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## Research Article

### University Students' Climate Change Knowledge and Adaptation Practices: Baseline Data for the Development of Climate Change Engagement Model

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#### ABSTRACT

Climate change (CC) will continue to harm the environment if mitigation efforts are slow. Raising the CC knowledge and awareness of individuals is crucial in prompting significant mitigating action or adaptation practices. In addition, empowering young people will potentially ignite more innovative strategies that are helpful in decelerating the impacts of CC. The study aimed to determine students' knowledge of CC and their adaptive practices. Based on the findings, a model to engage students in CC action was developed. The respondents were 132 students in a State University in Region III enrolled in AY 2022-2023. Data were gathered using a validated self-made questionnaire. Findings revealed that while most respondents were knowledgeable of the concept of climate change (62.88%), a sizable percentage were still misinformed. In addition, the respondents knew the causes of CC such as the emission of greenhouse gases (87.12%), deforestation (57.58%), and excessive fertilizer use (37.88%) but some causes of climate change were unknown to them. Moreover, most of them were cognizant of the consequences of climate change which include excessive rain (96.21%), flood (95.45%), and melting of snow (94.70%). But the response to "drought" as one of the consequences of climate change was only known to a few students (47.73%). As to the knowledge of the health effects of climate change, most students knew CC raises respiratory, water-borne, and skin diseases but some expressed their lack of knowledge about other diseases such as the possibility of triggering cancer and mental health issues. Moreover, students have developed CC adaptive practices such as consuming more fruits and vegetables than meat and conserving energy use at home, but they were observed to be inconsistent in some areas such as in practicing the 3Rs and in throwing away less food. The F-value of 0.021 and 0.82 *p-value*, to compare the CC adaptive practices of the respondents with respect to gender, support the acceptance of the null hypothesis. Gender is not a determinant of CC adaptive practices. This

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indicates that gender is not a barrier to CC action. The study concludes that students have limited knowledge about climate change, especially on the health impacts. Also, the students' CC adaptive practices imply lack of commitment to act on CC. The study recommends strengthening the integration of climate change into school policies, research, extension, and instruction and a strong support of school stakeholders in their implementation. A climate change engagement model is an output of this study which may be considered by schools in prompting students to participate in CC action. A future study may include the factors that hinder students' consistent involvement in CC action despite their awareness and knowledge about the negative consequences.

**Keywords:** *Causes of climate change, Climate change adaptive practices, Climate Change Engagement, Consequences of climate change, Health effects of climate change, Perceptions of climate change*

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## Introduction

Climate change (CC) poses a serious threat to habitats (Yadvinder et al., 2020), animal health and welfare (Lacetera, 2019), and people's way of life (Heshmati, 2020). The health effects of CC on humans are becoming more pronounced, including mental health issues (Hayes et al., 2018 & Cianconi et al., 2020), and infectious, neurological, and cardiovascular diseases (Rocque et al., 2019). A secure environment, access to clean water, nutritious food, and clean air are all at stake, and these can potentially reverse long terms progress in global health (World Health Organization, 2022). Wildfires becoming more frequent and intense, and a warmer environment has led to a decrease in water resources and decreased agricultural products. In coastal dwellings, flooding, and erosion are becoming more frequent (Global Climate Change, 2022) and these conditions lead to respiratory and skin diseases. Likewise, cardiovascular disease, injuries, and early deaths brought on by weather extremes, shifts in the prevalence and geographic distribution of food- and water-borne illnesses, and other infectious diseases, and dangers to people's mental health are becoming apparent (Centers for Disease Control and Prevention, 2022).

Moreover, the economy is also affected by CC. Fawzy et al. (2020) reported that around 68.5 million people were affected by natural

calamities in 2018, and the economic damages amounted to \$131.7 billion. The economic costs of wildfires in 2018 were also reported to be roughly comparable to the total costs of wildfires over the past ten years. If CC action is slow, the impact on the economy would be predictable.

These negative impacts affirm the assertion of the Intergovernmental Panel on Climate Change (IPCC) that if global temperature rises above 1.5°C, catastrophic health effects and fatalities will be inevitable (World Health Organization (2021). Response to CC, therefore, should be prompt and forceful considering the enormous devastation the world is now experiencing. Support for Sustainable Development Goal Number 13, "Climate Action," must be strengthened and nations should take urgent and more aggressive action against the accelerating CC effects (United Nations, 2022). However, government leaders across the globe are observed to lack decisiveness in staging programs to curb climate change effects (Hoyer, 2021). According to Houge (2020), there were pledges to cut carbon emissions, but few of them are legally obligatory, and goals are frequently ignored.

