Research Article

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Climate change awareness (knowledge and perception): Comparative study between natural science and social science students

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Article Information	ABSTRACT
Article History: Submitted: 2025-03-10 Revision: 2025-06-29 Accepted: 2025-07-14 Published: 2025-07-22 **Keywords:** Climate change awareness; knowledge; natural science students; perception; social science students	Climate change represents a critical and pressing global challenge that demands immediate attention. To effectively mitigate the impacts of climate change, it is essential to implement comprehensive educational programs that raise awareness, foster understanding, and equip individuals and communities with the knowledge and skills necessary to combat its effects. Climate change has been integrated into the curriculum in Indonesia across natural science and social science subjects. It is important to analyze the differences between these two subjects on climate change knowledge and perception. This study aims to compare students' knowledge and perceptions of climate change in natural science and social science students due to a gap in subject content. Furthermore, this study also examines the extent to which the level of knowledge affects students' perceptions of climate change. A questionnaire as a survey method about students' knowledge and perceptions of climate change and its impacts was given to 150 students of natural science and social science students in MAN 2 Padang Sidempuan. The results indicated there is no statistically significant difference between natural and social students in terms of climate change knowledge and perceptions (sig. > 0.05). These findings imply that the distribution of climate change knowledge and perceptions is relatively uniform across disciplinary backgrounds.
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INTRODUCTION

Climate change is a critical global issue at the moment. Since the recording of global temperatures in 1850, the year 2024 has been the hottest year with a temperature increase of 0.10°C from the previous year (National Centers for Environmental Information, 2025). The years 2014- 2023 recorded the hottest temperatures in the last 174 years, with the temperature in 2024 being 1.19°C higher than the global

average temperature in the 20th century (Silijander et al., 2023). This indicates the ongoing process of global warming on the Earth's surface. Various climate change issues, such as rising temperatures and sea levels, changing rainfall patterns, and weather anomalies, have impacts not only on humans but also on the environment and other living beings (Liu & Masago, 2025). The interconnectedness of these issues underscores the need for comprehensive, coordinated global efforts to mitigate and adapt to climate change in order to protect both human and ecological well-being.

Developing countries like Indonesia are highly vulnerable to climate change due to geographical, environmental, and socio-cultural conditions. According to the 2023 INFORM Risk Index, Indonesia is in the top third of nations most vulnerable to climate hazards, including heatwaves, droughts, and flooding (European Commission, 2023). Research on knowledge and perception of climate change needs to be conducted to see whether the community views it as a more dangerous phenomenon than other environmental issues (Prasad & Mkumbachi, 2021). Individual knowledge about climate change has a major effect on an individual's ability to mitigate climate change (Pahl et al., 2014). The way society transforms in response to mitigating and adapting to climate change is heavily shaped by the accuracy of people's understanding and perceptions of climate change (Busch et al., 2019). Knowledge of climate change refers to an individual's cognitive aspect to understand the facts about it, whereas perception is how that knowledge is translated into psychological awareness. On the other hand, perception reflects the psychological awareness individuals develop based on their understanding of these facts. This awareness often drives their willingness to engage in behaviors that can contribute to climate change mitigation and adaptation. Thus, fostering accurate knowledge and positive perceptions about climate change is fundamental for empowering communities, particularly in developing countries, to take proactive measures in response to this global crisis.

Individual knowledge about a specific topic will increase their concern for that topic (Sunstein & Llewellyn, 2006). According to Tjernström & Tietenberg (2008), the biggest factor causing the lack of individual motivation in climate change issues is the lack of knowledge about the climate change phenomenon itself. Perceptions of climate change risks vary among individuals and communities. This depends on the values, views, and personal experiences of individuals regarding climate change (Tapsuwan & Rongrongmuang, 2015). Research carried out by Xiang et al. (2019) shows there is a significant relationship between climate perception and climate action. People who perceive climate change are more likely to actively engage in climate action. Those who place high trust in scientific evidence of climate change often possess altruistic values and show a strong concern for the issue.

