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Is the Climate Change being Real? A Case Study of College Students' Climate Change Perception at Universiti Malaya

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Abstract

Climate change is a socio-scientific issue that affects human life. Climate change was induced by human activities (anthropogenic). People's perception of climate change might be important to taking action to address climate change. This paper aims to analyze horticulture class students' perceptions of climate change. Using a survey method, this study was conducted in the Biology Institute, Universiti Malaya, Malaysia. Fourthly, students who enroll in the horticulture class declare that they are willing to participate in the study. The questionnaire consists of 25 questions: reality (Q1-Q5), causes (Q6-Q10), valence of consequences 9 (Q11-Q14), spatial distribution (Q15-Q19), and temporal distribution (Q20-Q25). Data collection was done using a questionnaire in the form of a Google form that was completed for 30 minutes. The study finds that students believe climate change is a serious problem in the Malaysian region. Students also believe that climate change is caused by human activists rather than natural phenomena. Climate change has already been felt and is impacting local regions and the world. This climate crisis is causing a massive change in human lifestyle. In suggestion, all people around the world should take actions to tackling the climate change, both mitigation or adaptation ways. Mitigation and adaptation strategies are needed to limit the impact of climate change.

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INTRODUCTION

Climate change has been widely occurring in world regions. It's influences by the earth temperature increasement cause the human activity and reaching a crisis point (Baldwin et al., 2022). Climate change induced by human activities causes the world's rising temperatures. Human activities are causing climate change is shared by 97% of climate scientists (Cook et al., 2016). Human activities such as deforestation, greenhouse gas emissions, and land use change (Bodzin et al., 2014; Evseeva et al., 2021), thereby increasing the concentration of CO_2 gas in the atmosphere. CC can threaten food safety (Gitz et al., 2016), rising poverty rates (Hallegatte et al., 2016, 2018), Social inequality (Islam & Winkel, 2017), and biodiversity loss (Godfrey & Tunhuma, 2020). While Intergovernmental Panel on Climate Change (IPCC) reports predict global food shortages, coastal city flooding, and a refugee crisis unprecedented in history, critics argue that these documents fail to account for the economic costs of extreme weather events, as well as the displacement of people, among other factors that may exacerbate future climate scenarios. While most people agree that climate change is real (Steg et al., 2014), people may hold different beliefs about the extent to which climate change is caused by humans and what consequences it will have, where, and when (van Valkengoed et al., 2021).

Due to the severity of climate change impact, everyone should have a sense of responsibility to fight against CC through adaptation and mitigation strategies, including the youth (Kolenatý et al., 2022). Children and young people nowadays are growing up in unsure and perilous times, as the social, cultural, and environmental consequences of global climate change begin to infiltrate their daily lives and communities (Selby & Kagawa, 2010). Young people are forming their worldviews and behavioral patterns, and the cumulative effects of their lifestyle decisions and actions up to 2050 can make a significant difference in reducing Greenhouse Gas Emission (GGE). In addition, there is evidence of widespread worry about CC among children and youth (Clayton & Karazsia, 2020; Hickman et al., 2021) and a need to support and empower them with the knowledge they need to respond appropriately to these anxieties (Fielding & Head, 2012). This is due to the fact that they will be tomorrow's leaders, making decisions about transitioning to a low-carbon future to deal with environmental and societal consequences of CC (Hermans & Korhonen, 2017; Kuthe et al., 2019).

There are some studies who focuses on youth's willingness to act, knowledge, behavior, and attitude toward CC around the world. (Pickering et al., 2020a) focuses on 17–18-year-old Canadians' beliefs around whether their activities or lifestyle choices can help to lessen CC and knowledge of the efficacy of individual-level behaviors in reducing greenhouse gas emissions (GGE). Kuthe (2019) (Kuthe et al., 2019) emphasizes teenagers' level of climate change awareness in Germany and Austria. Hermans & Korhonen (2017) (Hermans & Korhonen, 2017) studied ninth graders' attitudes towards the consequences of climate change, their views on climate change mitigation and the impact of a set of selected predictors on their willingness to act in climate change mitigation. (Hickman et al., 2021) focuses on investigation of climate anxiety in children and young people globally and its relationship with perceived government response. Kolenaty (2022) (Kolenatý et al., 2022) investigate climate change education as a predictor of the youth's climate behavior. Lehnert et al., (2020) (Lehnert et al., 2020) assess their beliefs concerning the usefulness of actions that might ameliorate global warming and the degree to which they are willing to act. Other studies that focus on students' perceptions of climate change were conducted by Prasad & Mkumbachi (2021), 2021 surveying students at the Fiji Island Uniersity. Climate change perception in Malaysia has been explored by Yaacob et al. (2022), 2022 which focuses on community perceptions of the climate change issue in Peninsular Malaysia. Moreover, CC

awareness among students at Universiti Malaya is still being touched. Therefore, due to the typical Malaysian regions that save much biodiversity as tropical areas, climate action should be focused on and integrated into many fields of education. Furthermore, this study aims to reveal the students' current perception of climate change.

