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## Exploration of Climate Literacy Level of High School Students In Prospective New Capital City of Indonesia

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### ABSTRACT

*Climate change in the 21st century has become the primary concern of all the countries' leaders, including Indonesia. In education, learning related to climate change needs special attention not only on the knowledge aspect but also on the attitudes and behavior of students. East Kalimantan is one of the provinces in Indonesia, and the Indonesian government does expect it to be the new nation's capital. This research is descriptive analysis research. This research aims to determine students' level of climate literacy in aspects of basic knowledge, attitudes, and behavior. The survey does conduct on 240 students of grade 12th students from eight different schools in East Kalimantan, Indonesia. The sampling technique is stratified random sampling. The research instrument used was a questionnaire divided into three aspects: basic knowledge, attitudes, and behavior. In the basic knowledge aspect, the questionnaire consists of 15 questions with a Guttman scale (true-false). Each questionnaire consists of 10 statements with a Likert scale in attitude and behavior. The results showed that students' level of climate literacy in the basic knowledge aspect was only in the sufficient category, and the attitude and behavior aspects were in the high category. Although, in general, the level of student climate literacy in the aspects of attitude and behavior is in the high category, there are still some students classified at the low level. We conclude that students' climate literacy still needs to be improved in terms of basic knowledge and aspects of attitude and behavior to prevent the future negative impacts of climate change.*

## INTRODUCTION

During the 21st century, climate scientists predict that the earth's temperature will continue to rise. Two impacts must be anticipated global sea-level rise and the increased frequency of heatwaves, droughts, and floods. These changes will affect almost every aspect of human life. Scientific observations and results from climate models indicate that human activities are currently the leading

cause of most of the ongoing increase in global average surface temperature [1]. Increasing global temperatures, melting polar ice caps, rising sea levels, and changing the frequency of extreme weather events will impact the earth's populations [2].

Geographically, Indonesia is one of the countries most vulnerable to climate change. East Kalimantan is one of the provinces in Indonesia, and the Indonesian government does expect it to be the new nation's capital. The Regional Council for Climate Change (Indonesian: Dewan Daerah Perubahan Iklim, abbreviated DDPI) of East Kalimantan, in a public dialogue, revealed that data from the Meteorology, Climatology and Geophysics Agency (Indonesian: Badan Meteorologi, Klimatologi, dan Geofisika, abbreviated BMKG) stated that East Kalimantan, Indonesia, was experiencing climate change. The temperature in East Kalimantan has increased by 1 degree in the last 30 years, from 1990 to 2020. The pattern of the dry season and the rainy season has changed. BMKG predicts that if the temperature in East Kalimantan increases in the next few years, the dry season will be drier, and the rainy season will get more abundant water. The rainfall trend increases significantly above 50 mm from year to year, which can cause flooding and disrupt people's economic activities. The occurrence of climate change in East Kalimantan does cause by a drastic reduction in the number of forests and industrial activities. Land clearing and industrial activities cause an increase in greenhouse gases. BMKG predicts to increase further with the Indonesian government's policy to move the Indonesian state capital (Indonesian: The capital city of the country is called Nusantara and, from now on, abbreviated as IKN based on Law Number 3 of 2022 Article 1 Paragraph 2) to East Kalimantan Province [3].

Measurement of change is necessary to protect the community from the harmful effects of climate change, such as rising sea levels, floods, landslides, changes in rainfall, and other negative impacts. From a series of disasters due to climate change until 2020, they estimated that they had caused material losses of tens of trillions of rupiah and many dead and missing people [4]. Suppose preventive measures are not taken immediately based on analysis predictions. In that case, Indonesia will experience a shortage of water sources, decreased agricultural productivity, and the loss or destruction of habitat for various ecosystems, including coastal areas [5].

Updating climate change education through the formal education system can be one of the most important and influential ways to build the capacity to address the climate crisis [6]. The magnitude of the danger of the impact of climate change has made the Indonesian government begin to integrate climate change adaptation into the school curriculum. Integrating climate change adaptation into the 2013 Curriculum aims to increase [7]. The impact of climate change due to global warming is now increasingly visible around the world. However, there is a climate change literacy gap in our society, especially among youth. According to Luthfia, they admit their ignorance about climate change. Even if they already had some knowledge, this was definitely not an ideal condition [22]. Therefore, strengthening climate change skills among young people is an important task. The results of another study also carried out by Nabilah & Hariyono show that for each indicator result is that students can explain a scientific phenomenon and use scientific evidence at a moderate level, while still low in identifying scientific problems. Thus, it appears that overall the quality of climate literacy should be improved, especially in matters relating to climate change prevention [23]. Most educational research on climate change has focused on aspects of students' knowledge of climate change without considering the relationship between students' understanding and their desire to solve the problem. In a study exploring student attitudes to climate change, the research found that some first-year students in Mexico and Spain, in a representative sample of all students at these institutions, did not believe that humans caused climate change. These grim findings highlight the need to improve students' understanding and attitudes toward climate change [8].

