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Accelerating progress on sustainable development goals: Assessing secondary school students' knowledge of climate change actions

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Accelerating progress on sustainable development goals: Assessing secondary school students' knowledge of climate change actions

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Abstract. The youth plays significant role in realising the sustainable development goals (SDGs). What young people know about the SDGs and how to engage with the SDGs can contribute significantly to the realisation of the SDGs within the shortest possible time. Specifically, climate change is central to the SDGs because of its substantial nexus with economic, social and environmental outcomes for all regions of the world. Thus, this study investigates climate change awareness among secondary school students to guide climate change mitigation strategies and practices among young people for the attainment of the SDGs. The study adopts a qualitative research approach using content analysis of the essays on climate change written and presented by students of different secondary schools in Ota, Nigeria. The analysis reveals, among other things, that the students are knowledgeable about climate change and that their schools are the most prevalent source of climate change knowledge. The most-reported climate change effect from the essays include: rise in global temperatures, melting of ice, flooding, rise in sea level, drought, extinction of terrestrial and marine life and health challenges. Common mitigation strategies suggested by the students entail awareness, tree planting, use of low carbon vehicles, use of energy-saving bulbs, reduction of carbon emissions, and recycling of waste. With adequate climate change knowledge and mitigation strategies, many young people can contribute and engage practically with the climate change discourse, thereby improving the climate change statistics in their regions and accelerating progress on the SDGs.

1. Introduction

One of the most widely discussed issues confronting humanity at the moment is climate change. Although climate change occurrence is not new, the unusual rate at which the climate is changing has been a major cause of concern [1]. Climate change occurs both naturally [2, 3] and because of the activities of humans [4, 5, 6].

Climate change is an environmental phenomenon that has negative implications for social and economic outcomes. It has drastic effects on ecological, social and economic systems. Rising sea level (flooding), drought, the occurrence of wildfires and ecological disruptions are examples of the environmental effects induced by climate change [7, 8,]. Climate change also affects social systems through famine, displacement of people due to flooding, wildfires, and it causes respiratory and skin illnesses [9]. It can also have dire economic consequences as a



result of the loss of livelihoods for people that depend on rivers and rainfall [10,11,12,13]. Moreover, climate change increases the disease burden in many regions, thereby increasing the cost of health care [14]. Climate change threatens sustainable development because of its strong nexus with economic, social and environmental outcomes for all regions of the world. Despite the drastic changes in weather patterns [15], many Africans remain ill-informed about climate change. Climate change education can reduce its consequences on humans and the environment. [16] noted that awareness about climate change is a starting point to solving the climate change challenge.

Specifically, formal education is critical in creating a consciousness about global climate change and sustainable development because of environmental challenges such as the inclusion of climate change in the curriculum [17, 18, 19]. Besides, education provides a sustainable source of indigenous capacity to combat climate change which can be further passed on to future generations [20].

Youths are future decision-makers who will become responsible for implementing climate change mitigation policies in the future. Hence, there has to be a consideration for the intentional acquisition of necessary knowledge and skills that can help the next generation in adapting to climate change lifestyles.

Secondary school students represent a critical mass of future leaders. What students think about climate change is crucial in designing plans and actions for climate change adaptation in schools. Moreover, climate change knowledge amongst secondary school students is necessary for developing suitable curricula, thereby increasing the awareness of climate change, and encouraging active engagement of youths in climate change action. Thus, this paper investigates climate change knowledge among students in the secondary school to guide climate change mitigation strategies and practices among young people for realising the SDGs.

2. Brief Literature Review

2.1 Perception of Students on Climate Change

Extant research provides empirical evidence on the knowledge of students, awareness and understanding of climate change. These works focused on students from universities and other higher institutions of learning, high school students and primary school pupils. Some of the studies were discipline-specific. For instance, [21] examined the awareness of engineering students about climate change in Turkey. The study indicated considerable level of climate change knowledge among the students, with no difference in climate change knowledge across genders. Similarly, [22] assessed the knowledge, attitudes and behaviours of undergraduate and masters students of environmental science on climate change issues in Portugal. The study indicated that students believed the reality of climate change and caused by human activities. [18] also assessed climate change awareness of medical and nursing students in China, and revealed that respondents were knowledgeable in terms of the attendant health effects.