METHOD

A cross-sectional research design was employed in this study. The study was set to answer the research question: Are the biological students at Universiti Malaya undoubted climate change? This pity question could urge due to strategies will adopt to fight against it. People's perceptions of climate change have been of great interest for understanding how people respond to climate change. This study was a quantitative design with a survey method. The survey was taken during the 3rd week of May 2023 at the Biology Institute, Universiti Malaya. The surveyor was attending the students' class for one meeting. Students' climate change perceptions were taken by a questionnaire comprising 25 items from surveys in published studies (van Valkengoed et al., 2021). Questions were in the form of online forms (Google Forms). Categorize into five categories, which are reality (Q1-Q5), causes (Q6-Q10), valence of consequences 9 (Q11-Q14), spatial distribution (Q15-Q19), and temporal distribution (Q20-Q25). Responses were given on a 5-point Likert scale (1 = 'strongly disagree', 2 = 'agree', 3 = 'neutral', 4 = 'agree', 5 = 'strongly agree') for the positive questions, while ne negative questions follows Likert scale (1 = 'strongly agree', 2 = 'agree', 3 = 'neutral', 4 = 'disagree', 5 = 'strongly disagree').

The sample of this study included students who had enrolled in the horticulture class during their sixth semester (*N = 40, male = 10, female = 30*). Participants declared to be willing to fill out the test. Samples were chosen purposively with the criteria of students who have knowledge about the impact of climate change on human life, i.e, horticulture class. At first, the students' main lecture informs the students about the purpose of the survey. Students were gathering and sitting in their chairs. The survey activity began with the one session on guest lectures about apple crops and climate change. This session gives students a feeling of comfort and helps them avoid bias. At the end of the session, the surveyor gives students a barcode that can be scanned, which contains the URL Link. Students fill out the test for approximately 30 minutes. After all students finished their tasks, the class ended with the photo session. Students' climate change perception result was collected into a Google account and can be downloaded in CSV format. To make the analysis easier, we transform the CSV format into XLS format. The data was analyzed quantitatively using Excel. The score obtained is then calculated for the mean and standard deviation.

RESULT AND DISCUSSION

We describe the students' perception of climate change in detail as follows.

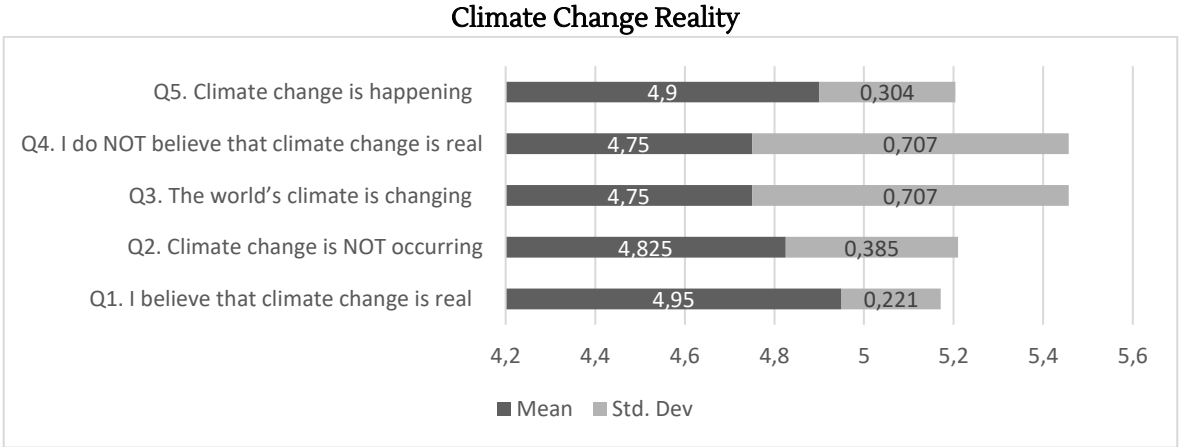

Figure 1. Students' Perception of Climate Change Causes

Based on the result, students' response of the question 1: *I believe that climate change is real* (mean = 4.950, Std. Dev = 0.221), question 3: *the world's climate is changing* (mean = 4.825, 0.385), question 5: *climate change is happening* (mean= 4.900, Std. Dev = 0.304). Students reject the question that climate change is not happening, represented by the response of question 2: *climate change is not occurring* (mean 4.825, Std.Dev = 0,385) and question 4: *I do not believe that climate change is real* (mean = 4.750, Std. Dev. = 0,707). All responses represented that students believe climate change is really happening and undoubted. Climate change has now become a reality, since many people in the 19th century kept questioning: Will human beings, by adding carbon dioxide and other heat-trapping gases to the atmosphere, significantly affect climate? (Somerville & Hassol, 2011). Despite Large portions of the general public in several countries denying the reality of climate change – and global warming in particular – most notably in the USA (Somerville & Hassol, 2011).