The explanation a presence there is a need for research to determine the level of climate literacy of high school students in terms of knowledge and aspects of student attitudes and behaviour, especially in East Kalimantan as a candidate for the new state capital of Indonesia. The results of this study have important implications for educational institutions in making decisions to integrate climate change materials in schools, not only in terms of knowledge but also in aspects of attitudes and behaviour. So

that students can behave and provide solutions related to climate change mitigation and adaptation in the future.

## METHOD

This research is descriptive analysis research with a quantitative approach method. The study population was all high school students in East Kalimantan, Indonesia. The sampling technique used a stratified random sampling technique, and the research sample obtained was 240 students of class 12th high school in East Kalimantan, Indonesia. Class 12th students have studied material on Climate Change in their school. The sample came from eight different schools; the details are presented in Table 1.

**Table 1.** Details of Sample Distribution

School Origin	n	%
SMAN 1 Bontang	20	8%
SMAN 2 Bontang	27	11%
SMAN 1 Balikpapan	35	15%
SMAN 2 Balikpapan	29	12%
SMAN 1 Tenggarong	38	16%
SMAN 2 Tenggarong	21	9%
MAN 1 Samarinda	35	15%
SMAN 5 Samarinda	35	15%
Total	240	100%

The technique of collecting data on student climate literacy in this study was using a questionnaire technique consisting of aspects of basic knowledge, attitudes, and behavior with the following details:

1. Regarding basic knowledge, we used a questionnaire with a Guttman scale (true-false) comprising 15 statements. This questionnaire was developed by adopting and modifying the instrument used by Leiserowitz and Smith [9].
2. We used a questionnaire with a Likert scale of 10 statements on attitude. The questionnaire was developed by adopting and modifying the instrument used by Christensen and Knezek [10]. The questionnaire consists of positive and negative statements, and the Likert scale consists of 1-4.
3. We used a questionnaire with a Likert scale of 10 statements on behavior. The questionnaire was developed by adopting and modifying the instrument used by Alan [11]. The questionnaire consists of positive and negative statements, and the Likert scale consists of 1-5.

Indicators of Climate Literacy in each aspect of the questionnaire are presented in Table 2 [1].

**Table 2.** Climate Literacy Indicators on Aspects of Basic Knowledge, Attitudes, and Behavior

Aspect	Indicator	Sum of Items
Basic Knowledge	1. Knowledge of climate	5
	2. Impact of global warming	7
	3. Knowledge of global warming adaptation	3
Attitude	Beliefs about climate change	10
Behavior	An absolute commitment to climate change	10

The adapted questionnaire was re-discussed through a Focus Group Discussion (FGD) to ensure its validity. The experts involved in the process are three lecturers in charge of the Earth Science Course. After the questionnaire was validated, the questionnaire was distributed via google forms due to the Covid-19 pandemic, and distributed the link of google forms to teachers who teach climate change materials in high schools to be re-distributed to students to fill out. The researcher reviewed whether all samples had returned the questionnaire's answers via google forms.

The data analysis technique used was adapted from Zhou & Chen [12] which consisted of 1) editing; 2) coding; 3) tabulation; 4) presentation of data and conclusion.

*a. Editing*

Editing is the process of examining data collected through a questionnaire. After the raw data is collected, check the data first to see whether all samples have provided answers to each question.

*b. Coding*

After the completeness is checked, the raw data is given a score for each answer.

- a. In basic knowledge, using a questionnaire with a Guttman scale (true-false), the correct answer was scored 1, while the wrong answer was 0.
- b. In attitude, we are using a questionnaire with a Likert scale. The score for positive statements is four if the answer strongly agrees; 3 if the answer agrees; 2 if the answer does not agree; 1 if the answer strongly disagrees; and vice versa for negative statements.
- c. In the behavior aspect of using a questionnaire with a Likert scale, the score given for positive statements is five if always; 4 if often; 3 if rare; 2 if sometimes; 1 if never; and vice versa for negative statements.

*c. Tabulation*

Tabulation summarizes raw data, displays it concisely, and classifies it into predefined categories. Tabulation is done on each indicator and statement of each aspect.

*a. The Aspect of Basic Knowledge*

After each answer on the basic knowledge aspect was scored, the data were analyzed using the following formula [13]:

$$\text{average score} = \frac{\text{the sum of all the average scores}}{\text{the total number of average scores}} \times 100 \tag{1}$$

Interpretation of students' climate literacy level on the basic knowledge aspect is presented in Table 3 [13].