The UN Framework Convention on Climate Change, the Paris Agreement, and the related Action for Climate Empowerment (ACE) agenda aim to inform, empower, and involve all stakeholders and key groups in climate change-

related policies and actions. However, despite widespread concern over climate change, there is still a lack of public support for aggressive initiatives (Fesenfeld & Rinscheid, 2022) against this global phenomenon. Delays in reducing emissions of carbon dioxide or other short-lived climatic pollutants are deemed detrimental to life and permanent effects on global warming, sea level rise, food security, and public health are a real threat to people. If there is a significant reduction of climate pollutants the rate of global temperature rise will slow down. There must be efforts to offset carbon dioxide emissions and keep temperature rise below 2°C (Climate and Clean Air Coalition, n.d.). The scientists cautioned that if global warming continues its current course, there will be serious repercussions. According to them, places that depend on snowmelt could experience a 20% decrease in water supply by the middle of the century if the climate rises by 2 degrees Celsius (3.6 degrees Fahrenheit). This would devastate agriculture and cause widespread food shortages and starvation (James, 2022).

Integrating climate change measures into national policies and plans is another essential move to reduce the impacts of CC and achieve a sustainable society. It is crucial to increase global resilience and adaptive capacities to the effects of global warming as well as education, awareness-raising, and the human and institutional ability for climate change mitigation. All levels of government must work together to accomplish Sustainable Development Goal number 13 (climate action). Local and regional government leaders must develop the skills and financial independence needed to carry out the objectives to act on climate change. Citizens must always remain at the center of all decisions (Council of Europe, 2022) since they need to unite for better implementation of climate change programs. Policy integration in climate change adaptation may be complex, and there are barriers that delay program implementations (Biesbroek, 2021) but government leaders must prioritize looking for ways to overcome obstacles. Russel et al. [2020] showed that while the European Union's climate change adaptation strategies may have encouraged nations to begin incorporating them into the national policy, they scarcely led to political

action, thereby resulting to constituting political failure. If other nations are similarly situated, then, climate change effects may become irreversible. A formidable starting point may start with access to data that enables early identification of what climate risks should be considered, which will lead to decision-making. To come up with sound decisions in handling climate change, information at the national level could be insufficient. Leaders must endeavor to seek information from the local level. This is because the effects of climate change vary even among towns, groups, and people. Supporting inclusive and participatory disaster risk reduction strategies and actively taking part in local and national inter-institutional coordination are viable ways to address climate change challenges (Canales, n.d.).

One of the sectors that can substantially contribute to CC action is the education sector. Climate change adaptation, mitigation, and action can only be attained if people are willing and committed to changing their traditional way of life. This can be possible if people are empowered to make decisions. Empowered decisions are borne out of a thorough understanding of what is really happening in the world amidst the climate change phenomenon. If people have the correct knowledge of the causes and effects of climate change, the communities' capacity to mitigate and adapt to climate change would be very much possible (Reid, 2019). Lack of knowledge is a major impediment to developing countries' efforts to adapt to climate change (Shahid & Piracha, 2016). As asserted by the World Health Organization (2022), increasing knowledge of the effects of climate change on health can help people adjust their behavior and support societal efforts to reduce greenhouse gas emissions. Additionally, it can aid in gaining the support of medical professionals for methods for mitigation and adaptation that will enhance health and lessen susceptibility.

Encouragingly, universities all around the world are becoming more aware of their role to educate students about climate change and develop skills necessary to actively contribute to climate change adaptation and mitigation. Higher education institutions are tasked with the responsibility of educating future

environmental auditors, community leaders, corporate managers, engineers, practitioners, technical professionals, policymakers, and, most importantly, the public about steps that can be taken to mitigate and adapt to climate change while also spreading social and governance measures. The cumulative increase in societal awareness gradually permeates and affects local and national governments. Community stakeholders should be able to manage climate change mitigation and adaptation in their respective spheres of influence, including through advocacy, daily actions, and professional careers (Leal Filho et al., 2021). Full awareness of the impacts of CC will ignite more serious concern from the school stakeholders, especially students. This concern for the planet and living systems can potentially result in a more aggressive CC action [United Nations Educational, Scientific and Cultural Organization (UNESCO), 2020]. Students' CC knowledge will enable them to make reasoned judgments over lifestyle choices; thus, reducing the anthropogenic causes of CC. Studies show that anthropogenic factors largely contribute to CC (Trenberth, 2018; Magnan, et al., 2021 & Abatzoglou and Williams, 2016). This implies that CC may be slowed down significantly if people change non-environment-friendly habits because of their awareness.