The fact that the Earth's climate has always changed over time is evidence that the warming condition isn't ever happening yet in history. There have been eight cycles of ice ages and warmer eras in the previous 800,000 years, with the end of the last ice age about 11,700 years ago marking the beginning of the contemporary climate era — and of human civilization. The majority of these temperature shifts are due to extremely slight differences in Earth's orbit that alter the quantity of solar energy our planet gets. The current warming trend is distinct in that it is certainly the product of human activity since the mid-1800s, and it is accelerating at a rate not seen in many millennia. Human activities have undeniably produced the atmospheric gases that have trapped more of the Sun's energy in the Earth system. This additional energy has warmed the atmosphere, ocean, and land, as well as causing widespread and rapid changes in the atmosphere, ocean, cryosphere, and biosphere (IPCC, 2022). In the mid-nineteenth century, scientists established the heat-trapping properties of carbon dioxide and other gases. Many of the scientific equipment used by NASA to investigate our climate are concerned with how these gases influence the passage of infrared radiation through the atmosphere. There is no doubt that higher greenhouse gas levels warm the Earth in response to the measured effects of these gas increases (Chan et al., 2018).

Some scientific evidences are seen and demonstrated by human civilization today, such as the loss of leaves by flowering plants when water supply is limited, as well as shelter-seeking behaviours and hibernation in animals in reaction to colder or drier conditions, are two of the most visible examples. Life on Earth appears to be adapted to some degree to a changing temperature, and this is evidence that climate changes, but our own experience with climate during our lifetimes, coupled with scientific records, also indicates that climate change is occurring. Also, the global temperature and precipitation patterns are being influenced by climate change. These consequences, in turn, have an impact on the severity and, in some circumstances, frequency of extreme environmental events such as forest fires, hurricanes, heat waves, floods, droughts, and storms (Rhodes, 2016). To deal with all these consequences, citizens, governments, international organizations, non-governmental organizations, schools, and universities are taking action to fight against the climate crisis. That action won't just impact the climate in the future; it could lead to more distrust of government among young people. Protests and campaigns to fight against the climate crisis indicate that the young generation has the knowledge, belief, and attitude toward climate change. In response to the climate crisis, studies have shown people's perception of climate change, including the public (Fernandino et al., 2019) and the student population (García Vinuesa et al., 2022; Pickering et al., 2020b).

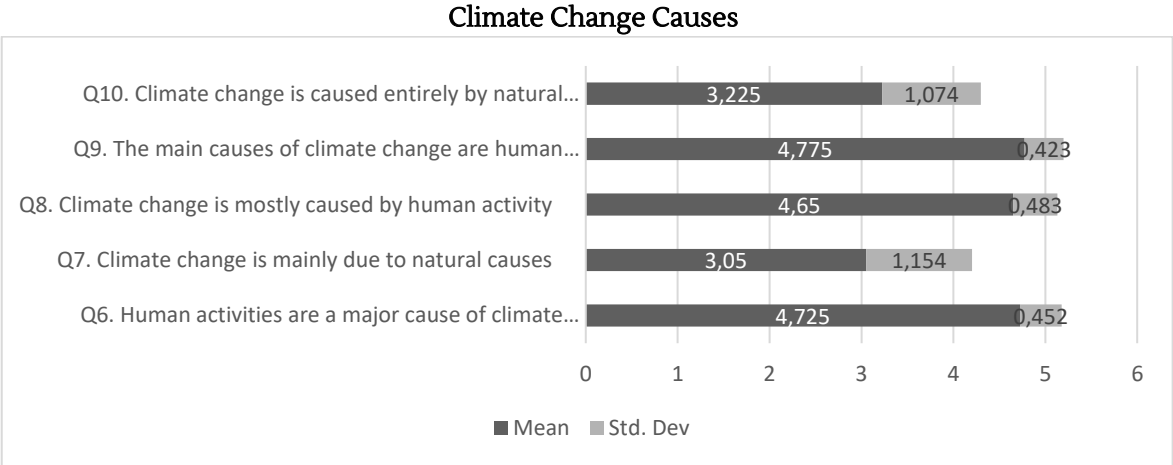

Figure 2. Students' Perception of Climate Change Causes

Based on the Figure 2, students' response to the questions related to the climate change causes as follows, question 6, *human activities are a major cause of the climate change* (mean = 4.725, Std. Dev = 0.452), question 8: *climate change is mostly caused by the human activity* (mean = 4.650, std. dev = 0.483), and question 9: *the main cause of climate change are human activities* (mean = 4.775, std. dev. = 0.423). This result means that students believe human activities cause climate change. On the other hand, students are also confused about whether the cause of climate change is human-induced or a natural phenomenon. This statement represents the finding of question 7: *climate change is mainly due to natural causes* (mean = 3.050, std. dev. = 1.154) and question 10: *climate change is caused entirely by natural processes* (mean = 3.225, std. dev. = 1.074). Climate change was undoubtedly caused by human activities (IPCC, 2021), which have been accumulating carbon emissions for years in the atmosphere and the heating trap.