**Table 3.** Interpretation of Students' Climate Literacy Level on Basic Knowledge Aspect

<b>Interpretation</b>	<b>Category</b>
≥ 90	Very high
80 ≤ average score ≤ 89	High
70 ≤ average score ≤ 79	Enough
60 ≤ average score ≤ 69	Low
≤ 59	Very low

*b. The Aspect of Attitude and Behavior*

After each answer on the aspect of attitude and behavior is scored, then each is calculated the average score obtained by the following formula [13]:

$$\text{average score} = \frac{\text{the sum of all the average scoes}}{\text{the total number of average scoes}} \tag{2}$$

After obtaining the average score, they are then classified. Interpretation of students' climate literacy level on attitude aspect is presented in Table 4 [14].

**Table 4.** Interpretation of Students' Climate Literacy Level on Attitude Aspect

Interpretation	Category
$3.26 \leq \text{average score} \leq 4.00$	Very high
$2.51 \leq \text{average score} \leq 3.25$	High
$1.76 \leq \text{average score} \leq 2.50$	Low
$1.00 \leq \text{average score} \leq 1.75$	Very low

And the interpretation of students' climate literacy level on behavior aspect is presented in Table 5 [15].

**Table 5.** Interpretation of Students' Climate Literacy Level on Behavior Aspect

Interpretation	Category
$4.21 \leq \text{average} \leq 5.00$	Very high
$3.41 \leq \text{average} \leq 4.20$	High
$2.61 \leq \text{average} \leq 3.40$	Enough
$1.81 \leq \text{average} \leq 2.60$	Low
$1.00 \leq \text{average} \leq 1.80$	Very low

*d. Presenting Data and Concluding*

After the data is tabulated, the next step is to present the data in diagrams or tables so that conclusions can be drawn on the level of student climate literacy based on basic knowledge, attitudes, and behavior.

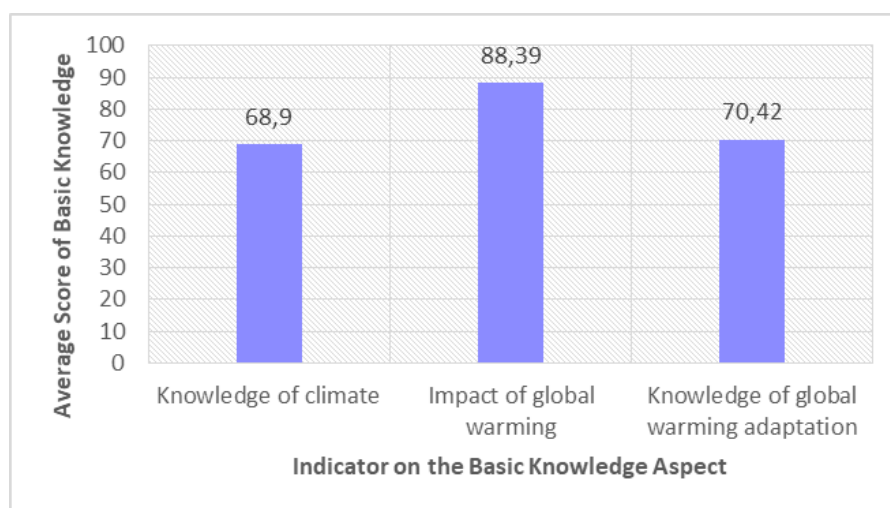
## RESULTS AND DISCUSSIONS

*Result*

This section presents the climate literacy level of high school students. Based on basic knowledge, attitude, and behavior, the research results are presented in groups.