A study by Sulistyawati et al. (2018) found that participants' knowledge of climate change and its effects on health was inadequate and fragmented. They claimed that communicating with family members is how they prefer to learn about climate change. The researcher recommended that suitable content and medium, adolescent knowledge of climate change and health needs to be improved. Likewise, Gautam et al. (2021) found that only 50 percent of secondary school pupils in Biratnagar are sufficiently informed about how climate change is affecting people's health. Moreover, Ryan and Bustos (2019) found in their study that countries have significant knowledge gaps in the development, application, and assessment of adaptation policies and the knowledge that is currently accessible on the various components of climate adaptation concerns is fragmented and lacks integration, which has a significant

impact on how useful it is in the development of policy.

Awareness of climate change must be raised by including students in project work activities and highlighting it in the curricular components. In the Philippines, the study by Barreda (2018) showed that students generally had high awareness of climate change but the knowledge of the health effects of climate change was not included in the study.

Hence, a study to know the knowledge of students about climate change is therefore deemed significant because findings are inputs to curricular integration and enhancement of climate change awareness. In the university where the data were gathered, there has been no study yet that determined the knowledge of students about climate change. Based on the findings, strategies to integrate climate change in the university were recommended. More importantly, a model to engage students in climate change action was developed in this study.

The study's main problem was to assess freshmen students' knowledge about climate change and their adaptation practices. In addition, the CC adaptation practices of the students were also determined. The findings were considered in the climate change engagement model (CCEM) developed by the researcher to increase the engagement of students in climate change action. The model can be adopted by educational institutions to increase the impact of their participation in CC mitigation and adaptation.

## Methods

The descriptive research design was employed in this study. Respondents were 132 freshmen students broken down into 71 males, 52 females, and 9 members of the LGBTQ. The respondents were selected using convenience sampling (nonprobability). The respondents were enrolled in a State University in Central Luzon, Philippines. A validated questionnaire (with a 0.81 reliability index) was used to gather data. The researcher sent the link where the Google form for the questionnaire can be accessed to faculty members handling freshmen students. The faculty members in turn

sent the link to their students. Data gathering went on for four weeks. The researcher disabled access to the link after four weeks since there were no more responses from the

students. The data were analyzed using frequency and percent, mean, and Analysis of Variance (ANOVA).

## Results and Discussion

### *Knowledge of Students About the Causes of Climate Change*

*Table 1. Knowledge of the Respondents on the Causes of Climate Change*

Options	f	%
Industrialization	48	36.36
Deforestation	76	57.58
Release of Greenhouse gases	115	87.12
Excessive use of fertilizer	50	37.88
Earthquake	32	24.24
Volcanic eruption	12	9.09

\*Note: Multiple responses

The respondents are aware that greenhouse gases (87.12%), deforestation (57.58%), and excessive fertilizer use (37.88%) contribute to the global climate change that is now taking place. However, the low responses of the students to the other causes are manifestations that students did not have a thorough understanding of the causes of climate change. The findings are consistent with the results of the

study by Gautam et al. (2021) where most respondents knew deforestation, industrialization, and greenhouse gases are causes of climate change. Both results also showed low responses to other causes of climate change. Findings imply the need to enrich students' knowledge about the causes of climate change to prompt their involvement in climate change action.

### *Knowledge about the Environmental Consequences of Climate Change*

*Table 2. Knowledge of the Consequences of Climate change (CC)*

Consequences	f	%
Climate Change Affects rain patterns	111	84.09
Climate change affects wind patterns	109	82.58
Changes in wind pattern	86	61.15
Flood	126	95.45
Melting of Snow	125	94.70
Excessive Rain	127	96.21
Landslide	92	69.70
Drought	63	47.73
Heat waves	112	84.85
Cold waves	70	53.03

Table 2 shows that students are knowledgeable about the consequences as supported by the high percentage of responses except for drought which accounted for 47.73 % of the respondents. What most respondents know to be

the consequences of climate change include excessive rain (96.21%), flood (95.45%), and melting of snow (94.70%). Findings show that students are generally knowledgeable about the consequences of climate change.