Other studies were comparative. [23] compared climate change perceptions of undergraduate students in Portugal, Mexico and Mozambique. From the study, it was found that Mexican students expressed a lesser belief that climate change was occurring while students from Mozambique showed a greater interest in climate change. Likewise, [24] compared the response of American and Chinese university students regarding policies related to climate change. The findings indicated that a greater proportion of Chinese students supported the notion that human activities mainly drive climate change.

Moreover, Chinese students showed greater inclination towards support for international agreement on climate change mitigation policies than their United States (U.S.) counterparts. [25] studied university students from 26 African countries and examined how their engagement in climate change-related activities affected their interest in climate change. The result indicated that engagement in climate change-related projects significantly influenced students' knowledge of climate change.

[19] studied climate change knowledge of undergraduate students in Western Nigeria. They found that students had significant knowledge of climate change and that no significant differences existed in their perceptions with regards to gender. On the contrary, the studies of [26] indicated that 18.2 % of undergraduate students in North-East Nigeria have never heard about climate change while 89% of those aware of climate change had a little knowledge of the causes and mitigation strategies for climate change. [27] compared the awareness and behaviours of university students and government officials regarding climate change in Southern Nigeria. Most of the study participants attest that climate change is human-induced. They were more knowledgeable of the effects of climate change in their region and less aware of the effects in other parts of Nigeria. There was insignificant difference between the perceptions of the government officials and the students.

The studies of [28] and [16] focused on high school students. [29] found some misconceptions in high school students' understanding of the consequences of climate change in Portugal. In the case of [28], the result indicated that students from urban areas had a higher understanding of climate change than those from rural areas. [29] examined the understanding of primary school pupils about energy and climate change in Australia and found that the pupils were not able to differentiate between vital environmental concepts such as climate change, greenhouse emissions, environmental pollution and global warming.

The review shows that misconceptions exist in the perceptions of high school students and elementary school pupils about climate change concepts and effects [28, 29]. Previous studies on climate change knowledge of students in Nigeria have focused on university students. There is a need to examine the understandings of secondary school students about climate change so that misconceptions can be corrected and strategies can be designed for improving climate change knowledge and actions at the secondary school level.

3. Methods

This research is based on a qualitative research approach using content analysis of essays on climate change written and presented by students of different high schools in Ota, Nigeria.

The students are in science, commercial and art classes of four high schools in Ota, Ogun State, Nigeria. The students were invited to submit an essay on climate change. Forty essays were submitted from which five best essays were purposively selected from each school, which makes a total of 20 essays. Qualitative research samples are usually purposive and are selected based on the ability to produce robust and text-based data that is relevant to the phenomenon being researched [30]. Moreover, samples in a qualitative study are few, providing in-depth and rich individual analysis which is a major necessity for qualitative studies [31].

Although 20 best essays were considered for analysis after the sixteenth essay was analysed the data reached a saturation point. This means that the sixteenth essay was not significantly different from the preceding fifteen essays. Reaching a saturation point, the authors decided that the sample size of 16 was sufficient for the study. Saturation is a scientific way of determining sample size in qualitative studies [32,33 and 34].

The information from the essays was analysed using content analysis, which is an approach for interpreting the content of text-based data through theme and pattern identification [35]. Content analysis is not only used to identify themes and patterns but also the frequency of the concepts studied [36]. Therefore, descriptive statistics such as frequencies, and rankings are utilised in discussing the results and compliment the content analysis.

