RESEARCH ARTICLE

Exploring students' climate change perception: the key factor of climate change mitigation and adaptation

Maisuna Kundariati[a,1], I. Ibrohim[a,2,*], Fatchur Rohman[a,3], Safwatun Nida[b,4], Wachidah Hayuana[a,5], Zia Aulia Zaidin Putra[a,6]

[a] Department of Biology, Faculty of Mathematics and Science, Universitas Negeri Malang, Jl. Semarang No. 5 Malang, East Java 65145, Indonesia

[b] Department of Science Education, Faculty of Mathematics and Science, Universitas Negeri Malang, Jl. Semarang No. 5Malang, East Java 65145, Indonesia

[1]maisuna.kundariati.2203419@students.um.ac.id; [2*]ibrohim.fmipa@um.ac.id;

[3]fatchur.rohman.fmipa@um.ac.id; [4]safwatun.nida.fmipa@um.ac.id;

[5]wachidah.hayuana.2103418@students.um.ac.id; [6]zazputra1992@gmail.com

Abstract: Climate change has felt by all individual now. Its impact is massive change in human daily life across countries. Therefore, it is necessary to assess students, as a youth, climate change perception. This study aimed to analyze the tenth grader students' climate change perception. This study is a quantitative design, with survey method. Using questioners, we were collected 283 high school students in Malang, Indonesia. All students are willing to giving their answer to the questions. Students were asked to rate the items based on the quality and relevance to the type of climate change perception that these items were supposed to assess on a scale from 1 (Terrible) to 5 (Excellent). The five items for each type of climate change perception were selected with 25 item questions in total. Five categories are: 1) reality (Q1-Q5), 2) causes (Q6-Q10), 3) valence of consequences (Q11-Q15), 4) spatial distances (Q16-Q20), 5) temporal distances (Q21-Q25). This study reveals that students have a belief that climate change is real. Some students have used to doing good habits to reduce energy use and have the will to tackle the crisis. Students also believe that climate change was caused by the human activities rather than natural phenomenon. Students have a good understanding of climate change, but there are still many students who have not yet taken their action to tackle climate change. From the result, we briefly argue that student's climate should be integrated in school learning in a form of climate change education to ensuring them taking their climate action in daily life.

Keywords: adaptation; climate change perception; mitigation

For correspondence:
ibrohim.fmipa@um.ac.id

Article history:
Received: 9 March 2024
Revised: 22 March 2024
Accepted: 27 March 2024
Published: 29 March 2024

10.22219/jpbi.v10i1.32655

p-ISSN: 2442-3750
e-ISSN: 2537-6204

How to cite:
Kundariati, M., Ibrohim, I., Rohmana, F., Nidab, S., Hayuanaa, W., & Putra,Z.A.A. (2024). Exploring students' climate change perception: the key factor of climate change mitigation and adaptation. *JPBI (Jurnal Pendidikan Biologi Indonesia), 10*(1), 185-194. https://doi.org/10.22219/jpbi.v10i1.32655

Introduction

Climate change has been faced by nations, including in Indonesia. Climate change has reportedly occurred since the industrial revolution (Wandana et al., 2020). CO_2 concentration in the atmosphere had risen to 48% above its pre-industrial level (before 1750). This situation was driven by human activities including coal electricity sources, deforestation (Leon et al., 2022), land use land change (Hansen et al., 2001; Ward et al., 2014), and transportation are the main sectors producing carbon dioxide. Other activities such as animal husbandry and poor waste handling also contribute to CH_4 gas emissions which also causing global warming (Rojas-Downing et al., 2017). Greenhouse gases, i.e CO_2, CH_4, CFCs cause the retention of some solar heat on the earth called the greenhouse effect and cause global warming. Thus, global warming and climate change lie in the cause-and-effect, human-induced warming contributes to broader changes in the Earth's climate system, manifesting as alterations in various climate parameters and patterns.

Signs of global warming can be seen from the rising sea levels, loss of a number of small islands (van der Ploeg et al., 2020), and the melting ice (Walsh, 2013). While the impact of the climate crisis can be seen in almost all countries and threatens food security (Gezimu Gebre et al., 2023; Gitz et al., 2016), gives rise to new disease outbreaks (Assunção et al., 2018; Hauser et al., 2021). Indonesia is geographically an archipelago surrounded by oceans making it vulnerable to natural disasters such as

storms and floods. The threat of drought also often hits a number of regions of Indonesia, especially eastern Indonesia. Furthermore, it is crucial for people to taking part of mitigation and/or adaptation strategies addressing the climate change (Anderson, 2012). Therefore, climate change perception among individual is the key factor to mitigate and adapted in the climate crisis.

