases. The second was pre-test- treatment - post-test experimental design. The pre and post-tests involved the administration of Climate Change Anxiety Inventory (CCAI) to assess the samples of the study in terms of anxiety towards climate change before and after treatment. The treatment phase involved learning and teaching three groups of samples each with a different teaching technique.

Sample and Sampling Technique

Three high schools in the state were involved in the study, each belonging to a group;

1. Constructivist group 29 students (10 male, 19 female)
2. Pictorial/discussion group 31 students (10 male, 21 female)
3. Traditional group students 30 students (12 male, 18 female)

These schools were selected through a stratified random sampling technique based on the division of all secondary schools in the state by the state's Ministry of Education into districts (6) and the districts into zones (21). Using the balloting method three of the six districts were selected and a zone was selected from each of the three districts. From each zone a school was selected using the balloting method. However in the selection of the schools from the zones, mixed schools without climate change clubs formed the pool from which the selection was made. At the commencement of the study, the balloting technique was employed to select 105 students, 35 from each of the three high schools, with mixed abilities from Science, Commercial and Arts Classes. However a total of 15 students could not complete the study due to illness and representation of the school at various competitions. Thus 90 students (32 male and 58 female) completed the study. The constructivist and the pictorial/discussion groups are urban students while the traditional group is made up of students from the rural area. This sample selection was made after the three developmental phases of CCAI were completed.

Development of Instrument

The development of Climate Change Anxiety Inventory (CCAI) was in three phases before it was finally tested on the samples of this study. The focus of this instrument was to elicit information from students on how they feel when they think of climate change in their neighbourhood, nation and globally. The development of CCAI was patterned alongside Computer Anxiety Scale (CAS) an instrument developed by Okebukola and Woda (1993).

The first developmental phase of this instrument involved two groups of students. First are 25 high school students (senior secondary I and II) who have heard about climate change but have not been involved in climate change activities such as membership of a climate change club, which is not present in their school. The second developmental phase involved a group of 25 students, who are aware of climate change and are actively involved in climate change activities, especially membership of the climate change club in their school. The selection of the schools was purposive and based on the presence and absence of a climate change club in the chosen school. These two groups of students in their individual schools were asked to express in at least four words or phrases that best describe how they feel when they think of climate change or remember its effects on human, flora, fauna and the physical environment. At the end of this exercise 30 adjectives emerged that best describe the anxiety of these 50 secondary school students.

Validation and Reliability of Instrument

The developed adjectives (30) from the 50 SS I and SS II students were further subjected to two validation processes, this is the third phase. The first involved the researcher and a panel of experts involving a senior school geography teacher, a psychologist and a science educator who is also an expert in anxiety instrument development. Their comments eliminated repeated, 'similar in meaning' and other unnecessary words or phrases that were considered as not having the potential of measuring what CCAI is expected to measure. CCAI was found to be 0.63 and 0.64 for the first and second administrations respectively. This marked the end of the developmental phase, thus a valid and reliable CCAI emerged.

Treatment Phase

The Constructivist Group: The first week of this phase began with familiarization with and among the students; they were then placed in 6 cooperative learning cells made up of between

5 and 6 students with mixed gender and abilities. Each cooperative learning cell had a notebook, a leader and a scribe was appointed by members of each cell. The responsibility of the cell leader was to provide basic leadership and control while the scribe was assigned the role of taking notes on issues discussed and agreed on by each cooperative learning cell. The researcher provided the basic 'structure' (Bardsley, 2004) which is the basis for the academic discussion by introducing the concept of climate change in such a manner by relating it as a contemporary issue being experienced in our local community. Students' views were sought on the concept and began the process of shifting the students' view from their current knowledge to the unknown.

The group in their various cells attempted to define and explain the concept of climate change, global warming, ozone layer depletion and green technology. The researcher interjects intermittently if a leader or member in a cell calls for attention or if the researcher perceives the need to offer an idea or a guide to any cell within the group. At other times general statements or applications are made, by the researcher, to the entire group that will stimulate or change the line of discussion if a general misconception appears to emerge or the need to switch to another concept for discussion. This process of cycles of learning involved interactive question and answer, critical analyses and negotiation of meaning leading to the discovery of new knowledge for the students. The researcher played the role of a facilitator during the process of negotiation of knowledge with and among the learners.

Each cooperative learning cell through the scribe provided feedback on their ideas of climate change, global warming, ozone layer depletion and green technology by writing statements and making diagrammatic representations of their understanding of the concept of climate change. The essence of this feedback is that it reflects students' ideas and reconstructed knowledge 'within both their personal and social contexts'.

The second week of the treatment phase for this group began with discussion on the second topic; causes of climate change and underlying issues that are responsible for climate change were discussed. The process of negotiation followed the same style as the first week. Two periods of the second week were used for this interaction. The consequences of climate change, being the third topic, began at the second session of the second week till the end of the third week. Thus the topic lasted four periods contrary to three as expected. This was basically due to the nature of constructivist epistemology and some misconceptions that emerged from the participants requiring clarifications- such as 'tsunami is a consequence of climate change'. Intensive questions and answers sessions, negotiations coupled with some complex applications and local and international examples of the consequences of climate change were addressed. The fourth and final topic was on controlling climate change- mitigation and adaptation techniques, span for a week employing the same learning process.