Human activities have led to the release of Green House Gases (GHG) including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and the halocarbons (a group of gases containing fluorine, chlorine, and bromine). The GHG results in an accumulation of heat in the Earth's system, commonly referred to as "global warming". The Earth's climate has responded through higher temperatures in the atmosphere, land and ocean, ice melting, rising sea level, and increases in extreme weather events (heat waves, wildfires, heavy rains and flooding) (Trenberth, 2018). Indeed, changes in extremes have the greatest influence on society and the environment as a result of climate change. The changes caused by the rise of deforestation (Raitzer et al., 2015; Steel, 2014), land use change (Hansen et al., 2001), industries, and fossil fuel emission (Kaddo, 2016), Countries hold meetings to reach mutual agreements to reduce carbon emissions and keep the earth's temperature no more than 1.5°C compared to pre-industrial levels (Masson-Delmotte et al., 2019). The international framework of Sustainable Development Goals (SDGs) includes several goals, including climate action. Furthermore, some strategies and policies have been made to ensure the transition of sustainability.

Climate Change Valence of Consequences

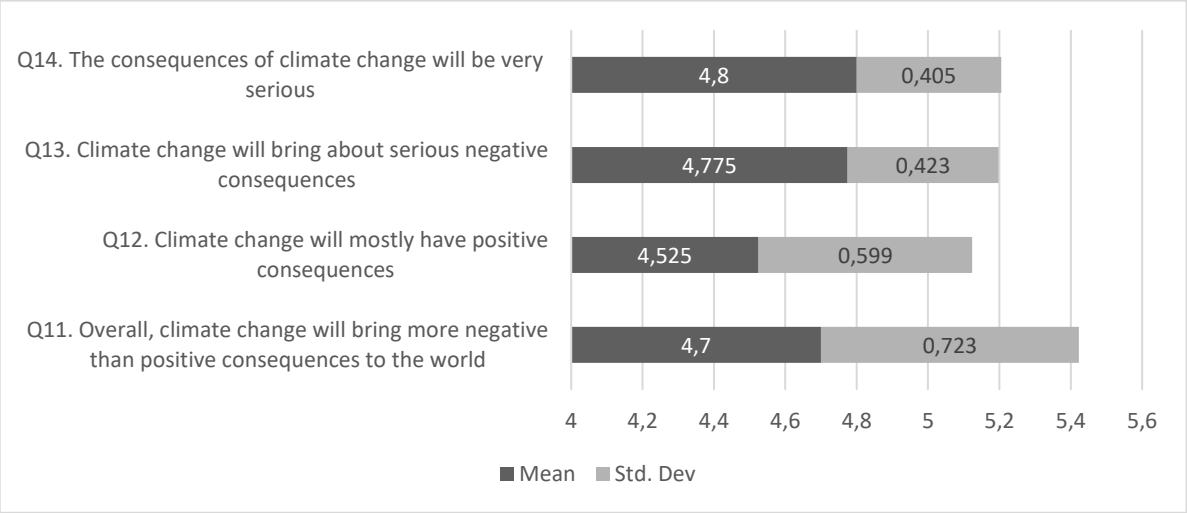

Figure 3. Students' Perception of Climate Change Valence of Consequences

Based on the Figure 3, students believe to the valence consequences of climate change was represented to the following questions; *overall, climate change will bring more negative than positive consequences to the world* (mean = 4.700, std. dev. = 0.723), *climate change will mostly have positive consequences* (mean = 4.525, std. dev. = 0.599), *climate change will bring about serious negative consequences* (mean = 4.775, std. dev. = 0.423), The *consequences of climate change will be very serious* (mean = 4.800, std. dev. = 0.405). Students' responses indicate that they believe climate change will bring negative consequences to the world. Climate change will have a negative impact on the environment and human civilization, including extreme events such as floods and droughts, long-term changes in sea levels, shifts in rainfall patterns, and increasing temperatures.

Even minor climate changes are likely to have significant and catastrophic implications that will almost surely affect every part of the globe. Around 8% of climate change is already occurring and is directly related to this global phenomenon. Global stability is under threat, with decreased stability accompanied by increased pressure on governments, as well as the risk of civil upheaval and political instability in countries (Warner & Boas, 2019). Many aspects of biodiversity are impacted by urbanization and rural development, including increased danger of forest fires and wildlife habitat loss. Changes in coastal land use have an impact on income distribution since coastal countries contribute a substantial portion of the world's natural resources, such as oil, gas, and coal (Tvaronavičienė, 2021). These impacts of climate change will be felt across multiple sectors and regions.