A comprehensive education is needed to address the problems caused by climate change (Prasad & Mkumbachi, 2021). Education about climate change should not only provide knowledge but also raise risks and negative impacts of this (Cornejo et al., 2024). Senior High Schools play a pivotal role in educating students about climate change, serving as the most influential source of information on the topic (Ofori et al., 2023). This formal educational setting is followed by media outlets such as radio and television, which contribute significantly to raising awareness. The internet also serves as a valuable resource, complementing these traditional forms of education by providing students with access to a broader range of climate-related content. Knowledge about climate change can be enhanced in formal education such as schools as a result of the development of learning materials (Harker-Schuch & Bugge-Henriksen, 2013). Such educational efforts not only increase students' understanding of climate change but also foster a deeper sense of responsibility and urgency, ultimately contributing to a more informed and proactive society. By equipping the younger generation with accurate information and the necessary skills, we can pave the way for effective climate action and long-term sustainability.

The learning process in schools can influence the level of ability and perception of students towards climate change. The field of science taught will influence the process of information absorption and the way students think about certain phenomena. Natural science and social science majors in senior high school have their distinctive scientific characteristics. The field of natural science focuses more on the study of natural objects, while the social sciences emphasize the study of society. Both fields are directly related to climate change, even though they have contrasting objects of study. Comparison of science and social students helps to reveal the gap of knowledge and perception in both groups on climate change, such as science students' poor policy comprehension or social science students' lack of a solid scientific foundation.

This study aims to analyze the level of knowledge and perception of students regarding climate change based on clusters of scientific fields, namely science and social sciences. This study is compared students' knowledge and perceptions of climate change based on different fields of study. Furthermore, this study also examines the extent to which the level of knowledge affects students' perceptions of climate change. The findings of this study may provide suggestions for the development of s curriculum that systematically integrates with climate change-related issues by stakeholders.

RESEARCH METHODS

This study was conducted by doing a survey on January 21st - February 11th, 2025. The preparation was done by administering a questionnaire to 694 high school students via Google Form. The instrument is given in 24 questions, consisting of 4 aspects of students' knowledge and 4 aspects of perceptions about climate change and its impacts. Aspects of students' knowledge include: basic knowledge, causal knowledge, effect knowledge, and action-related knowledge (Taddicken et al., 2018). While aspects of student perception include: reality, causes, valence of consequences, and spatial and temporal consequences. Each aspect, both of knowledge and perception, is used, containing 3 questions to be answered by respondents.

The questions presented in the questionnaire were adopted and modified according to research needs. Students' basic knowledge on climate change covers fundamental concepts such as the definition of climate change as a long-term alteration in climate and weather patterns, awareness of the relationship between climate change and global warming, and recognizing rising global temperatures as both a symptom and an indicator of ongoing climate change, which suggests students' understanding. Students' causal knowledge on climate change encompasses both natural and human-induced factors, recognizing that climate change can occur naturally over long periods, identifying human activities as primary contributors to recent climate change, and also understanding that the use of fossil fuels plays a significant role in accelerating the climate change process. Students' effect knowledge on climate change includes environmental, ecological, and socio-economic impacts that indicate an awareness of the wide-ranging and interconnected impacts of climate change on both natural systems and human societies. Students' action-related knowledge on climate change reflects an understanding of practical, individual-level efforts to mitigate its impacts that can contribute to reducing global warming and the broader effects of climate change, and indicates that students are aware of the importance of personal responsibility in climate challenges.

While the students' perception of climate change in the reality aspect indicates a strong belief in its existence and relevance to the issue, and experiencing its impacts in daily life. Students' perception of climate change on the causes aspect regarding the causes of climate change demonstrates an informed and balanced viewpoint, acknowledging that both natural Earth processes and human activities contribute

to climate change, which reflects their understanding. The students' perception regarding the consequences of climate change reflects a strong awareness of its serious and far-reaching impacts as a direct threat to themselves, their families, and future generations, recognize its potential to endanger the survival of living organisms and meteorological events that indicates a high level of concern and a clear understanding of the negative and potentially devastating outcomes of climate change. Students' perception of climate change in terms of spatial and temporal consequences shows an awareness that climate change is both locally and nationally relevant, as well as urgent and ongoing, and these impacts are already present in their communities, which reflects that climate change is both a present and future challenge with immediate and localized impacts.