Studies on investigating climate perception been done across nations (Aleixo et al., 2021; Prasad & Mkumbachi, 2021; Ratinen, 2021; Wang & Zhou, 2020; Zeeshan et al., 2021). The geographical distribution of climate change perception is of paramount importance in contemporary climate discourse, reflecting the nuanced ways in which diverse communities experience and interpret the impacts of climate change. Recent research underscores the significance of regional context in shaping public awareness and attitudes toward climate change. For example, a study highlighted the spatial variability in climate change beliefs across the United States, emphasizing the role of local climate experiences and political ideologies in influencing public perception (Spektor et al., 2023). Additionally, the work explored the connection between geographic location and adaptation strategies, recognizing the need for region-specific approaches to address the differential impacts of climate change on vulnerable communities (Fu et al., 2022). Understanding the geographical nuances is crucial for tailoring communication and policy efforts, as emphasized by recent findings from the Yale Program on Climate Change Communication (Leiserowitz, 2019), which reveal the importance of localized messaging to effectively engage communities in climate action. Recognizing and respecting these geographic variations in climate change perception is instrumental in developing targeted and contextually relevant interventions to foster sustainable practices and resilience at both local and global scales.

From the literature review we have described, a study on students' climate change perception among Indonesian students is still limited. Because the geographical influence students' climate change perception, country such as Indonesia is matter to investigate. Indonesia have facing several disasters and social issues which related to the climate change, it become crucial to take primary step to tackling this problem. Indonesia is located in the equatorial region which provides climate opportunities and challenges. Phenomena such as floods, droughts, heat waves are very likely to occur in climate change scenarios, but Indonesia also has extensive tropical forests that can absorb carbon which causes greenhouse gases. This study aims to explore high school students' climate change perception at Malang City, one of the cities which impacted by the climate change. Students are important subjects in the evaluation of climate change perception, because young people can be agents of sustainable change. By knowing the perception of climate change, we can determine steps in carrying out mitigation and adaptation efforts through education with holistic and systematic, so as to achieve the goal of SDGs 13-climate action.

Method

Research Setting

This study adopted a cross-sectional survey design (Cresswell, 2011). This cross-sectional survey design in this research was conducted in May-September 2023 at six senior high schools at Malang, East Java, Indonesia. This study aims to analyse high school students' climate change perception. The cross-sectional design provides researchers to measure and observe variable at the same time (Ibrohim et al., 2023).

Participant

In this study, we aimed for a sample size of 283 participant. Participants was 10th graders of six high school student at Malang City, East Java, Indonesia. Those willing to participate were provided with the link to the online questionnaire. The participants' demography was present at Table 1.

Table 1. Participants' Demography

Criteria	Groups	n (N=283)	Percentage (%)
Gender	Male	99	34.98
	Female	184	65.02
Age	>15	5	0.02
	15-16	268	94.67
	<16	10	35.33

Based on Table 1, the most participants were women (65.02%) while men were only 34.98%. The average age of participants in this study was in the age range of 15-16, which was 94.67%.

Instruments and Data Collection

Students were asked to rate the items based on the quality and relevance to the type of climate change perception that these items were supposed to assess on a scale from 1 (Terrible) to 5 (Excellent). The five items for each type of climate change perception were selected with 25 item questions in total. Five categories are: 1) reality (Q1-Q5), 2) causes (Q6-Q10), 3) valence of consequences (Q11-Q15), 4) spatial distances (Q16-Q20), 5) temporal distances (Q21-Q25). This research instrument adapts from the climate change perception instrument developed by van Valkengoed, Steg & Perlaviciute (2021). Questions are distributed in the form of Google Forms. This is done to support paperless programs. The research permit was certified by the department on education Malang, East Java and the principal. Licensing is used to ensure that these activities are known and granted permission by the school. After obtaining permission to collect data, researchers gave questionnaires to six biology teachers in six schools to distribute to students. The questionnaire was carried out at the end of the biology learning hour for approximately 30 minutes, so as not to interfere with the course of learning at school. The teacher will check students who have and have not completed the questionnaire. On the google form, it has been arranged once so that students can only answer the questionnaire once.

Data Analysis

The data obtained is the result of filling out student questionnaires stored in Google Form. Data is downloaded in .csv form and then converted into .xls for easy data analysis. Next, the data obtained are sorted by gender and age. These two criteria are important factors in the analysis of climate change perceptions because gender is closely related and influential to climate change perceptions (Bessah et al., 2021; Haque et al., 2023). While age describes the cognitive level of students or participants in this study. Next, the data is sorted by answers and scores. The highest score was 5 (strongly agree) and the lowest was 1 (strongly disagree) for questions that expressed agreement with the statement. Other questions have the highest score of 4 (always) and the lowest score of 1 (never) for questions that ask frequency. Meanwhile, other questions ask for feelings of care or willingness to be acted on given a choice of score ranges of 1-10. Data that has been converted into scores is searched for the frequency that appears the most and expressed in percentage form. This percentage illustrates the student's perspective on climate change.

Results and Discussion

The result of climate change perception among high school students present below. Students' climate change perception figuring the seven indicators; 1) climate change related behavior, 2) climate reality, 3) climate change causes, 4) valence of consequences, 5) spatial distances, 6) temporal distances, 7) willingness to act.