In the health sector, climate-related disorders such as asthma, allergies, respiratory ailments, and cancer are among the health consequences of climate change. As a result, the consequences of human health and environmental change on human health and the environment must be taken into account (Bell et al., 2018). It establishes a framework for assessing the consequences of changing air, land, and ocean temperatures, as well as minimizing anthropogenic uncertainty in health outcomes. All of this contributes to decisions on health, environmental sustainability, health care, and other concerns at the local, national, and global levels. There are some types of environmental degradation about which we need to understand more and take preventative steps. In order to reduce the detrimental effects of climate change on human health and the environment, we must confront its unavoidable consequences.

Climate Change Spatial Distance

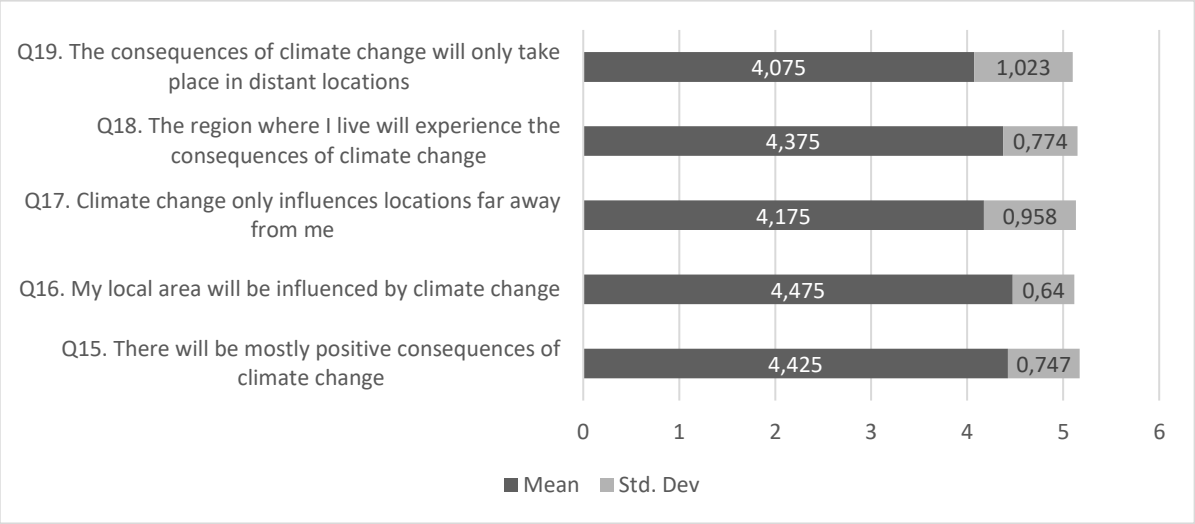

Figure 4. Students' Perception of Climate Change and Spatial Distances

Based on the Figure 4, students believe to the valence consequences of climate change was represented to the following questions, *there will be mostly positive consequences of climate change* (mean = 4.525, std. dev. = 0,747), *my local area will be influenced by climate change* (mean = 4.475, std. dev. = 0.640), *climate change only influences locations far away from me* (mean = 4.175, std. dev. = 0.958), *the region where I live will experience the consequences of climate change* (mean = 4.375, std. dev. = 0.774), *the consequences of climate change will only take place in distant locations* (mean = 4.075, std. dev. = 1.023). The result indicates that students believe climate change occurs not only at a far away from them but also in their local area. Climate change has occurred across the world. Polar ice shields are melting, and the sea is rising. In some regions, extreme weather events and rainfall are becoming more common while others are experiencing more extreme heat waves and droughts. Many countries have experienced the effects of climate change, including in Southeast Asian countries.

South East Asia is often faced with floods, as are larger tropical cyclones and storm surges. Extreme weather events are projected to become more intense and frequent, wreaking havoc on property, productive assets, human life, and livelihoods. Flooding in low-lying populated areas, such as coastal regions and river basins, will have an impact on farms and towns, as well as infrastructure like roads and bridges. Prolonged droughts are a concern throughout the dry season, especially during El Niño years, when longer summers, higher temperatures, and less rainfall reduce water levels in rivers, dams, and other reservoirs. This causes crop failure and jeopardizes food security as well as water availability for consumption, irrigation, and hydropower generation in locations where societal demand is increasing (Development Bank, 2009).