4. Results and discussion

4.1 Results

The study investigated the extent of climate change knowledge of secondary school students in Ota, Nigeria. The profiles of the students whose essays were analysed are presented in *Table 1*. The students that partook in the essay were from four secondary schools in Ota, Ogun State, Nigeria. Six of the students (A, D, H, I, L and M) were boys while ten were girls (B, C, E, F, G, J, K, N, O and P). Two of the students were in senior secondary class 1 (A and K), seven of them (B, F, H, I, J, O and P) were in senior secondary class 2 while the remaining seven (C, D, E, G, L, M and N) were in senior secondary class 3. As indicated in *Table 1*, the students were from two major class divisions which included 13 science students (A, B, D, F, H, I, J, K, L, M, N, O and P) and three art students (C, E and G).

Table 1 The Profile of the Students

School	Student	Gender:	Class:	Division	Climate change knowledge	Source of climate change knowledge
1	A	Male	SS1	Science	Yes	School
	B	Female	SS2	science	Yes	school
	C	Female	SS3	Art	Yes	Television
	D	Male	SS3	science	Yes	school
2	E	Male	SS3	Art	Yes	School
	F	Female	SS2	Science	Yes	school
	G	Female	SS3	Art	Yes	Television
	H	Female	SS2	Science	Yes	school
3	I	Female	SS2	Science	Yes	school
	J	Male	SS2	science	Yes	school
	K	Male	SS1	Science	Yes	school
	L	Female	SS3	Science	Yes	Television
4	M	Female	SS3	Science	Yes	Television
	N	Male	SS3	Science	Yes	school
	O	Female	SS2	Science	Yes	school
	P	Female	SS2	Science	Yes	school

Source: The Authors'

4.1.1 Climate Change Knowledge

All the students were knowledgeable about climate change, as shown in *Table 1*. The source of their climate change knowledge also differed. Three students (G, L and M) indicated television as the source of their knowledge. In contrast, the remaining thirteen (13) students (A, B, D, I, J, K, N, O and P) indicated that they obtained their knowledge of climate change from their school.

4.1.2 Effects of climate change

Seven (7) different themes were identified from the essays as effects of climate change. Further evaluation of the effects (Fig 1) indicated that most (87.5%) of the students identified the rise in global temperatures as the significant effect of climate change. It is followed by ice melting (81.3%), sea-level rise (75%), flooding (62.5%), drought (56.3%), extinction of terrestrial and marine life (43.8%) and health challenges (25%).

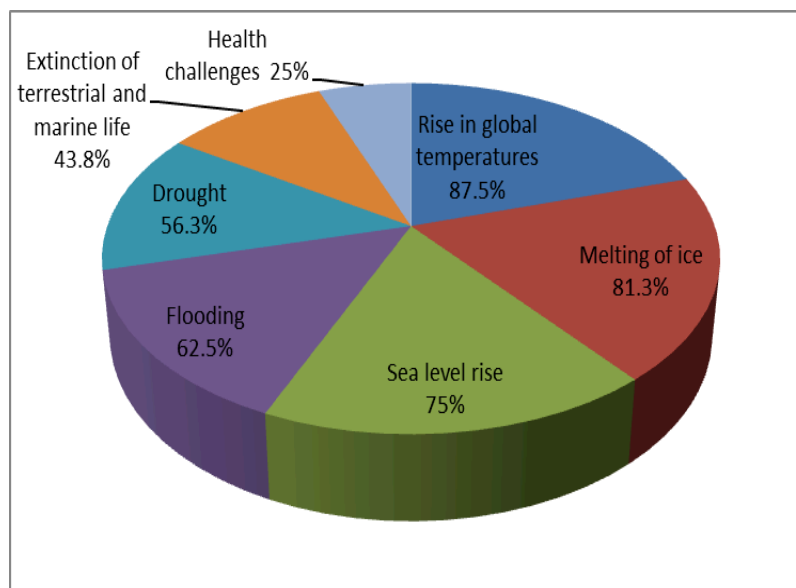


Fig 1: Effects of climate change

Source: The Authors'

Summary of excerpts from the essays:

4.1.2.1 Rise in global temperatures

'Climate change leads to an increase in weather temperatures, and this makes people very uncomfortable. It also causes drought and famine'.