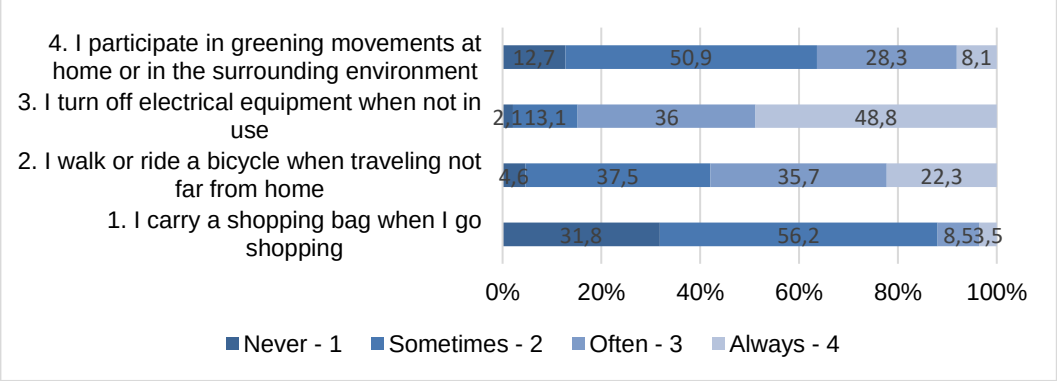

Figure 1. Questions assessing climate change related behavior among 283 students

Questions on Figure 1 present the students' climate change related behavior. The majority of students

stated that they sometimes carry a shopping bag when shopping (56.2%), sometimes use a bicycle when traveling not far from home (37.5%), always turn off the electronic devices after use (48.8%), and sometimes participate in greening movement (50.9%). Sustainability behavior looks better in students' habits of turning off electronic devices rather than using bicycles. The same categories were mentioned most frequently when participants were asked to describe the contributions, they were already making to climate reality (Figure 2).

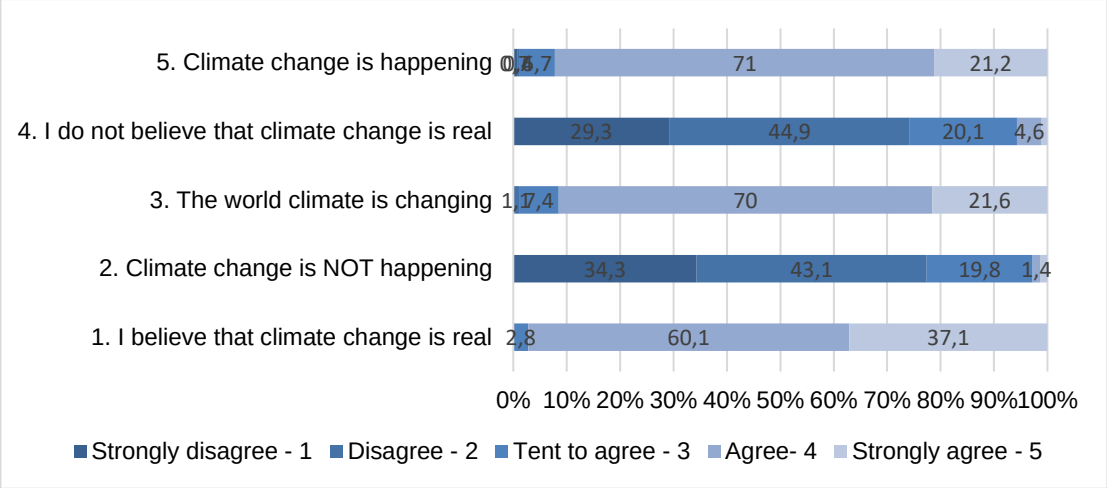

Figure 2. Questions assessing climate reality among 283 students

Questions Figure 2 represents the students' acceptance of climate reality. The majority of students say believe that climate change is real (60.1%), the world climate is changing (70%), and climate change is happening (44.9%). When students were asked negative questions, such as climate change is not happening, most of them answered disagree (43.3%) and strongly disagree (34.3%). Another negative statement was I do not believe climate change is real, most students answered disagree (44.9%). While the link of climate change cause students' perception tends to be caused by human activities (Figure 3).