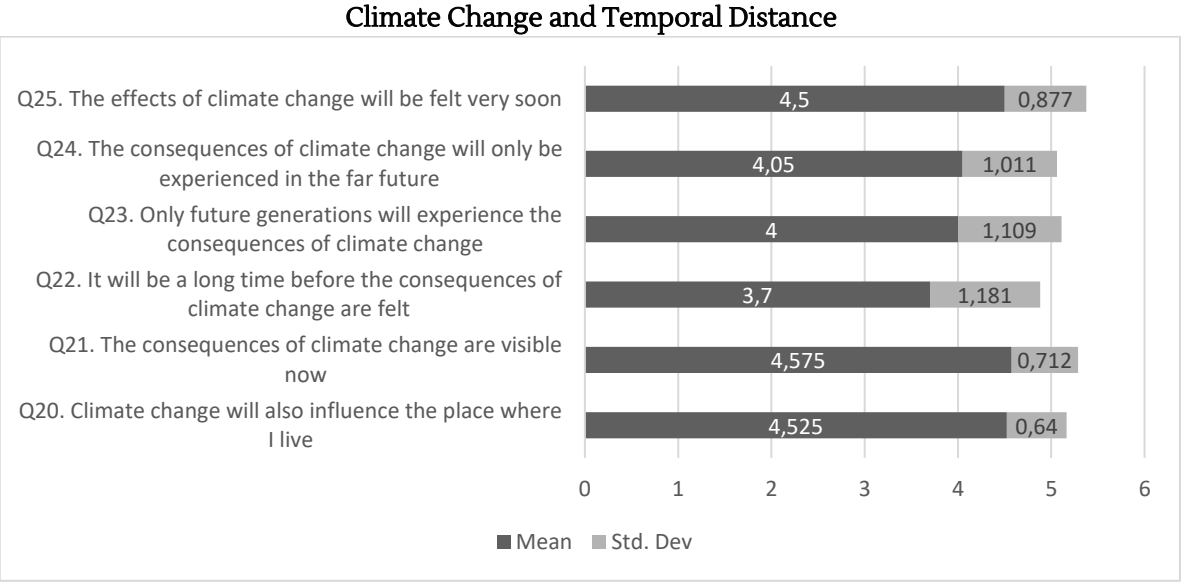

Figure 5. Students' Perception of Climate Change Temporal Distances

Based on the Figure 5, students believe to the valence consequences of climate change was represented to the following questions, *climate change will also influence the place where I live* (mean = 4.525, std. dev. = 0.640), *the consequences of climate change are visible now* (mean = 4.575, std. dev. = 0.712), *it will be a long time before the consequences of climate change are felt* (mean = 3.700, std. dev. = 1.181), *only future generations will experience the consequences of climate change* (mean = 4.000, std. dev. = 1.109), *the consequences of climate change will only be experienced in the far future* (mean = 4.050, std. dev. = 1.011), *the effects of climate change will be felt very soon* (mean = 4.500, std. dev. = 0.877). Based on the finding, students believe that climate change have impacting human life now and is not waiting for next year or even next generation.

Climate change has already been felt by all now because mitigation and adaptation strategies are really needed to tackle the crisis. Climate change mitigation entails avoiding and reducing heat-trapping greenhouse gas emissions into the atmosphere in order to keep the globe from warming to more extreme temperatures. Climate change adaptation entails changing our behavior, systems, and, in some circumstances, lifestyles to safeguard our families, economies, and the environment in which we live from the effects of climate change (Anderson, 2012). The more we reduce emissions now, the easier it will be to adapt to the changes we cannot prevent in the future. The actions or strategies should be implemented by all people with the government policies' help. Climate change mitigation and adaptation are done to save the lives of the young and the next generations.

CONCLUSION

Climate change is now to be considered as a global crisis that humans should fight against. From that background, it is important to know the students' perception of climate change. Also, people's perception be discerning to decide the adaptation and mitigation strategies could be taken. The study finds that students believe climate change is a serious problem in the Malaysian region. Students also believe that human activities rather than natural phenomena cause climate change. Climate change has already been felt and is impacting local regions and the world. This climate crisis is causing a massive change in human lifestyle. In suggestion, all people around the world should take actions to tackling the climate change, both in mitigation or adaptation ways. Mitigation and

adaptation strategies are needed to limit the impact of climate change.

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REFERENCES

Anderson, A. (2012). Climate Change Education for Mitigation and Adaptation. *Journal of Education for Sustainable Development*, *6*(2), 191–206.

Baldwin, C., Pickering, G., Dale, G., Baldwin, C., Pickering, G., & Knowledge, G. D. (2022). Knowledge and self-efficacy of youth to take action on climate change. *Environmental Education Research*, *0*(0), 1–20.