4.1.2.2 Melting of ice

'Because of the hot weather, the ice regions will begin to melt and cause flooding'.

4.1.2.3 Sea level rise

'Many people living in coastal areas will experience sea-level rise because of climate change'.

4.1.2.4 Flooding

'Many towns close to rivers and seas will experience flooding because of the melting of ice in the North and South poles'.

4.1.2.5 Drought

'There will be drought and desertification because of irregular rainfall'.

4.1.2.6 Extinction of terrestrial and marine life

‘Climate change will make the environment unbearable for animals and sea creatures and many of them will die’.

4.1.2.7 Health challenges

‘Climate change can cause diseases like skin burn because of very high weather temperatures’.

4.1.3 Climate Change Mitigation Strategies

Fig. 2 indicates the climate change mitigation strategies suggested by the students. The most common climate change mitigation strategy suggested by the students was awareness (100%), followed by tree planting (87.5%), use of low carbon vehicles (62.5%), use of energy-saving bulbs (43.8%), reduction of carbon emissions (37.5%) and recycling of waste (37.5%).

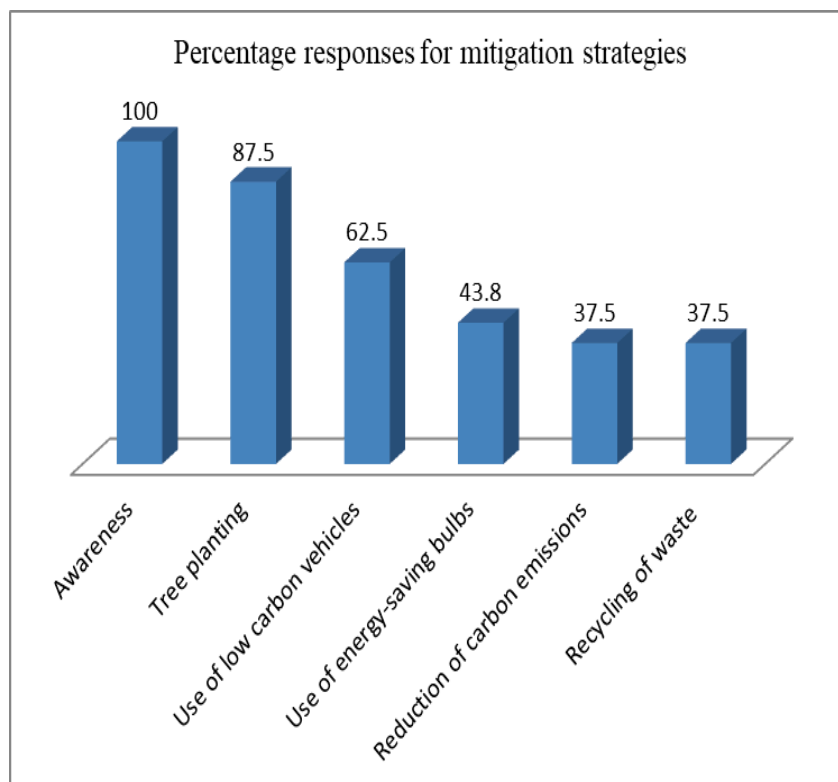


Fig 2: Climate change mitigation strategies
Source: The Authors’

Some remarks from the essay:

4.1.3.1 Awareness

‘I believe the first step to reducing climate change is making people aware of the damage being caused by climate change. Even today, many people have no idea what climate change is, neither do they understand that the simple things they do like burning refuse could cause the release of these greenhouse gases that lead to climate change. So I believe carrying out enlightenment programmes would go a long way in reducing climate change’.

4.1.3.2 *Tree planting*

'We need to plant more trees because trees absorb CO₂ from the atmosphere and release oxygen. This will reduce the amount of CO₂ in the atmosphere'.