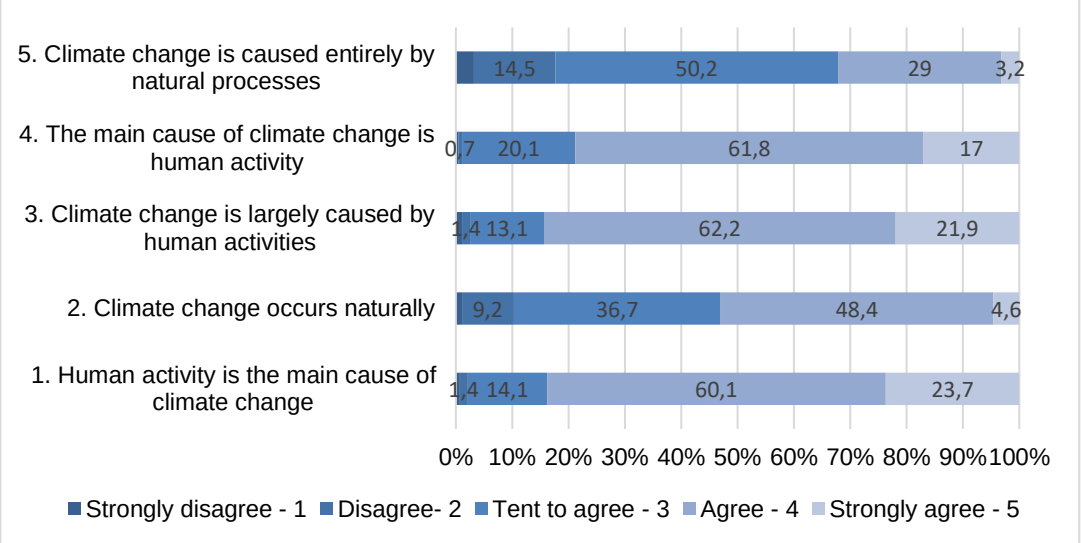

Figure 3. Questions assessing climate causes

Questions at Figure 3 representing the students' perception on climate change causes. The majority students believe that human activities are the main causes of climate change (60,1%), climate change occurs naturally (48,4%), climate change is largely caused by human activities (62,2%), the main cause of climate change is human activity (61,8%), and climate change is caused by natural processes (50,2%). Students seem confused about whether climate change is a natural phenomenon, or human induced

instead. This is natural because climate is a natural process, but climate change can be said to be a natural process where the changing was induced by humans. Climate change has been known to bring consequences to the human life, while the students believe about the climate change valence consequences can be seen in Figure 4.

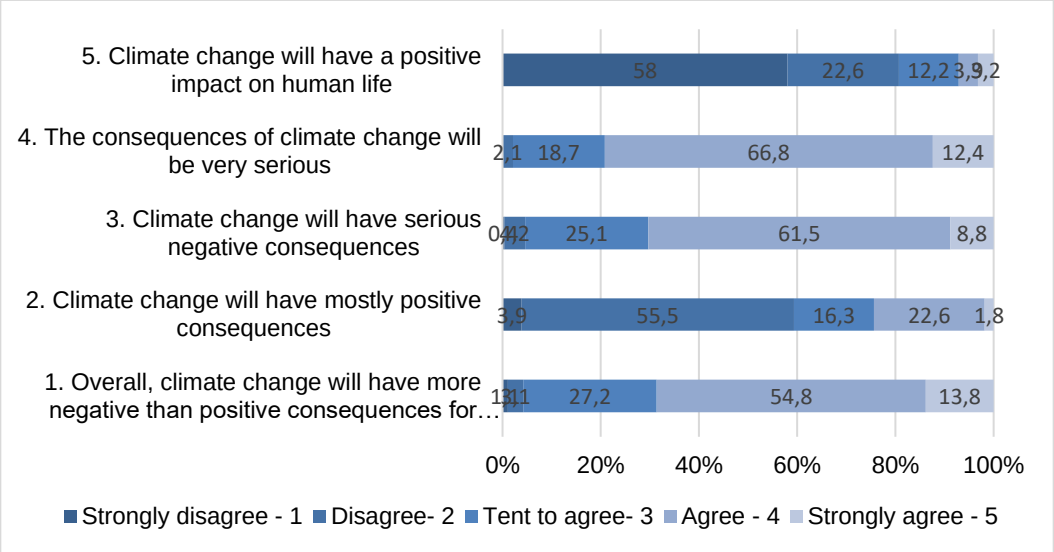

Figure 4. Questions assessing valence of consequences of the climate change

Questions on Figure 4 represent the valence of consequences of the climate change. Mostly, students answer that climate change have more negative than positive consequences for the world (54,8%), climate change will have serious negative consequences (61,5%), the consequences of climate change will be very serious (66,8%). meanwhile they are disagreeing that climate change will have mostly positive consequences (55,55%) and strongly disagree that climate change will have positive impact on human life (58%). While, the spatial impact relate to the climate change will be seen at Figure 5.