The sampling technique was random sampling, and to calculate the sample size by using the Slovin formula (Santoso, 2023). This formula can help in determining a representative sample, thus enhancing the accuracy of the study's results and minimizing potential biases. A total sample of 150 students was obtained, consisting of 85 natural science students and 65 social science students as research subjects. The determination of the number of samples can be done using the following formula:

$$n = N/(1 + N(e)^2) \tag{1}$$

Information:
n = Sample size or number of respondents
N = Population size
e = Percentage of sampling error accuracy tolerance; e = 0.1.

Data were analyzed by descriptive statistics to examine potential differences in the levels of knowledge and perception regarding climate change and its impacts between high school students from the natural science and social science students. Given the distinct educational focus of these majors, it was important to determine whether students' academic backgrounds influenced their understanding of climate-related issues. To achieve this, a non-parametric test (Mann-Whitney/U test) was employed to check the presence of statistically significant differences in the students' knowledge and perceptions of climate change based on their respective disciplines. This approach allowed for a clear comparison of the two groups, providing insight into how the curriculum and exposure to climate-related content in different majors might shape students' awareness of environmental issues. In addition to the Mann-Whitney (U test), descriptive statistical analysis was carried out to summarize the data and present an overview of the trends and patterns observed in the responses. All statistical procedures were conducted using SPSS Statistics version 27, which provided the necessary tools for processing and interpreting the data. The software enabled a robust and accurate analysis, ensuring that the results were both reliable and valid, thus allowing for meaningful conclusions to be drawn about the students' climate change awareness.

FINDING AND DISCUSSION

Climate change knowledge is categorized into four aspects: basic, causal, effect, and action-related knowledge. Natural science students show higher basic knowledge than social science students (Figure 1). This discrepancy can be attributed to the scientific background and curriculum of the natural science students, which often includes more detailed and structured discussions on climate change, its underlying mechanisms, and its scientific implications. It is likely due to their curriculum's focus on scientific mechanisms (Tsaqib et al., 2020). In contrast, social science students outperform in causal, effect, and action-related knowledge. Social science students have knowledge about factors that cause climate

change and a greater understanding of the impact of the phenomenon on human life. This reflects their training in analyzing human-environment interactions and socio-economic impacts, particularly through subjects like Geography, which covers climate change in more depth than Biology. The subject that supports the climate change topic in the Natural science major is Biology, while in the Social science major is Geography. In the Biology subject, the climate change topic is only presented as an introduction. Meanwhile, in Geography, discuss about mechanisms and impacts of climate change that is more detail, thereby enhancing students' more comprehensive understanding of climate change.The fact that Social science students are accustomed to analyzing cause and effect of a phenomenon compared to natural science students who have a more structural field of study.
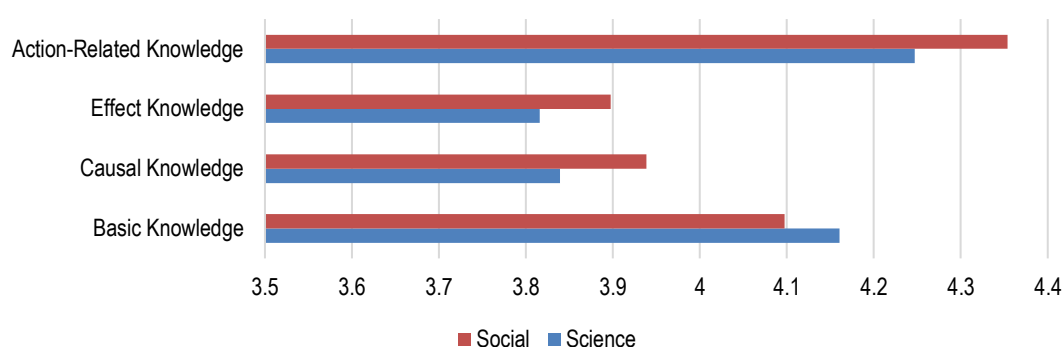