4.1.3.3 *Use of low carbon vehicles*

'Use of already invented hydrogen-fuelled vehicles should be intensified in order to reduce carbon monoxide. Also, other alternative transport systems, such as bicycles and scooters, should be encouraged. For example, a boy in my school rides his bicycle to school every morning. If fifty other students could do this, we will have a cleaner atmosphere! It appears ridiculous and impossible, but we will have lesser carbon in the atmosphere'.

4.1.3.4 *Use of energy-saving bulbs*

'More people have to start using LED bulbs because LED bulbs consume less energy, emit less heat and last longer'.

4.1.3.5 *Reduction of carbon emissions*

'The government should stop factories from emitting so much smoke and also discourage indiscriminate burning of bushes and refuse dumps'.

4.1.3.6 *Recycling of waste*

'We can reduce climate change by recycling waste. We can turn plastic bottles into beautiful Christmas trees and pencil cases'.

4.2 *Discussions*

From the essay, it was discovered that all the students were knowledgeable about climate change. This result resonates with the studies of [19], who found that undergraduate students in Western Nigeria had a significant climate change knowledge. Likewise, [21] found a great degree of climate change knowledge amidst students in Turkey. However, in Portugal, high school students were found to have a moderate knowledge of climate change [28]. Although the extent of climate change knowledge was not assessed in this study, the study indicates that the students have climate change knowledge (i.e. its effect cum reduction strategies).

Moreover, the study also assessed the sources from which students obtained climate change knowledge. The essays identified the school system as the most popular avenue of climate change knowledge. Contrarily, the studies of [37] revealed that most university students in Nigeria obtained climate change knowledge through the internet and international media. Although this study did not investigate the existence of a climate change curriculum in the schools, some teachers taking subjects like geography, biology and agriculture may likely have mentioned some climate change terms. These include environmental pollution, global warming, greenhouses gases, extinction of wildlife because these subjects are closely linked with environmental science. The claim from the majority of the students that their climate change knowledge came from their schools supports the studies of [17] that formal education can create awareness about climate change.

The essays further reveal that students were also aware of the effects. The global temperature rise was the most reported effect of climate change. This finding does not take us by surprise because the adverse and sharp weather condition is a common and obvious consequence of climate change [15]. However, a detailed analysis on climate change effects as identified by the students' shows that only 25% (see Table 2) mentioned health challenges as one of the effects. Although the literature provides evidence of the health implications of climate change on mankind [9,14], this finding indicates that students were not very familiar with the health effects of climate change. The knowledge of the students about climate change effects appears to be skewed towards environmental issues. However, medical and nursing students identified

health effects such as respiratory illnesses and heat stress as one the greatest effects of climate change [18]. This indicates that the students' views about the effects of climate change may be influenced by factors such as discipline.

In addition, the paper analysed the climate change reduction strategies suggested by the students. Awareness of climate change was the most common climate change mitigation strategy suggested. This resonates with the findings of [16] that climate change awareness is a first step to solving the climate change challenge. Furthermore, the findings revealed the use of low carbon vehicles, use of energy-saving bulbs and reduction of carbon emissions as strategies for mitigating climate change effects. The studies of [38] showed that an increase in the uptake of low carbon vehicles such as electric vehicles will result in significant reduction of atmospheric CO₂. [39] also found that energy saving bulbs has great potentials of reducing atmospheric CO₂ which triggers climate change. The challenge of climate change also carries opportunities, particularly in the development of technologies and systems for mitigating its harmful effects. As suggested by the students, the use of low carbon vehicles, energy-saving bulbs and reduction of carbon emissions can reduce climate change. These mitigation strategies can trigger students' interest in these technologies, thereby creating opportunities for economic and social progress while mitigating climate change.