The treatment phase ended in the fifth week with each cooperative learning cell leader making a 10-mintues summary presentation of basic issues, negotiated issues and agreed by members of each cell. Then the entire group was exposed to a documentary film on climate change titled 'The day after Tomorrow' produced by Al-gore the former vice-president of the United States of America. On the last day of the fifth week final question and answer session was provided on climate change as discussed in the last four weeks in relation to the documentary 'as a reality

show' and especially as it relates to local and global effects and possibilities that may be experienced or being experienced. Thus the treatment phase for the constructivist group was ended.

The Pictorial/Discussion Group: This group involved a research assistant as teacher. During this treatment the teacher engaged the students in critical discussion on climate change aided with the use of Microsoft PowerPoint spiced with pictures. The teacher verbally introduces the concept, backs it up with a slide presentation with further explanation on the slide and students are encouraged to make contributions. Thus for every slide the teacher offers explanations and students are motivated to make contributions and the class discussions were interjected with one-or-two questions either from the teacher or the students. At the end of each lesson an opportunity was created for more questions from the students. The teacher answered verbally and when essential employed the use of the slides in answering students' questions for the purpose of clarity. The students were taken through these steps of teaching for the same four topics on climate change as in the previous groups discussed earlier. The treatment for this group lasted three weeks and the post-test instrument was administered.

The Traditional Group: The teaching procedure here, conducted by a regular senior secondary teacher, was teacher centred. The teacher introduced the topic and dominated the teaching process with the 'talk-and-chalk' principle. The concept to be taught was written on the board while the teacher explains, writing again on the board with another 'talk'. This 'talk-and-chalk' procedure continued and ended with questions from the students while the teacher provided the answers. The treatment phase which lasted for three weeks had the same schedule as the pictorial/discussion group. During the post-test stage CCAI were administered to the selected sampled students in their individual schools. The instrument was completed and collected on the spot.

RESULTS AND DISCUSSION

In response to the first question, a preliminary post-test descriptive analysis was conducted on the climate change anxiety scores of students in the constructivist, pictorial/discussion and the traditional group. Table 1 show that the pictorial/discussion group displayed the highest level of climate change anxiety of 6.74 while the constructivist had the least of 3.38. This result shows that the Pictorial/Discussion had the greatest influence on most

Table 1: Frequency Means and Standard Deviations of Climate Change Anxiety Scores of Students in Constructivist Pictorial/Discussion and Traditional Group

Group	N	Means	Std. Deviations
Constructivist	29	3.38	3.05
Pictorial/Discussion	31	6.74	3.39
Traditional	30	4.30	1.42
Total	90	4.84	3.08

The one-way analysis of variance was employed to test for significant difference among the group on climate change anxiety to provide more insight into this analysis. The result of the Fisher's test in table 2 indicates that $\{F(2, 89) = 11.99; p \leq .05\}$. A post hoc test was conducted to obtain greater insight on the result obtained on climate change anxiety to identify the group

that is responsible for the significant difference. The tukey analysis points to the pictorial/discussion as being responsible for the no significant difference that exists among the group on climate change anxiety.

Table 2: One-way ANOVA on Climate Change Anxiety on Students in Constructivist Pictorial/Discussion and Traditional Group

Post Anxiety	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	182.76	2	91.38	11.99	.00
Within Groups					
Total	663.06	87	7.62		
	845.822	89			

The outcome of this analysis is that pedagogy significantly influenced students' climate change anxiety.

In response to the second question in this paper, the student's t-test was used to provide the answer. The climate change anxiety scores of the students in the urban and rural schools were analysed using the independent sample t-test. Table 3 shows the result obtained from this analysis.

Table 3: Means Standard Deviations and t-test Scores of Urban and Rural Students on Climate Change Anxiety

Location	N	Mean	Std. Deviation	T	Sig.
Urban	60	5.11	3.62	1.19	.00
Rural	30	4.30	1.42		

Table 3 shows that the urban students had higher climate change anxiety mean scores of 0.81 than the rural students thus exhibiting more anxiety. Furthermore, table 3 shows {t (2, 88) = 1.19; $p \geq .05$} for climate change anxiety. Location was found to significantly influence students' level of anxiety towards climate change in favour of students from the rural area. Aside from the possible influence of the method of instruction, personal experience of the effect of climate change may have been witnessed to be more impactful on the socio-economic life of urban citizenry than the rural.