Figure 1. Student's Knowledge on Climate Change

Overall, all students demonstrate a high level of climate change awareness. Understanding was assessed via a questionnaire, with results (Table 1) showing varying strengths across the four aspects. These findings highlight areas for targeted educational improvements. Students' various aspects knowledge of climate change was assessed by calculating the percentage of correct answers provided in response to a questionnaire designed to gauge their understanding. By analyzing the responses, a comprehensive students' awareness and understanding of climate change could be developed. The results of these calculations, reflecting the percentage of correct answers for each knowledge aspect, are presented in Table 1. This table provides a clear overview of how well students performed in each aspect, offering insight into areas where students may have stronger or weaker knowledge. Such data are valuable for identifying gaps in students' understanding, which can inform the development of targeted educational interventions to improve climate change literacy.

Table 1. Percentage of Student's Knowledge on Climate Change

Aspects	Statement	Natural Science Students					Social Science Students				
		VA (%)	A (%)	N (%)	NA (%)	VNA (%)	VA (%)	A (%)	N (%)	NA (%)	VNA (%)
Basic Knowledge	Climate change is a long-term shift in the patterns of climate and weather elements.	21.18	64.71	11.76	2.35	0.00	18.46	76.92	3.08	1.54	0.00
	Climate change is closely related to the increase in global temperature (global warming).	34.12	57.65	7.06	1.18	0.00	26.15	64.62	7.69	1.54	0.00

Aspects	Statement	Natural Science Students					Social Science Students				
		VA (%)	A (%)	N (%)	NA (%)	VNA (%)	VA (%)	A (%)	N (%)	NA (%)	VNA (%)
Causal Knowledge	The rising temperature is a symptom of climate change.	29.41	62.35	5.88	2.35	0.00	16.92	70.77	9.23	3.08	0.00
	Climate change is a natural process that occurs over a long period of time.	20.00	45.88	27.06	7.06	0.00	20.00	58.46	15.3	6.15	0.00
	Human activities, such as industrial activities, agriculture, transportation, and mining, are the main factors contributing to climate change.	21.18	48.24	23.53	4.71	2.35	23.08	56.92	16.9	0.00	3.08
	The use of fossil fuels exacerbates climate change.	27.06	43.53	23.53	5.88	0.00	26.15	53.85	7.69	10.7	1.54
Effect Knowledge	Climate change causes prolonged droughts and floods.	17.65	54.12	24.71	3.53	0.00	18.46	55.38	18.4	7.69	0.00
	Climate change causes a decrease in biodiversity.	21.18	57.65	16.47	4.71	0.00	23.08	53.85	18.4	4.62	0.00
	Climate change increases poverty rates and the spread of diseases.	9.41	52.94	29.41	8.24	0.00	21.54	55.38	13.8	9.23	0.00
Action-Related Knowledge	Walking is a small step that can be taken to reduce the impact of climate change	38.82	43.53	9.41	8.24	0.00	33.85	55.38	7.69	3.08	0.00
	Planting trees can reduce global warming and climate change.	56.47	40.00	3.53	0.00	0.00	18.46	76.92	3.08	1.54	0.00
	Reducing plastic use is closely related to reducing the effects of global warming.	30.59	52.94	10.59	5.88	0.00	26.15	64.62	7.69	1.54	0.00

Table 1 shows that the majority of students agree on each aspect of knowledge regarding climate change in this study. The statement "Climate change increases poverty rates and the spread of diseases" is the statement with the highest level of strong agreement among science and social studies students. This indicates a high level of student understanding of the ecosystem services provided by trees for life, especially regarding climate change. The numerous tree-planting campaigns called for in both the mass media and educational materials have increased students' understanding of the functions of trees for life. Simultaneously, the highest level of agreement among both natural science and social studies students

regarding climate change knowledge is in the basic knowledge. However, in the aspects of causal knowledge and effect knowledge, there are some students who do not agree with the statements provided by the researcher. The aspect of the statement "Climate change increases poverty rates and the spread of diseases" is the aspect with the highest disagreement among natural science students while the statement that "The use of fossil fuels exacerbates climate change" is the aspect with the highest level of disagreement in the social science students. It is indicating lingering misconceptions on students' knowledge in causal and effect knowledge.