**Knowledge of the Health Effects of Climate Change**

Table 3. Knowledge of the Health Effects of Climate change

Health Effects	f	%
1. Waterborne disease	78	59.09
2. Nutritional deficiencies	67	50.76
3. Vector-borne disease	45	34.09
4. Air pollution-related problems	67	50.76
5. Cancer	38	28.79
6. Mental Health Problems	25	19.08

On the health effects of climate change, students are aware that climate change can affect health such as water-borne diseases, nutritional deficiencies, vector-borne diseases, air pollution, cancer, and mental health as shown in Table 3. However, it is apparent that a sizable portion of students lacks information on the health effects of climate change. There is a low proportion of respondents who were knowledgeable of the possibility of developing cancer (28.79%) and mental health (19.08%). Nogueira et al. (2020), argued in their study that due to increased exposure, climate change is already raising the risk of cancer. During severe weather occurrences like hurricanes and wildfires, people are exposed to carcinogens. Climate change affects cancer survival in addition to raising cancer risk. Extreme weather conditions can make it more difficult for cancer patients to access care and for cancer treat-

ment centers to provide it. These factors necessitate that cancer treatment centers assess and reduce their own greenhouse gas emissions while also ensuring that their disaster preparedness plans can survive climate risks. Fortunately, many measures used to combat climate change also lower exposure to or releases of carcinogens. On the other hand, the study of Cianconi et al. (2020) concluded that climate change consequences might be immediate or delayed, direct or indirect, and positive or negative. Acute events may have effects via traumatic stress-like processes, resulting in psychopathological patterns that are well-understood. Additionally, exposure to intense or protracted weather-related events can have delayed effects, including diseases like posttraumatic stress disorder, or even be passed down to future generations.

**Respondents' Sources of Information About Climate Change**

Table 4. The Respondents' Sources of Information about Climate Change

Sources	f	%
Television	103	78.03
Teachers	100	75.76
Internet	118	89.39
Textbooks	73	55.30
Newspaper	45	34.09

\*Note: Multiple responses from the respondents

Students mostly get information about climate change from the internet (89.39%) followed by television (78.03%). The proportion of students claiming teachers as their source of information is 75.76%. Some learned about climate change from textbooks (55.30%) and others from newspapers (34.09%).

Findings show the three top sources of information among the respondents. These are the internet, television, and teachers. The findings are similar to the result of the study conducted by Gautam et al. (2021) in Nepal where television ranked the first source of climate change information followed by teachers and the internet. Findings imply the need to enrich

climate change news over television and the internet since these are the main platforms which students acquire knowledge from. Also, the

role of teachers in providing climate change information to students is manifested by the response of the students.

### **Respondents' Climate Change Adaptation Practices**

*Table 5. Climate Change Adaptation Practices of Students*

Adaptation practices	Often to Always (4)	Sometimes (3)	Rarely (2)	Never (1)	Mean	SD	Verbal Description
Do you use public transport?	81	39	10	2	3.51	0.05	Always to Often
Do you save energy at home?	71	47	13	1	3.42	0.07	Always to Often
Do you consume organic food?	68	51	11	2	3.40	0.05	Always to Often
Do you eat more fruits and vegetables than meat or fish?	71	44	14	3	3.39	0.11	Always to Often
Do you use more energy-efficient gadgets or appliances at home?	64	44	21	3	3.28	0.05	Always to Often
Do you plant trees or ornamental plants?	51	66	12	3	3.25	0.08	Sometimes
Do you influence family, friends, and others about ways on how to help act on climate change?	44	72	14	2	3.20	0.22	Sometimes
Do you practice recycling reusing, and reducing waste?	53	56	18	5	3.19	0.09	Sometimes
How do you walk or cycle going to school?	51	49	21	11	3.06	0.04	Sometimes
Do you participate in environmental campaigns in your school or barangay?	38	59	33	2	3.01	0.07	Sometimes
Do you throw away less food?	14	59	47	12	2.57	0.08	Sometimes

Legend: Never: 1-1.75; Rarely: 1.76-2.51; Sometimes: 2.52-3.27; Often to Always: 3.28-4.0

The adaptive practices of the students are shown in Table 5. The students claimed that they "often to always" use public transport ( $\bar{x}$ =3.51); save energy at home in terms of water use and electricity ( $\bar{x}$ =3.42); use more energy- consume organic food ( $\bar{x}$ =3.40); eat more fruits and vegetables than meat or fish ( $\bar{x}$ =3.39); and use more energy-efficient gadgets or appliances at home ( $\bar{x}$ =3.28) such as the energy saving LED lights.