Conclusion

The paper investigated climate change knowledge among students in the secondary school, intending to guide climate change mitigation strategies and practices among young people for the attainment of the SDGs. All the students who participated in the essay were knowledgeable about climate change. It was also found that their schools were the most common source of knowledge on climate change. Students' awareness of the effects of climate change appears to be skewed towards environmental and disaster-related effects. Awareness was the most reported climate change mitigation strategy. Use of low carbon vehicles, energy-saving bulbs and reduction in carbon emissions were other climate change mitigation strategies suggested by the students.

The findings indicate that the use of formal education in creating awareness and equipping future leaders with necessary competencies for mitigating climate change cannot be undermined. More than ever, intentional training of students on climate change concepts and other associated environmental issues are needed to increase awareness and correct misconceptions and misunderstandings associated with climate change and its effects. Specifically, the design of a climate change curriculum in secondary schools will enhance students' understanding of climate change and trigger their interest in climate change action and projects. With adequate climate change knowledge and mitigation strategies, many young people can contribute and engage practically with the climate change discourse, thereby improving the climate change statistics in their regions and accelerating progress on the SDGs.

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Conflict of Interest

There is no conflict of interest.

References

- [1]. Gashaw T, Mebrat W, Hagos D and Nigussie A (2014). Climate Change adaptation and mitigation measures. *Ethiopia Journal of Biology, Agriculture and Healthcare*, **4** 148-152
- [2]. Sörlin, S., Lane, M. (2018). Historicising climate change—engaging new approaches to climate and history. *Climatic Change*, **151**, 1–1. <https://doi.org/10.1007/s10584-018-2285-0>
- [3]. Haunschild R, Bornmann L, Marx W (2016). Climate Change Research in View of Bibliometrics. *PLoS ONE*, **11**(7)
- [4]. Tunji-Olayeni, PF , Omuh, IO , Afolabi, AO, Ojelabi, RA and Eshofonie, EE. (2019). Effects of construction activities on the planetary boundaries. *Journal of Physics: Conf. Series* 1299 (2019) 012005 IOP Publishing doi:10.1088/1742-6596/1299/1/012005.
- [5]. Trenberth, K.E. (2018). Climate change caused by human activities is happening and it already has major consequences. *Journal of Energy and Natural Resources Law*, **36** (4), 463- 481
- [6]. Rapp D. (2014). *Anthropogenic Influences on Climate Change*. In: *Assessing Climate Change*. Springer Praxis Books. Springer, Cham
- [7]. Tunji-Olayeni, PF , Omuh, IO , Afolabi, AO, Ojelabi, RA and Eshofonie, EE. (2019). Climate change mitigation and adaptation strategies for construction activities within planetary boundaries: limitations of developing countries. *Journal of Physics: Conf. Series* doi:10.1088/1742-6596/1299/1/012006
- [8]. Kilroy, G. (2015). A review of the biophysical impacts of climate change in three hotspot regions in Africa and Asia. *Regional Environmental Change*, **15**, 771–782, <https://doi.org/10.1007/s10113-014-0709-6>
- [9]. Sanson A.V., Burke S.E.L. (2020). *Climate Change and Children: An Issue of Intergenerational Justice*. In: Balvin N., Christie D. (eds) *Children and Peace*. Peace Psychology Book Series. Springer, Cham
- [10]. Rufino, M., P. Thornton, S. Ng'ang'a, I. Mutie, P. Jones, M. van Wijk, and M. Herrero. (2013). Transitions in agro-pastoralist systems of East Africa: Impacts on food security and poverty. *Agriculture, Ecosystems and Environment*, **179**, 215–230, doi:10.1016/j.agee.2013.08.019
- [11]. Akinyemi, O, Efobi, U., Osabuohien, E. and Alege, P. (2019). Regional Integration and Energy Sustainability in Africa: Exploring the Challenges and Prospects for ECOWAS. *African Development Review*, **31**(4), 517-528. DOI: <https://doi.org/10.1111/1467-8268.12406>