This study also divides students' perceptions of climate change into four aspects: reality, causes, valence of consequences, and spatial and temporal consequences (Figure 2 & Figure 3). This study results show that natural science students have a higher belief level that climate change is indeed happening than social science students. Based on aspect of reality, natural science students have a more developed perception of climate change than social science students. Overall, both natural science and social science students agree that climate change is caused by human activities. Majority of students acknowledge that climate change is real and primarily caused by human activities, demonstrating considerable concern about its consequences. Although there is no significant differences, the causes aspect shows that natural science students have a higher level of belief that activities by human are the main cause of it. Valence of consequences and spatial and temporal consequences aspects indicate that students agree that climate change will have a direct impact on life. Most students also agree that they have already felt the process of climate change happening currently.
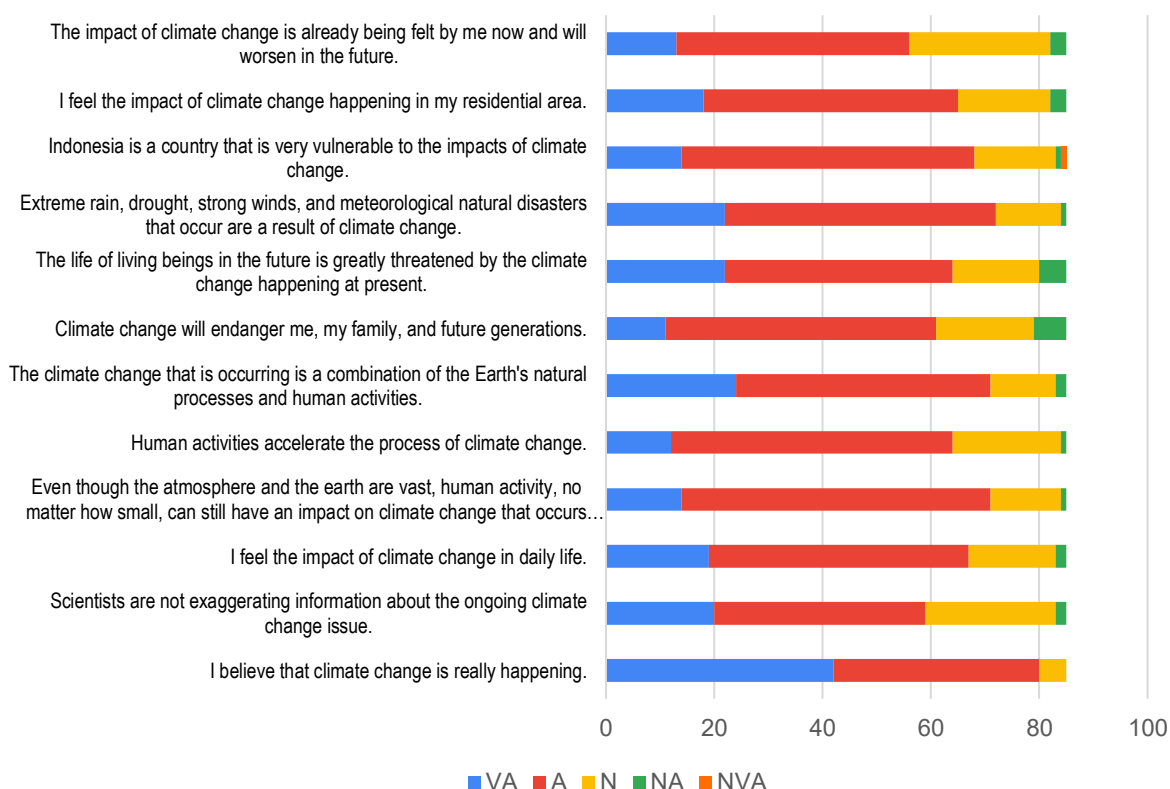