Bell, J. E., Brown, C. L., Conlon, K., Herring, S., Kunkel, K. E., Lawrimore, J., Luber, G., Schreck, C., Smith, A., & Uejio, C. (2018). Changes in extreme events and the potential impacts on human health. In *Journal of the Air and Waste Management Association* (Vol. 68, Issue 4, pp. 265–287). Taylor and Francis Inc. https://doi.org/10.1080/10962247.2017.1401017

Bodzin, A. M., Anastasio, D., Sahagian, D., Peffer, T., Dempsey, C., & Steelman, R. (2014). Investigating climate change understandings of urban middle-level students. *Journal of Geoscience Education*, *62*(4), 417–430. https://doi.org/10.5408/13-042.1

Chan, G., Stavins, R., & Ji, Z. (2018). *International Climate Change Policy*. https://doi.org/10.1146/annurev-resource

Clayton, S., & Karazsia, B. T. (2020). Development and validation of a measure of climate change anxiety. *Journal of Environmental Psychology*, *69*, 101434. https://doi.org/https://doi.org/10.1016/j.jenvp.2020.101434

Cook, J., Nuccitelli, D., Green, Sarah., Richardson, M., Winkler, B., Painting, R., Way, R., Jacobs, P., & Skuce, A. (2016). Consensus on consensus: a synthesis of consensus estimates on human-caused global warming. *Environmental Research Letters*, *11*(4).

Development Bank, A. (2009). *Climate Change in Southeast Asia Focused Actions on the Frontlines of Climate Change Contents*.

Evseeva, O., Evseeva, S., & Dudarenko, T. (2021). The impact of human activity on the global warming. *E3S Web of Conferences*, *284*, 11017. https://doi.org/10.1051/e3sconf/202128411017

Fernandino, G., Elliff, C. I., Sousa, J. H. de O., Frutuosa, G. A., Gama, H. S., & Albuquerque, I. S. (2019). Public perceptions of climate change: a case study with school teachers and undergraduate students in Brazil. *Royal Meteorological Society*, *74*(9), 320–325.

Fielding, K. S., & Head, B. W. (2012). Determinants of young Australians' environmental actions: the role of responsibility attributions, locus of control, knowledge and attitudes. *Environmental Education Research*, *18*(2), 171–186. https://doi.org/10.1080/13504622.2011.592936

García Vinuesa, A., Rui Mucova, S. A., Azeiteiro, U. M., Meira Cartea, P. Á., & Pereira, M. (2022). Mozambican students' knowledge and perceptions about climate change: an exploratory study in Pemba City. *International Research in Geographical and Environmental Education*, *31*(1), 5–21. https://doi.org/10.1080/10382046.2020.1863671

Gitz, Vincent., Meybeck, Alexandre., Lipper, Leslie., Young, Cassandra., & Braatz, Susan. (2016). Climate change and

food security: Risks and responses. In *Food and Agriculture Organization of the United Nations*. https://doi.org/10.1080/14767058.2017.1347921

Godfrey, S., & Tunhuma, F. A. (2020). The Climate Crisis: Climate Change Impacts, Trends and Vulnerabilities of Children in Sub Saharan Africa. In *UNICEF*. https://doi.org/10.2307/j.ctvmd85w3.12

Hallegatte, S., Bangalore, M., Bonzanigo, L., Fay, M., Kane, T., Narloch, U., Rozenberg, J., Treguer, D., & Vogt-Schilb, A. (2016). Poverty and climate change: Reducing the Vulnerability of the Poor through Adaptation. In *The Economics of Climate-Resilient Development*. https://doi.org/10.4337/9781785360312.00012

Hallegatte, S., Fay, M., & Barbier, E. B. (2018). Poverty and climate change: introduction. *Environment and Development Economics*, *23*(3), 217–233. https://doi.org/DOI: 10.1017/S1355770X18000141

Hansen, A. J., Neilson, R. P., Dale, V. H., Flather, C. H., Iverson, L. R., Currie, D. J., Shafer, S., Cook, R., & Bartlein, P. J. (2001). Global Change in Forests: Responses of Species, Communities, and Biomes: Interactions between climate change and land use are projected to cause large shifts in biodiversity. *BioScience*, *51*(9), 765–779. https://doi.org/10.1641/0006-3568(2001)051[0765:GCIFRO]2.0.CO;2

Hermans, M., & Korhonen, J. (2017). Ninth graders and climate change: Attitudes towards consequences, views on mitigation, and predictors of willingness to act. *International Research in Geographical and Environmental Education*, *26*(3), 223–239. https://doi.org/10.1080/10382046.2017.1330035

Hickman, C., Marks, E., Pihkala, P., Clayton, S., Lewandowski, R. E., Mayall, E. E., Wray, B., Mellor, C., & van Susteren, L. (2021). Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. *The Lancet Planetary Health*, *5*(12), e863–e873. https://doi.org/10.1016/S2542-5196(21)00278-3

IPCC. (2021). Climate Change 2021: The Physical Science Basis - Summary for the Policymakers (Working Group I). In *Climate Change 2021: The Physical Science Basis.*

IPCC. (2022). *IPCC AR6 Working Group II: Headline Statements from the Summary for Policymakers* (Vol. 2022, Issue February).