- [12]. Akinyemi, O., Osabuohien, E., Alege, P. & Ogundipe, A. (2017). Energy Security, Trade and Transition to Green Economy in Africa. *International Journal of Energy Economics and Policy*, **7(3)**, 127-136.
- [13]. Egbetokun, S., Osabuohien, E., Onanuga, O., Akinbobola, T., Gershon, O. & Okafor, V. (2020). Environmental Pollution, Economic Growth and Institutional Quality: Exploring the Nexus in Nigeria. *Management of Environmental Quality*, **31 (1)**, 18-31. DOI: 10.1108/MEQ-02-2019-0050
- [14]. Hu, H, Landrigan, PJ, Fuller, R, Lim, SS, Murray, CJL (2018). New Initiative aims at expanding Global Burden of Disease estimates for pollution and climate, *The Lancet Planetary Health*, **2(10)**, 415-416, DOI:[https://doi.org/10.1016/S2542-5196\(18\)30189-X](https://doi.org/10.1016/S2542-5196(18)30189-X)
- [15]. Godfrey, A, Le Roux-Rutledge, Cooke, S and Burton, M. (2009). Africa Talks Climate: The Public Understanding of Climate Change in Ten Countries; Department for International Development: London, UK, 2009. Available online: <http://downloads.bbc.co.uk/rmhttp/mediaaction/pdf/AfricaTalksClimateExecutiveSummary.pdf> (accessed on 10 March 2020).
- [16]. Dewi, R.P. and Khoirunisa, N (2018) Middle school student's perception of climate change at Boyolali District, Indonesia, *IOP Conf. Series: Earth and Environmental Science*, **200** (2018) 012061 doi :10.1088/1755-1315/200/1/012061
- [17]. Whitley, C.T.; Takahashi, B.; Zwickle, A.; Besley, J.C.; Lertpratchya, A.P. (2018). Sustainability behaviors among college students: An application of the VBN theory. *Environmental Education Research*, **24**, 245–262.
- [18]. Yang, L, Liao, W, Liu, C, Zhang, Na, Zhong, S and Huang, C (2018). Associations between Knowledge of the Causes and Perceived Impacts of Climate Change: A Cross-Sectional Survey of Medical, Public Health and Nursing Students in Universities in China. *International Journal of Environmental Research and Public Health*, **15**, 2650; doi:10.3390/ijerph15122650
- [19]. Agboola, OS and Emmanuel, M (2016). Awareness of Climate Change and Sustainable Development among Undergraduates from two Selected Universities in Oyo State, Nigeria. *World Journal of Education*, **6(3)**, 70-81.
- [20]. Mochizuki, Y and Bryan, A (2015) Climate Change Education in the Context of Education for Sustainable Development: Rationale and Principles. *Research*, **9(1)**, 4–26, 10.1177/0973408215569109
- [21]. Bakaç, E (2018). Engineering Faculty Students' Perceptions on Climate Change. *Environment and Ecology Research*, **6(4)**, 240-247, 2018 <http://www.hrpub.org>, DOI: 10.13189/eer.2018.060404
- [22]. Santos P.T., Bacelar-Nicolau P., Pardal M.A., Bacelar-Nicolau L., Azeiteiro U.M. (2016) Assessing Student Perceptions and Comprehension of Climate Change in Portuguese Higher Education Institutions. In: Leal Filho W., Adamson K., Dunk R., Azeiteiro U., Illingworth S., Alves F. (eds) *Implementing Climate Change Adaptation in Cities and Communities. Climate Change Management*. Springer, Cham
- [23]. Morgado, F., Bacelar-Nicolau, P., Rendon von Osten, J., Santos, P., Bacelar-Nicolau, L., Farooq, H., Alves, F., Soares, A. and Azeiteiro, U. (2017). Assessing university student perceptions and comprehension of climate change (Portugal, Mexico and Mozambique), *International Journal of Climate Change Strategies and Management*, **9(3)**, 316-336. <https://doi.org/10.1108/IJCCSM-08-2016-0123>