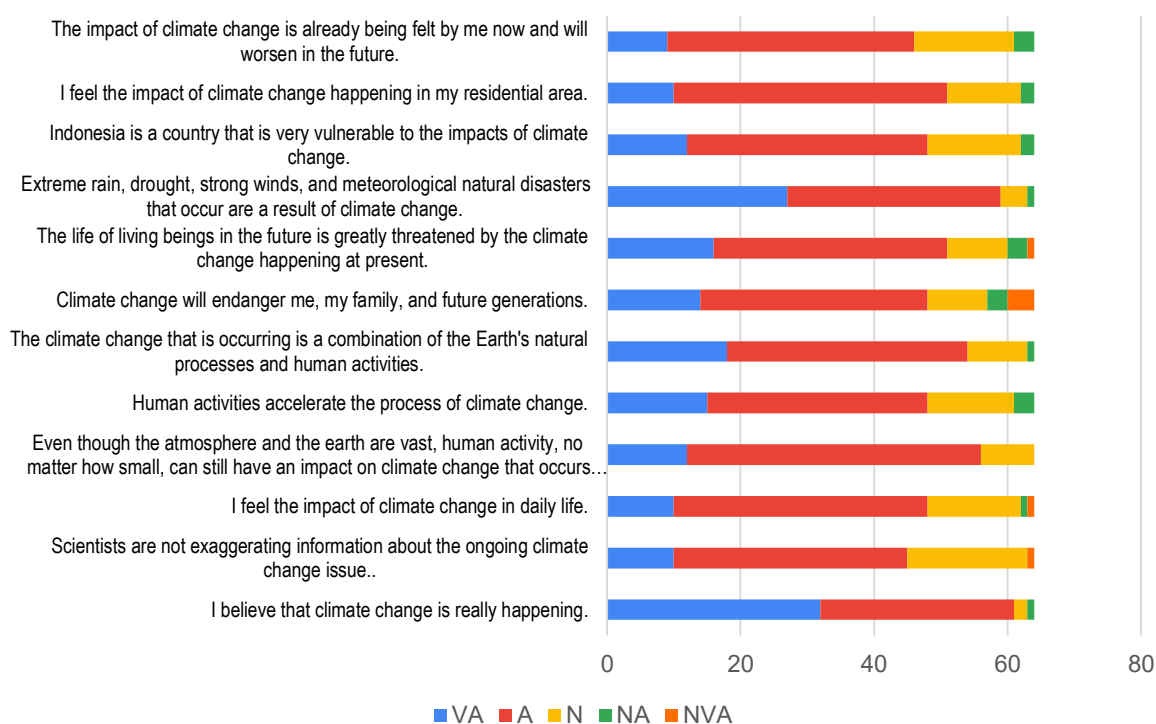Figure 2. Natural Science Students' Perception on Climate Change

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Figure 3. Social Science Students' Perception on Climate Change

This study shows that students' perceptions of climate change have high values, whether they are natural science or social studies students. This shows that the perception of climate change is determined by the subjects received by students, also influenced by several other factors outside of school. Research by Diem et al., (2025) shows that the perception of climate change among high school students has differences from different geographical regions, varying due to cultural, political, and geographical contexts. According to Azeiteiro et al. (2018), high school students' perceptions of climate change are influenced by some factors, such as their educational experiences, their comprehension of the causes of climate change, their contentment with the responses of the national government, and their faith in international climate policy a study in Germany revealed high values and gender differences in climate change beliefs among high school students, indicating that differences in perception are complex and connected to gender differences in interest in climate change (Jaramillo et al., 2023) education plays an crucial role in students' knowledge and perception. The inclusion of climate change material integrated into school subjects can enhance students' understanding in senior high school students. It is also can shape students' perceptions and behaviors regarding climate change. Effective educational strategies can enhance knowledge, foster pro-environmental behaviors, and address misconceptions, ultimately preparing students to tackle climate challenges.

The percentage of student responses regarding their perceptions of climate change was also calculated based on the answers provided in a specially designed questionnaire (Table 2). It is providing a comprehensive overview of their perspectives on the issue, including four aspects: reality, causes, valence of consequences, and spatial and temporal consequences. By analyzing the answers provided, it became possible to quantify the varying degrees of perceptions that students exhibited regarding climate-related challenges. The results of this analysis offer valuable insights into how students perceive the issue of climate change, shedding light on areas where further education or awareness might be

needed. Additionally, the data helps to identify patterns or trends in students' responses, which could inform future educational strategies and interventions focused on climate change awareness.