The study findings are consistent with the results of the study conducted by Ratinen (2021) where students agreed that walking and biking are important strategies for mitigating climate change, reducing meat consumption, and switching off lights and electrical appliances when not in use.

Other adaptive practices were not regularly done, which included planting trees or ornamental plants; ( $\bar{x}$ =3.25); influencing family,

friends, and others about ways how to help act on climate change ( $\bar{x}$ =3.20); practicing recycling reusing, and reducing waste( $\bar{x}$ =3.19); walking or cycling going to school( $\bar{x}$ =3.06); participating in environmental campaigns in

school or barangay( $\bar{x}$ =3.01); and throwing away less food( $\bar{x}$ =2.57). The non-consistent sustainable practices of students were also noted by Purnomo and Kurinia (2019) among students in Indonesia.

**Comparison of CC Adaptive Practices based on Gender**

Table 6. Comparison of CC Adaptive Practices based on Gender

Profile	F-value	p-value	Decision	Interpretation
Gender	0.021	0.82	Accept Ho	Not Significant

Based on the computation of ANOVA, the F value generated is 0.021 and the p-value is 0.82. These values support the acceptance of the null hypothesis, which states that students' climate change adaptation practices do not differ significantly based on their gender. This means that gender has no influence on what students do to act on climate change. This implies further that gender is not a barrier to CC action.

**Proposed Climate Change Engagement Model (CCEM)**

The findings of the study showed that students are not fully knowledgeable of the possible consequences of climate change, especially on health and students are not consistent in doing their adaptive climate change practices. The proposed CCEM for climate change engagement will attempt to increase the involvement of students in climate change action or mitigation.