- [24]. Jamelske, E. Boulter, J, Jang, W, Barrett, J, Miller, L and Han, W (2015). Examining differences in public opinion on climate change between college students in China and the USA. *Journal of Environmental Studies and Sciences* (2015) **5**, 87–98, DOI 10.1007/s13412-015-0229-9
- [25]. Akrofi, M.M, Antwi, S.H. and Gumbo, J.R. (2019). Students in Climate Action: A Study of Some Influential Factors and Implications of Knowledge Gaps in Africa, *Environments*, 2019, **6**, 12; doi:10.3390/environments6020012
- [26]. Oruonye, E.D (2011). An assessment of the level of awareness of the effects of climate change among students of tertiary institutions in Jalingo Metropolis, Taraba State Nigeria. *Journal of Geography and Regional Planning*, **4(9)**, 513-517
- [27]. Ojomo, E, Elliott, M, Amjad, U and Bartram, J (2015). Climate Change Preparedness: A Knowledge and Attitudes Study in Southern Nigeria. *Environments*, 2015, **2**, 435-448; doi:10.3390/environments2040435
- [28]. Azeiteiro U.M., Bacelar-Nicolau P., Santos P.T., Bacelar-Nicolau L., Morgado F. (2018). Assessing High School Student Perceptions and Comprehension of Climate Change. In: Leal Filho W., Manolas E., Azul A., Azeiteiro U., McGhie H. (eds) *Handbook of Climate Change Communication: 3*, Climate Change Management, Springer, Cham
- [29]. Boylan, C (2008). Exploring elementary students' understanding of energy and climate change, *International Electronic Journal of Elementary Education*, **1(1)**, 1-15
- [30]. Vasileiou, K, Barnett, J, Thorpe, S Young, T (2018). Characterising and justifying sample size sufficiency in interview-based studies: systematic analysis of qualitative health research over a 15-year period, *BMC Medical Research Methodology* (2018) **18**:148 <https://doi.org/10.1186/s12874-018-0594-7>
- [31]. Sandelowski M. (1996). One is the liveliest number: the case orientation of qualitative research. *Research in Nursing and Health*, **19(6)**, 525–529.
- [32]. Saunders, B, Sim, J, Kingstone, T, Baker, S, Waterfield, J, Bernadette, B, Burroughs, H and Jinks, C. (2017). Saturation in qualitative research: exploring its conceptualisation and operationalisation. *Quality and Quantity* (2018) **52**, 1893–1907 <https://doi.org/10.1007/s11135-017-0574-8>
- [33]. Morse, J. M. (2015). Analytic Strategies and Sample Size. *Qualitative Health Research*, **25(10)**, 1317–1318. <https://doi.org/10.1177/1049732315602867>
- [34]. Guest, G., A. Bunce, and L. Johnson. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field Methods*, **18**, 59–82.
- [35]. Hsieh, H-F and Shannon, S.E. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research*, **15(9)**, 1277-1288, DOI: 10.1177/1049732305276687
- [36]. Rose, S, Spinks, N and Canhoto, A.I (2015). *Management research: applying the principles*. Routledge, Taylor and Francis, New York
- [37]. Ayanlade, A and Jegede, M.O (2016). Climate Change Education and Knowledge among Nigerian University Graduates. *Weather, Climate and Society*, **8**, DOI: 10.1175/WCAS-D-15-0071.1
- [38]. Hill, G, Heidrich, O, Creutzig, F and Blythe, P. (2019). The role of electric vehicles in near-term mitigation pathways and achieving the U.K.'s carbon budget, *Applied Energy*, **251**(2019), 113111

- [39]. Garcia, RB, Angulo, GV, JR, Tavizon, EF .(2014). LED Street Lighting as a Strategy for Climate Change Mitigation at Local Government Level, Proceedings of the IEEE 2014 Global Humanitarian Technology Conference, California, USA.