Table 2. Percentage of Student's Perception on Climate Change

Aspects	Statement	Natural Science Students					Social Science Students				
		VA (%)	A (%)	N (%)	NA (%)	VNA (%)	VA (%)	A (%)	N (%)	NA (%)	VNA (%)
Reality	I believe that climate change is truly happening.	49.41	44.71	5.88	0	0	50	45.31	3.13	1.56	0
	Scientists are not exaggerating the information regarding the issue of climate change.	23.53	45.88	28.24	2.35	0	15.63	54.69	28.13	0	1.56
	I can feel the impact of climate change in everyday life.	22.35	56.47	18.82	2.35	0	15.63	59.38	21.88	1.56	1.56
Causes	Although the atmosphere and the Earth are vast, even the smallest human activities can have an impact on the climate changes in atmosphere.	16.47	67.06	15.29	1.18	0	18.75	68.75	12.50	0	0
	Human activities accelerate climate change process.	14.12	61.18	23.53	1.18	0	23.44	51.56	20.31	4.69	0
	The climate change that is happening is a result of both natural processes of the Earth and human activities combined.	28.24	55.29	14.12	2.35	0	28.13	56.25	14.06	1.56	0
Valence of consequen-ces	Climate change will endanger me. my family, and future generations	12.94	49.41	18.82	5.88	0	25	54.69	14.06	4.69	1.56
	The survival of living organisms in the future is heavily threatened by the ongoing climate change.	25.88	49.41	18.82	5.88	0	25	54.69	14.06	4.69	1.56
	Extreme rainfall, droughts, strong winds, and meteorological disasters are consequences of the climate change currently occurring.	25.88	58.82	14.12	1.18	0	42.19	50	6.25	1.56	0
Spatial and Temporal	Indonesia is a country that is	16.47	63.53	17.65	1.18	1.18	18.75	56.25	21.88	3.13	0

Aspects	Statement	Natural Science Students					Social Science Students				
		VA (%)	A (%)	N (%)	NA (%)	VNA (%)	VA (%)	A (%)	N (%)	NA (%)	VNA (%)
Consequen-ces	highly vulnerable to climate change effects.										
	I can feel the effects of climate change occurring in the area where I live.	21.18	55.29	20	3.53	0	15.63	64.06	17.19	3.13	0
	The impacts of climate change are already being felt today and will become even more severe in the future.	15.29	50.59	30.59	3.53	0	14.06	57.81	23.44	4.69	0

The findings presented in the Table 2 indicate that most students share a similar viewpoint on various aspects of climate change perception. Among the different statements analyzed, the causes of climate change get the highest levels of strong agreement both natural science and social science students. This indicates a shared understanding across majors that even minor human actions can contribute significantly to the environmental changes we observe, emphasizing the need for collective responsibility and awareness in addressing global climate issues. The widespread recognition among students that human actions, no matter how small, can significantly influence the Earth's climate, pointing to the need for heightened environmental awareness and responsibility (Han & Ahn, 2020). In the valence of consequences aspect, the research revealed that a small proportion of students disagreed with the consequences of climate change. While the majority acknowledged the risks associated with climate students expressed disagreement with these assertions. This suggests that a minority of students, despite recognizing climate change as a pressing issue, may not fully grasp or agree with the severity of its consequences for both current and future generations. Climate change will have profound impacts on humans, animals, and the overall environmental (Shivanna, 2022). As temperatures rise, ecosystems will be disrupted, and species may struggle to adapt or survive. Humans will face challenges such as extreme phenomenons. Meanwhile, animal populations may experience shifts in habitat availability and food sources, leading to potential declines in biodiversity. Overall, the impact of climate change will be far-reaching, affecting all aspects of life on Earth. These differing viewpoints highlight the need for further education and dialogue to deepen the understanding of climate change's far-reaching impacts.