Islam, N., & Winkel, J. (2017). Climate change and social inequality: The health and social costs of global warming. In *Department of Economic & Social Affairs* (Issue 152, pp. 1–247). https://doi.org/10.4324/9781315103358

Kaddo, J. R. (2016). *Parkland College Climate Change: Causes, Effects, and Solutions*. http://spark.parkland.edu/ah/164

Kolenatý, M., Kroufek, R., & Činčera, J. (2022). What Triggers Climate Action: The Impact of a Climate Change Education Program on Students' Climate Literacy and Their Willingness to Act. *Sustainability (Switzerland)*, *14*(16). https://doi.org/10.3390/su141610365

Kuthe, A., Keller, L., Körfgen, A., Stötter, H., Oberrauch, A., & Höferl, K. M. (2019). How many young generations are there?—A typology of teenagers' climate change awareness in Germany and Austria. *Journal of Environmental Education*, *50*(3), 172–182. https://doi.org/10.1080/00958964.2019.1598927

Lehnert, M., Fiedor, D., Frajer, J., Hercik, J., & Jurek, M. (2020). Czech students and mitigation of global warming: beliefs and willingness to take action. *Environmental Education Research*, *26*(6), 864–889. https://doi.org/10.1080/13504622.2019.1694140

Masson-Delmotte, V., Zhai, P., Pörtner, H.-O., Roberts, D., Skea, J., Shukla, P. R., Pirani, A., Moufouma-Okia, W., Péan,

C., Pidcock, R., Connors, S., Matthews, J. B. R., Chen, Y., Zhou, X., Gomis, M. I., Lonnoy, E., Maycock, T., Tignor, M., & Waterfield, T. (2019). *Global warming of 1.5°C*. www.environmentalgraphiti.org

Pickering, G. J., Schoen, K., Botta, M., & Fazio, X. (2020a). Exploration of youth knowledge and perceptions of individual-level climate mitigation action. *Environmental Research Letters*, *15*(10). https://doi.org/10.1088/1748-9326/abb492

Pickering, G. J., Schoen, K., Botta, M., & Fazio, X. (2020b). Exploration of youth knowledge and perceptions of individual-level climate mitigation action. *Environmental Research Letters*, *15*(10). https://doi.org/10.1088/1748-9326/abb492

Prasad, R. R., & Mkumbachi, R. L. (2021). University students' perceptions of climate change: the case study of the University of the South Pacific-Fiji Islands. *International Journal of Climate Change Strategies and Management*, *13*(4–5), 416–434. https://doi.org/10.1108/IJCCSM-12-2020-0126

Raitzer, D. A., Bosello, F., Tavoni, M., Orecchia, C., Marangoni, G., & Nuella Samson, J. G. (2015). *Southeast Asia and the Economics of Global Climate Stabilization*.

Rhodes, C. J. (2016). The 2015 Paris climate change conference: COP21. *Science Progress*, *99*(1), 97–104. https://doi.org/10.3184/003685016X14528569315192

Selby, D., & Kagawa, F. (2010). Runaway Climate Change as Challenge to the 'Closing Circle' of Education for Sustainable Development. *Journal of Education for Sustainable Development*, *4*(1), 37–50. https://doi.org/10.1177/097340820900400111

Somerville, R. C. J., & Hassol, S. J. (2011). Why the confusion? Communicating the science of climate change. In *Physics Today*. www.physicstoday.org

Steel, B. S. (2014). Deforestation and Forest Degradation. *Science and Politics: An A-to-Z Guide to Issues and Controversies*, *February*. https://doi.org/10.4135/9781483346328.n39

Steg, L., Perlaviciute, G., van der Werff, E., & Lurvink, J. (2014). The Significance of Hedonic Values for Environmentally Relevant Attitudes, Preferences, and Actions. *Environment and Behavior*, *46*(2), 163–192. https://doi.org/10.1177/0013916512454730

Trenberth, K. E. (2018). Climate change caused by human activities is happening and it already has major consequences. In *Journal of Energy and Natural Resources Law* (Vol. 36, Issue 4, pp. 463–481). Taylor and Francis Ltd. https://doi.org/10.1080/02646811.2018.1450895

Tvaronavičienė, M. (2021). Effects of climate change on environmental sustainability. *E3S Web of Conferences*, *250*. https://doi.org/10.1051/e3sconf/202125001005

van Valkengoed, A. M., Steg, L., & Perlaviciute, G. (2021). Development and validation of a climate change perceptions scale. *Journal of Environmental Psychology*, *76*(March 2020), 101652. https://doi.org/10.1016/j.jenvp.2021.101652

Warner, J., & Boas, I. (2019). Securitization of climate change: How invoking global dangers for instrumental ends can backfire. *Environment and Planning C: Politics and Space*, *37*(8), 1471–1488. https://doi.org/10.1177/2399654419834018

Yaacob, M., So, W. W. M., & Iizuka, N. (2022). Exploring Community Perceptions of Climate Change Issues in Peninsular Malaysia. *Sustainability (Switzerland)*, *14*(13). https://doi.org/10.3390/su14137756