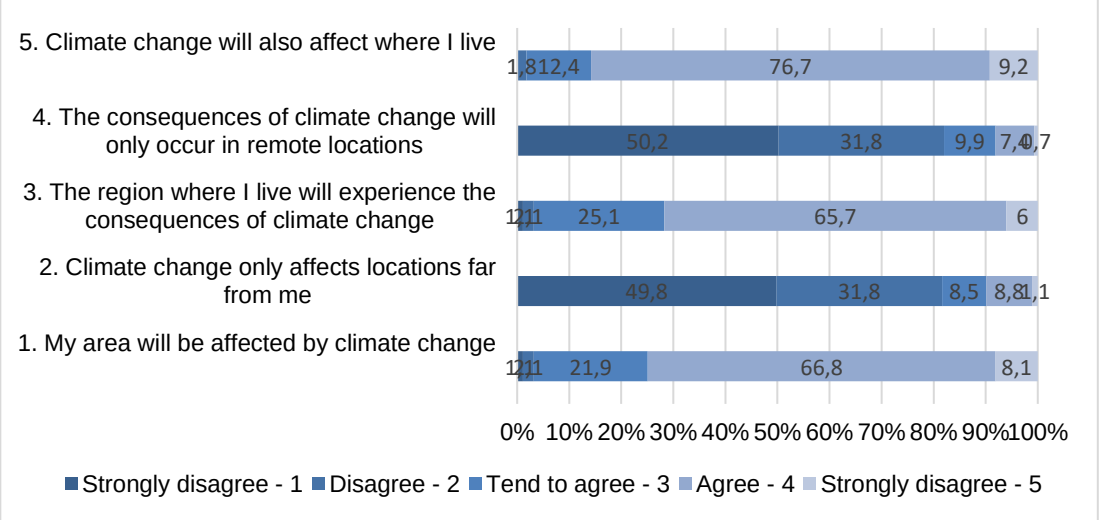

Figure 5. Questions assessing spatial distance of climate change

Questions on Figure 5 representing the spatial distance of the climate change. The majority students say that, their area will be affected by climate change (66,8%), the region their live will experience the consequences of climate change (65,7%), climate change will also affect where they live (76,7%). Meanwhile, they strongly disagree that climate change only affects locations far from them (49,9%) and the consequences of climate change will only occur in remote locations (50,2%). The same response to the temporal distance of climate change present at Figure 6.

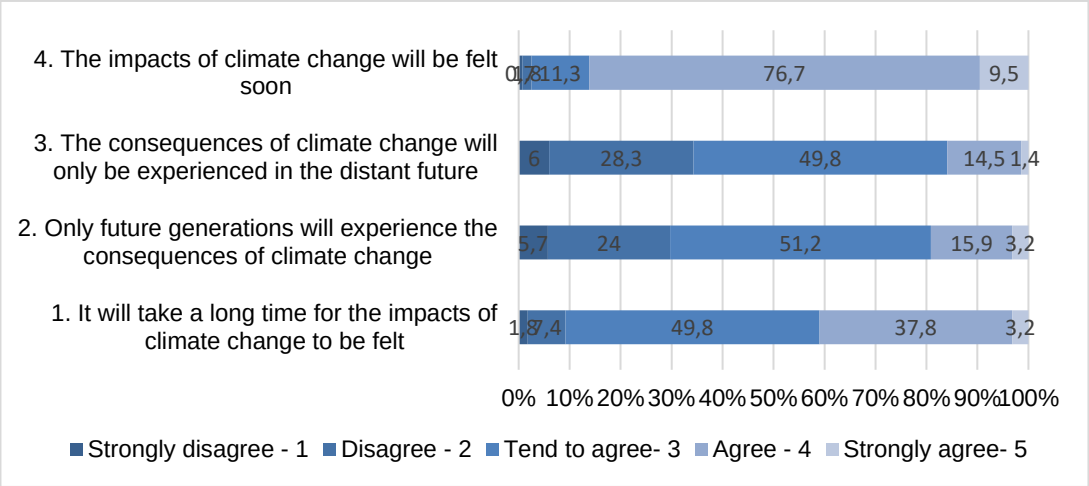

Figure 6. Questions assessing temporal distances of climate change

Questions on Figure 6 representing the temporal distance of climate change. The majority students seriously believe that climate change will take a long time for the impacts of climate change to be felt (49,8%), on future generations will experience the consequences of the climate change (51,2%), the consequences of climate change will only experience in the future distant (49,9%). However, the results of student responses also stated that the effects of climate change would also be felt immediately (76.7%).

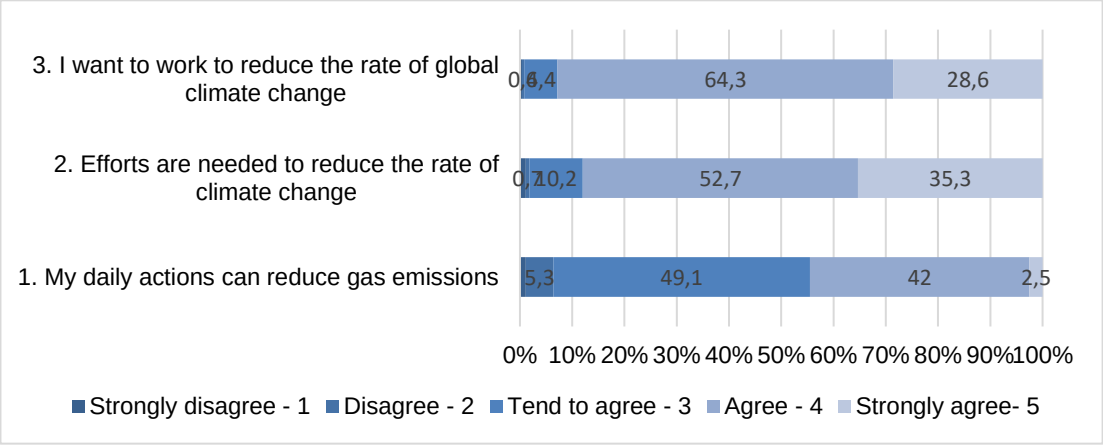

Figure 7. Questions assessing of students' willingness to act toward the climate change

Questions on Figure 7 represent the students' willingness to act. The majority students tend to agree that daily actions can reduce gas emissions (49,1%), agree that efforts are needed to reduce the rate of climate change (52,7%), and they are agreeing to work to reduce the rate of global climate change (64,3%).