The data were analyzed quantitatively, requiring the careful selection of appropriate statistical tests to ensure that they align with the underlying characteristics of the data. To ensure the validity of the subsequent analyses, it was essential to first assess the homogeneity and normality of the data. These preliminary tests help determine whether the data meet the assumptions necessary for conducting certain statistical procedures, such as parametric tests. Normality test to examine the data distribution (Table 3), providing a clear indication of whether the data meet this assumption. The findings from this initial step are crucial for informing the selection of appropriate analytical methods in the next stages of the research process. Normality test result shown the data are based on its significance value (0.000) is less than significance level (0.05). This indicates that the data is not normally distributed. And the data will be tested in homogeneity test (Table 4).

Table 3. Result of Normality Test

Major	df	Sig.
Science Student	85	.000
Social Student	65	.000

Table 4. Result of Homogeneity Test

Score	F	df1	df2	Sig.
Based on Mean	.552	1	148	.459

The results of homogeneity test has significant value based on the mean is 0.459 that more than significance level of 0.05. It indicates that the variance of perception and knowledge data between natural science and social science students is homogeneous. Because the data is not normally distributed, it is suitable for conducting the Mann-Whitney U test as a non-parametric alternative, which gives us the chance to see how the two groups are related (McKnight, 2010; Emerson, 2023). By using this test, we can compare the perceptions and knowledge of high school science and social studies students regarding climate change (Table 5).

Table 5. Results of the Mann-Whitney Test

Score	
Mann-Whitney U	2664.500
Wilcoxon W	6319.500
Z	-.605
Asymp. Sig. (2-tailed)	.545

According to Pratiwi (2016), the characteristics of natural science students are more critical in responding to a problem and possess logical thinking, are always optimistic in everything, have polite attitudes and behaviors, and have a strong desire to learn. Meanwhile, the characteristics of social science students include advantages in socializing, a strong sense of solidarity, and the ability to work well in all fields. Even though the characteristics of science and social studies students should be different, this does not affect the knowledge and perceptions of science and social studies students regarding climate change. This is reinforced by the results of the Mann Whitney test (Table 5) that the Asymp. Sig. (2-tailed) value is 0.545 that is more than the significance level of 0.05. It indicates that H0 is accepted, there is no significant difference in knowledge and perception between natural science and social science high school students regarding climate change. This is also in line with the preliminary study conducted by (Hasan et al., 2025), which found that there were no significant differences between several disciplines regarding climate change.

The topic of climate change has been integrated into the learning curriculum at school. The integration of climate change-related topics within a curriculum has an impact on students' knowledge and perceptions regarding climate change (Favier et al., 2021; Sharma, 2012)). In the Merdeka curriculum, topics related to climate change have been integrated from elementary school to high school levels. Education can be one of the most important indicators that give an understanding of climate change challenges, thereby increasing public awareness of climate change (Apollo & Mbah, 2021; Ofori et al., 2023). Students will be better prepared to understand the challenges of climate change with increased understanding (Sharma, 2012; Hassan et al., 2025). With samples from different fields of study, natural science and social science high school students, the study provides robust evidence that students' knowledge and perceptions of climate change are evenly distributed.

CONCLUSION

This study concluded that students' knowledge (including basic knowledge, causal knowledge, effect knowledge, and action-related knowledge) and perception (including reality, causes, valence of consequences, and spatial and temporal consequences) related to climate change, in senior high school, showed no significant differences across the natural science and social science students (sig. > 0.05). This finding suggests that the overall level of awareness regarding climate change is uniformly distributed, indicating a consistent understanding among students regardless of their specific educational background or demographic characteristics. The results also imply that the educational interventions currently in place may be effective in reaching a broad spectrum of students, fostering an equal understanding of climate change. However, it also raises important questions about whether this uniformity in knowledge reflects a superficial understanding of the issue or a deeper, more meaningful engagement with climate-related challenges. The results of this study can serve as a basis for developing a curriculum that integrates climate change into both science and social studies programs. Although there is no significant difference in students' knowledge and perceptions, further research is needed to identify appropriate approaches for each field of study. Future research could further investigate the factors that contribute to such consistency and explore strategies to promote more critical thinking and action-oriented knowledge among students.

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