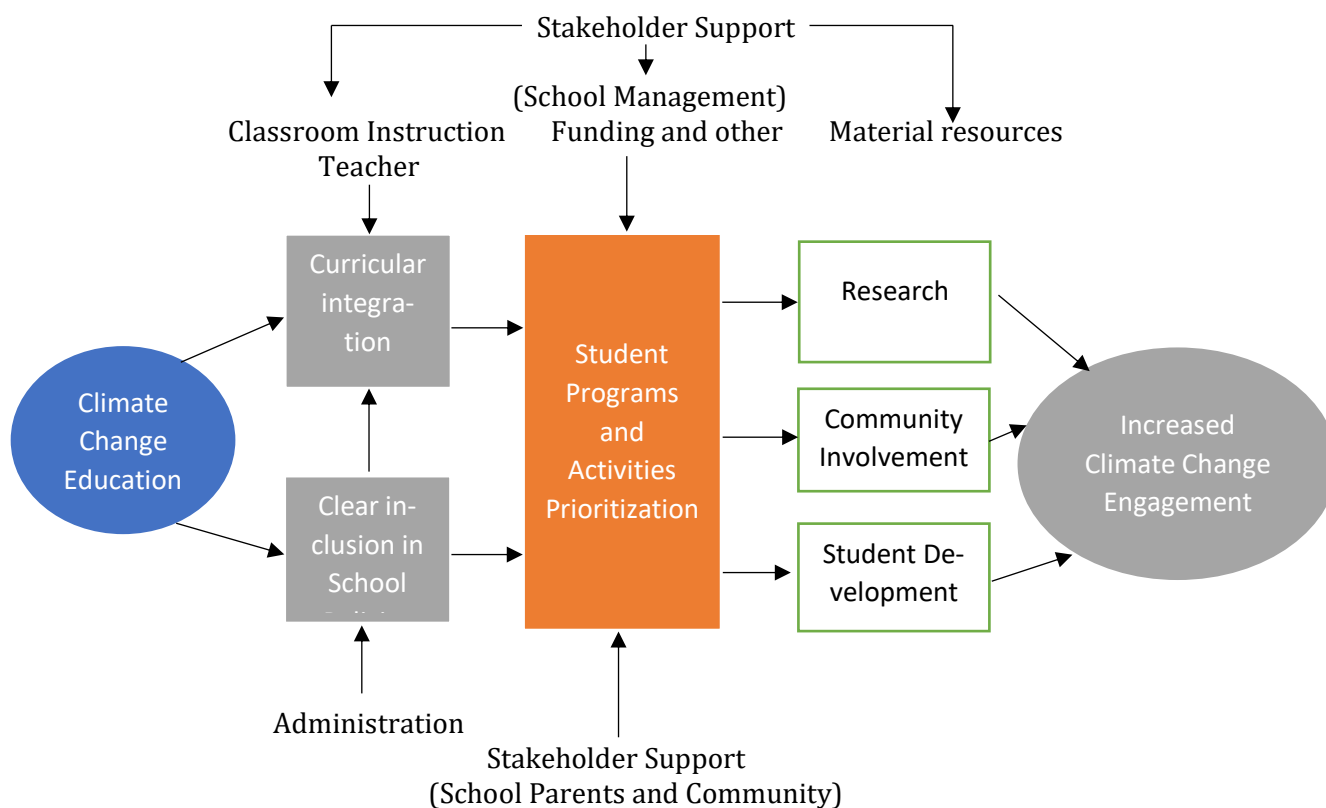


Figure 1. Climate Change Engagement Model (CCEM)



The Climate Change Engagement Model (CCEM) shown in Figure 1 emphasizes the need to prioritize climate change education in schools. At the administrative level, school policies must include climate change which will govern student programs and activities. At the classroom level, teachers must integrate climate change education into curricular programs. Discussions, classroom activities, and projects /assignments should include climate change education (CCE) to raise the awareness of students and cause them to develop intrinsic motivation for climate change action in school or in the community where they belong. All programs and activities related to climate change engagement must be fully supported by school stakeholders such as teachers, parents, the community, and the school management, especially for budget and other material resources. To effectively engage students in climate change mitigation and adaptation, teachers may encourage them to engage in research related to climate change. Likewise, students may also be encouraged to join community activities for climate change action. Seminars, training, or symposiums for students should also include topics on climate change.

## Conclusion

The findings of the study revealed that students have knowledge about climate change, its causes, and effects but not wide enough, especially on the health aspect. For example, students were not knowledgeable that climate change can cause cancer and mental health issues. This is a manifestation of the need to educate young people about the devastating effects of climate change, not only on physical health but also on mental health. There is an increasing number of mental health issues among young people today (Limone & Toto, 2022), and reducing climate change as a risk factor will be beneficial.

The results of the study bolster the conclusion of the research by the University of California San Francisco as cited by Fernandez (2022) that the effects of climate change will be felt acutely throughout the world, with an increased risk of cancer, particularly affecting the lungs, skin, and gastrointestinal organs, as well

as rising temperatures, wildfires, and poor air quality. Likewise, the World Health Organization (2022) also asserted that climate change poses significant hazards to mental health and well-being, and therefore, nations must be urged to integrate mental health assistance in their response to the climate change catastrophe. The results of the present study highly support these assertions. Educational institutions should then emphasize the health effects of climate change in programs or activities related to climate change awareness and action.

Moreover, the study found that students carried out adaptive climate change practices such as the use of public transport, saving energy at home in terms of water use and electricity, consuming organic food; eating more fruits and vegetables than meat or fish; and using more energy-efficient gadgets or appliances at home such as the energy saving LED lights. However, students were not consistent in other practical mitigating actions such as involvement in tree planting, the practice of the 3Rs, walking and cycling, and engaging in environmental campaigns. In addressing climate change, people must be consistent in their adaptation practices.

## Recommendations

Schools must enhance plans, programs, and policies to provide wide opportunities for students to be fully informed and involved in climate change action. There must be an increased awareness of the urgency of coming together to combat the effects of climate change. It is necessary to deepen the educational integration of climate change issues and provide opportunities for students to participate in climate change action. The Climate Change Engagement Model (CCEM) may be adopted in schools to increase student awareness and engagement in climate change mitigation and adaptation.

## Limitations of the Study

The selection of respondents employed a non-probability sampling technique. Future research may use probability sampling for more conclusive results.

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