Climate change perception refer to how individuals, communities, and societies understand, interpret, and make sense of climate change. It encompasses people' awareness, attitude, beliefs, emotions, and understanding of the causes, impacts, and solutions related to the climate change. Current studies on students' perceptions of climate change reality reveal a growing awareness and concern among young people about the impacts of environmental degradation. Research conducted by Leiserowitz et al. (2020) found that a majority of students surveyed across different countries expressed worry about climate change and believed it to be a pressing issue. The increasing demand for climate education in schools, with students advocating for comprehensive and accurate information about the causes and consequences of climate change. These findings underscore the pivotal role of education in shaping students' understanding of climate realities and empowering them to take action to mitigate its effects. As the next generation of leaders and decision-makers, students' perspectives on climate change are crucial for driving meaningful change towards a more sustainable future.

Climate change is an undeniable reality, with overwhelming scientific evidence pointing to its existence

and dire consequences for our planet. The Intergovernmental Panel on Climate Change (IPCC), in its Fifth Assessment Report, unequivocally stated that human activities, particularly the burning of fossil fuels and deforestation, are the primary drivers of global warming. This has led to rising temperatures, melting ice caps, more frequent and severe weather events, and disruptions to ecosystems worldwide. The urgency to address climate change cannot be overstated, as its impacts are already being felt by communities around the globe and will only worsen without concerted action to reduce greenhouse gas emissions and transition to sustainable practices.

Climate change is primarily caused by human activities rather than natural processes. The Intergovernmental Panel on Climate Change (IPCC), in its Fifth Assessment Report, stated that it is "*extremely likely*" that human influence has been the dominant cause of the observed warming since the mid-20th century (IPCC, 2022). This conclusion is supported by extensive scientific research and evidence, including data from climate models, observations of greenhouse gas concentrations, and analysis of historical climate records. While natural factors such as volcanic eruptions and variations in solar radiation have historically influenced Earth's climate, the current rapid pace of climate change is largely attributed to human activities, particularly the burning of fossil fuels and deforestation (Leon et al., 2022). These human-induced activities have led to the unprecedented increase in atmospheric greenhouse gas concentrations, exacerbating the greenhouse effect and driving global warming. Therefore, while natural processes still play a role in shaping Earth's climate, the overwhelming consensus among climate scientists is that human activities are the primary drivers of the current climate change crisis.

Climate change perception is a complex and dynamic field influenced by a range of factors. According to Leiserowitz et al. (2019), public awareness and understanding of climate change are shaped by educational backgrounds, with higher levels of education often correlating with a more nuanced comprehension of the issue. Cultural and regional influences are also crucial, as highlighted by studies such as (Smith & Leiserowitz, 2014), which emphasize the impact of cultural perspectives on climate change perception. Additionally, media plays a significant role, with research by Barkemeyer et al. (2017) illustrating how media portrayal can shape public opinion. Personal experiences, both direct and indirect, contribute to individual perceptions, as suggested by studies like (Whitmarsh, 2008) that explore the role of personal experiences in forming climate change attitudes. Psychological factors, as outlined in the work of (Spence et al., 2012), include temporal discounting and varying degrees of optimism or pessimism, influencing the urgency individuals feel towards addressing climate change. The social and political context, discussed in studies such as (McCright & Dunlap, 2011), encompasses political ideology and the influence of environmental movements, providing a broader understanding of the societal dynamics that contribute to climate change perception. Recognizing and integrating insights from these diverse sources are essential for developing effective communication strategies and policies to address the global challenge of climate change. Youth climate change perception also influenced by nations which influenced the cultural and societal background.

Public perception plays a crucial role in driving effective climate change mitigation and adaptation strategies. Understanding how individuals perceive climate change can inform policy-making and foster community engagement in sustainable practices. Research indicates that public perception of climate change is influenced by various factors, including personal experience, socio-economic status, cultural beliefs, and media coverage (Leiserowitz et al., 2020). Perceived risks and benefits associated with climate action can shape individual behaviors and attitudes towards mitigation and adaptation measures (Leiserowitz et al., 2020). Moreover, communication strategies that resonate with diverse audiences and emphasize the urgency of climate action are essential for mobilizing collective efforts (Maibach et al., 2008). By addressing misconceptions and promoting climate literacy, policymakers can enhance public support for climate policies and facilitate the transition to a sustainable future.

Ensuring students to have knowledge and behavior related to the climate change can be done by a systematic educational curriculum, called Climate Change Education (CCE). By increasing awareness and understanding of the causes, impacts, and potential solutions to climate change, education empowers individuals and communities to take informed actions (Hung, 2014). Education fosters a sense of responsibility and encourages sustainable behaviors, such as reducing carbon emissions, conserving resources, and adopting resilient practices (UNESCO, 2021). Moreover, education enables communities to develop innovative strategies for adapting to the changing climate, including implementing green infrastructure, enhancing disaster preparedness, and promoting ecosystem conservation. Ultimately,

climate change education serves as a catalyst for collective action, facilitating the transition to a more sustainable and resilient future.