Therapeutic Potency of Culturo-Techno-Contextual Approach

The Culturo-Techno-Contextual Approach is an emerging teaching and learning strategy in response to the question, what will be the fate of the younger African climate scientist in a globalised and technologically competitive world? Emergence of this approach spans more than thirty years of research into how to present science-related concepts meaningfully African students in order to boost achievement and renew their interest and attitude. In 1986, an African giant in science and environmental education, Samuel Bajah, and his research team developed the Early Learning of Science in Africa approach (ELSA). By the early 1990s, the Science Teachers Associations of Nigeria, Ghana, Liberia, and Sierra Leone adopted the guided-discovery approach with an African flavour. After the turn of this century, more intense attention was paid to research, and varieties of cooperative learning methods for Africans were born (Okebukola, 2020). These different individual approaches identified by research to be

potent now metamorphosed into a simple blend of elegant, flexible and adaptable approaches to various cultural contexts in Africa. This led to the emergence of the CTCA.

The theoretical background for this approach draws largely from work on contexts and culture. The theory emphasises culture localisation as a basis for understanding human behaviour. The dynamism of culture is also recognised. For instance the cultural context in Africa of the nineteenth century is different from the twentieth with regard to some elements, notably those influenced by changing technology. In turn, the twenty-first century will be different from the twentieth; yet there are common elements which remain unique and unchanging. These common elements form the focus of CTCA (Ahove, 2018).

The CTCA is based on its efficacy of yielding outstanding results in the training of educators (Okebukola, 2020). Many educators for decades held on to a one-size-fits-all approach in different national contexts that were found potent in the U.S. and UK. This approach includes concept mapping, cooperative learning, advanced organisers, hierarchical learning, and analogies and metaphors. These were used for teaching in Africa with minimal success shown in the poor results of students in science in many African countries. The deployment of CTCA for the development of climate change education in the Nigeria educational system is therefore a sure beat for the upcoming tech-driven younger generation of Nigeria who also bring African indigenous knowledge with them into the environmental class. This approach is the near-future technique to enhance meaningful learning and effective climate change mitigation and adaptation action in Nigeria and Africa as a whole.

One of the ground-breaking exploratory studies on the CTCA approach was presented at the National Association for Research in Science Teaching conference in Baltimore, Maryland in 2016, and drew the attention of scholars (Ahove, 2018). At the conference, the presentation was focused on a survey and quasi-experimental stage which engaged 5,032 secondary (high school) biology students and their teachers (311) in Lagos state, Nigeria. Survey data covered environmental topics in biology reported by students and teachers to be difficult to teach or learn; the twelve most-difficult topics were found for testing the efficacy of a variety of techniques for lowering the perception of difficulty and enhancing achievement. To test CTCA, an experimental and a control group learnt “Energy Flow in the Ecosystem;” the experimental group used CTCA over a one-month period, while teachers in the control group were asked to teach using their usual method. The CTCA experience was an integrated frameworks-indigenous knowledge system of three factors: environmental related science, technology-mediation, and local context. The first focus of the study was on what impact CTCA had in improving the achievement and attitude of high school students on a normally-perceived difficult ecology concept.

Data indicates that on both measures, the experimental group out-performed the control. Interviews of students and teachers further confirmed that the effect of the three components of CTCA in an African indigenous classroom was more impactful than when the three components were deployed separately. Observation indicated that the CTCA group students were quite excited to find expressions for their indigenous knowledge as the class proceeded and the lesson weaved strongly into their local contexts by way of relevant examples.

The second question assesses how ambient the CTCA environment is for environmental related science teachers and students in Nigeria. The experimental group of students and teachers

confirmed that CCTA can be implemented with relative ease. The challenge of internet access may, however, sometimes arise for the technology component of CCTA in some rural communities.

This exploratory study provides a foundation for the validation of the potency of CTCA. Clearly the outcome of the study discussed cannot be extrapolated beyond this sample but it provides a kick-start for other researchers to subject CTCA to further tests and train environmental educators and teachers on the deployment of this all-important culturally- and contextually-relevant method of effective delivery for science related concepts integrated with African indigenous knowledge. This is clearly one of the future approaches for successful climate change mitigation and adaptation education in Nigeria and indeed for Africa. We have to begin the development and improvement of this approach for our future generation because the problems of Africa can be best solved by Africans within the African context, and any other approach will bring nothing but struggle. This article is therefore a clarion call for other techniques aside from CTCA for improving the teaching and learning process in environmental education in Africa.

CONCLUSION

This study has attempted to develop a valid and reliable climate change anxiety instrument as well as investigate the influence of pedagogy on students' climate change anxiety. Result obtained within the limitations of this study shows that pedagogy significantly influenced students' climate change anxiety. Principally, climate change has been reported to stimulate anxiety among secondary students especially in Africa due to the western oriented teaching and communication technique employed in our schools and teaching materials. The constructivist epistemology, pictorial/discussion and traditional method do not exhibit the same influence on students' level of anxiety towards climate change.

The implication of this research and high point to be stressed here in this academic discussion is that, the climate education and research community should begin to develop and deploy culture-centric teaching and learning methods unique to the environment of the learning. This is a major lacuna that this article attempts to bridge. An Afrocentric teaching and learning approach such as the Culturo-Techno-Contextual Approach appears to be an essential technique that may be introduced in future research within a similar research context as reported in the Nigerian learning environment. The deployment of CTCA may be a major key for a more effective amelioration of climate crisis panic because of the therapeutic potency of dealing with climate crisis anxiety among youths in Nigeria.

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