Conclusion

The conclusion of this research is that the majority of students are aware that climate change is real, understand that climate change is caused by humans, the impact of climate change has also been felt now and will worsen in the future. Students have used to do good things to save energy, such as turning the electricity devices when they are no longer used, using bicycles when going to places that are not far away, and carrying bags for shopping. Although, some students stated that they did not use bicycles and did not carry shopping bags. Students' understanding of the reality of climate change, spatial distance, temporal distance, climate causes are quite good but does not yet have implications for their behavior related to the climate. Climate change behavior, encompassing individual and collective actions, plays a crucial role in addressing the global climate crisis. By altering our consumption patterns, embracing sustainable practices, and advocating for policy changes, we can mitigate the adverse effects of climate change. Small actions, like reducing energy consumption or opting for eco-friendly transportation, collectively contribute to significant reductions in greenhouse gas emissions. Climate change behavior is not just about mitigating environmental damage; it also fosters a more resilient and equitable society by prioritizing the well-being of both people and the planet. Through collective action and conscious decision-making, we have the power to shape a more sustainable future for generations to come. At the end of this paper, we argue that school learning should be more aware on climate crisis issue through a systematic way of education called climate change education.

Acknowledgement

We would like to send our gratitude to the Ministry of Educational, Cultural, Research, and Higher Education of Republic Indonesia for the research grant with the number of contract (20.6.28/UN32.20.1/LT/2023) and the teachers who get participated in this study.

Conflicts of Interest

There is no conflict of interest of this study.

Author Contributions

M. Kundariati: methodology, writing original paper; **I. Ibrohim:** analysis; research instrument; **F. Rohman:** review and editing; **S. Nida:** review and editing; **W. Hayuana:** data organizing and analysis; and **Z. A. Z. Putra:** data collecting.

References

Aleixo, A. M., Leal, S., & Azeiteiro, U. M. (2021). Higher education students' perceptions of sustainable development in Portugal. *Journal of Cleaner Production*, *327*. https://doi.org/10.1016/j.jclepro.2021.129429

Anderson, A. (2012). Climate Change Education for Mitigation and Adaptation. *Journal of Education for Sustainable Development*, *6*(2), 191–206. https://doi.org/10.1177/0973408212475199

Assunção, R., Martins, C., Viegas, S., Viegas, C., Jakobsen, L. S., Pires, S., & Alvito, P. (2018). Climate change and the health impact of aflatoxins exposure in Portugal – an overview. *Food Additives & Contaminants: Part A*, *35*(8), 1610–1621. https://doi.org/10.1080/19440049.2018.1447691

Barkemeyer, R., Figge, F., Hoepner, A., Holt, D., Kraak, J. M., & Yu, P.-S. (2017). Media coverage of climate change: An international comparison. *Environment and Planning C: Politics and Space*, *35*(6), 1029–1054. https://doi.org/10.1177/0263774X16680818

Bessah, E., Raji, A. G. O., Taiwo, O. J., Agodzo, S. K., Ololade, O. O., Strapasson, A., & Donkor, E. (2021). Gender-based variations in the perception of climate change impact, vulnerability and adaptation strategies in the Pra River Basin of Ghana. *International Journal of Climate Change*

Strategies and Management, *13*(4–5), 435–462. https://doi.org/10.1108/IJCCSM-02-2020-0018
Cresswell, J. W. (2011). *Educational Research: Planing, Conducting, and Evaluating Quantitative and Qualitative Research*. Person Prentice Hall.
Fu, B., Wu, X., Wang, Z., Wu, X., & Wang, S. (2022). Coupling human and natural systems for sustainability: experience from China's Loess Plateau. *Earth System Dynamics*, *13*(2), 795–808. https://doi.org/10.5194/esd-13-795-2022
Gezimu Gebre, G., Amekawa, Y., & Ashebir, A. (2023). Can farmers' climate change adaptation strategies ensure their food security? Evidence from Ethiopia. *Agrekon*, *62*(2), 178–193. https://doi.org/10.1080/03031853.2023.2230959
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
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
Haque, A. T. M. S., Kumar, L., & Bhullar, N. (2023). Gendered perceptions of climate change and agricultural adaptation practices: a systematic review. *Climate and Development*, *15*(10), 885–902. https://doi.org/10.1080/17565529.2023.2176185
Hauser, N., Conlon, K. C., Desai, A., & Kobziar, L. N. (2021). Climate Change and Infections on the Move in North America. In *Infection and Drug Resistance* (Vol. 14, pp. 5711–5723). Dove Medical Press Ltd. https://doi.org/10.2147/IDR.S305077
Hung, C. C. (2014). Climate Change Education: Knowing, doing, and being. In *Science of the Total Environment* (Vol. 650, Issue 4).
Ibrohim, I., Kusumaningrum, I. K., Hamimi, E., Putra, W. E., Utomo, J., Kundariati, M., Hajar, M. U., & Malek, N. A. N. B. N. (2023). Science students' literacy and faculty members' perspective toward nanotechnology: Is it needed in 21st century education? *Eurasia Journal of Mathematics, Science and Technology Education*, *19*(12). https://doi.org/10.29333/ejmste/13835
IPCC. (2022). *IPCC AR6 Working Group II: Headline Statements from the Summary for Policymakers* (Vol. 2022, Issue February).
Leiserowitz, A. (2019). *climate change in the american mind*. https://doi.org/10.17605/OSF.IO/CJ2NS
Leiserowitz, A., Maibach, E., Rosenthal, S., Kotcher, J., Bergquist, P., Ballew, M., Goldberg, M., Gustafson, A., & Wang, X. (2020). *Climate Change in the American Mind: April 2020*. https://doi.org/10.1007/s1058400690603
Leon, M., Cornejo, G., Calderón, M., González-Carrión, E., & Florez, H. (2022). Effect of Deforestation on Climate Change: A Co-Integration and Causality Approach with Time Series. *Sustainability (Switzerland)*, *14*(18). https://doi.org/10.3390/su141811303
Maibach, E. W., Chadwick, A., McBride, D., Chuk, M., Ebi, K. L., & Balbus, J. (2008). Climate Change and Local Public Health in the United States: Preparedness, Programs and Perceptions of Local Public Health Department Directors. *PLoS ONE*, *3*(7), e2838. https://doi.org/10.1371/journal.pone.0002838
McCright, A. M., & Dunlap, R. E. (2011). The Politicization of Climate Change and Polarization in the American Public's Views of Global Warming, 2001–2010. *The Sociological Quarterly*, *52*(2), 155–194. https://doi.org/10.1111/j.1533-8525.2011.01198.x
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
Ratinen, I. (2021). Students' knowledge of climate change, mitigation and adaptation in the context of constructive hope. *Education Sciences*, *11*(3), 1–14. https://doi.org/10.3390/educsci11030103
Rojas-Downing, M. M., Nejadhashemi, A. P., Harrigan, T., & Woznicki, S. A. (2017). Climate change and livestock: Impacts, adaptation, and mitigation. In *Climate Risk Management* (Vol. 16, pp. 145–163). Elsevier B.V. https://doi.org/10.1016/j.crm.2017.02.001
Smith, N., & Leiserowitz, A. (2014). The Role of Emotion in Global Warming Policy Support and Opposition. *Risk Analysis*, *34*(5), 937–948. https://doi.org/10.1111/risa.12140
Spektor, M., Fasolin, G. N., & Camargo, J. (2023). Climate change beliefs and their correlates in Latin America. *Nature Communications*, *14*(1). https://doi.org/10.1038/s41467-023-42729-x
Spence, A., Poortinga, W., & Pidgeon, N. (2012). The Psychological Distance of Climate Change. *Risk Analysis*, *32*(6), 957–972. https://doi.org/10.1111/j.1539-6924.2011.01695.x
UNESCO. (2021). *Getting every school climate-ready: how countries are integrating climate change issues in education*. United Nations Educational, Scientific and Cultural Organization. https://unesdoc.unesco.org/ark:/48223/pf0000379591
van der Ploeg, J., Sukulu, M., Govan, H., Minter, T., & Eriksson, H. (2020). Sinking Islands, drowned logic; Climate change and community-based adaptation discourses in Solomon Islands.

Sustainability (Switzerland), *12*(17). https://doi.org/10.3390/su12177225

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

Walsh, J. E. (2013). Melting ice: What is happening to Arctic sea ice, and what does it mean for us? *Oceanography*, *26*(2). https://doi.org/10.5670/oceanog.2013.19

Wandana, S., Arachchige, U., Preethika, P., Wadanambi, R., Wadanambi, R. T., Wandana, L. S., Chathumini, K. K. G. L., Dassanayake, N. P., Preethika, D. D. P., & Arachchige, U. S. P. R. (2020). *The effects of industrialization on climate change*. https://www.researchgate.net/publication/344479407

Wang, B., & Zhou, Q. (2020). Climate change in the Chinese mind: An overview of public perceptions at macro and micro levels. In *Wiley Interdisciplinary Reviews: Climate Change* (Vol. 11, Issue 3). Wiley-Blackwell. https://doi.org/10.1002/wcc.639

Ward, D. S., Mahowald, N. M., & Kloster, S. (2014). Potential climate forcing of land use and land cover change. *Atmospheric Chemistry and Physics*, *14*(23), 12701–12724. https://doi.org/10.5194/acp-14-12701-2014

Whitmarsh, L. (2008). Are flood victims more concerned about climate change than other people? The role of direct experience in risk perception and behavioural response. *Journal of Risk Research*, *11*(3), 351–374. https://doi.org/10.1080/13669870701552235

Zeeshan, M., Sha, L., Tomlinson, K. W., & Azeez, P. A. (2021). Factors shaping students' perception of climate change in the western Himalayas, Jammu & Kashmir, India. *Current Research in Environmental Sustainability*, *3*. https://doi.org/10.1016/j.crsust.2021.100035