*1. The Aspect of Basic Knowledge*

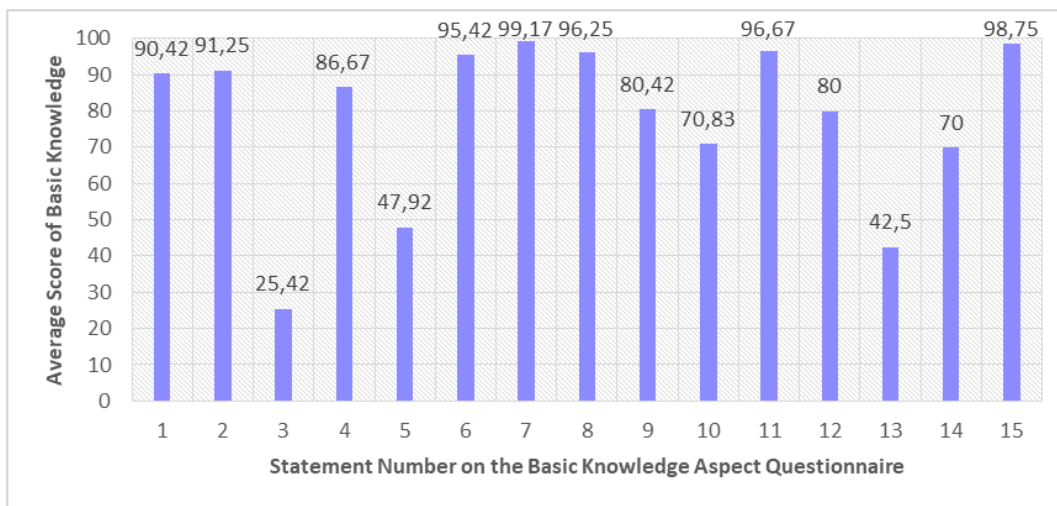
Based on data analysis on essential knowledge, the average score of students' basic knowledge obtained at 78.11 is enough. Analysis of the average score was also carried out on each indicator and each question of basic knowledge aspect. Results are obtained for each indicator of the basic knowledge aspect, as presented in Figure 1.



**Fig 1.** Result of the Basic Knowledge Aspect Each Indicator

In Figure 1, it can see that the highest average score of the basic knowledge aspect is in indicator 2, namely on the impact of global warming, with a average score of 88.39 (high category), while the lowest average score is in indicator 1, namely knowledge of climate with a average score of 68, 9 (low category).

The basic knowledge aspect obtained results for each question, as presented in Figure 2.



*Fig 2. Result of the Basic Knowledge Aspect Each Number*

Figure 2 shows that the highest average score of student climate literacy in basic knowledge is in answer to question number 7 (most of the global warming is caused by human activities) with a average score of 99.17 in the very high category. The lowest average score is in answer to statement number 3 (climate often changes from year to year), with a average score of 25.42 in the very low category.

The analysis was reviewed based on the percentage of students in each category of the basic knowledge aspect, presented in Table 6.

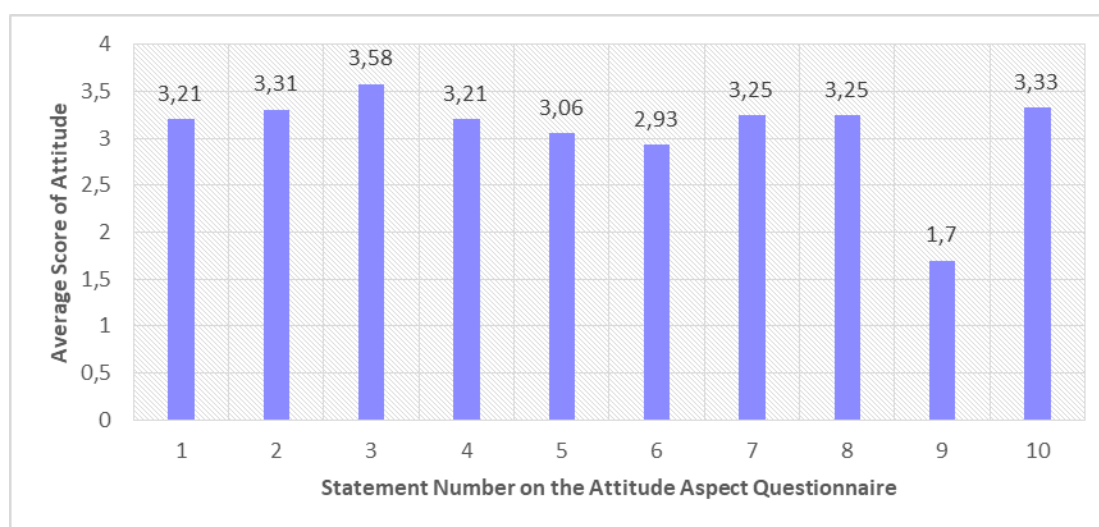
**Table 6. Percentage of Students by Category of the Basic Knowledge Aspect**

Category	Sum of Students	Percentage
Very high	34	14%
High	108	45%
Enough	43	18%
Low	39	16%
Very low	16	7%
<b>Total</b>	<b>240</b>	<b>100%</b>

Table 6 shows the distribution of students' climate literacy level categories in basic knowledge, mainly in the good category.

2. *The Aspect of Attitude*

Based on data analysis at the level of student climate literacy in the attitude aspect, the average average score is 3.09 is in the high category. The study of each statement of the attitude aspect is presented in Figure 3.



**Fig 3.** Result of the Attitude Aspect Each Number

Figure 3 shows that the highest average score of students' climate literacy in the attitude aspect is in answer to statement number 3 (I believe sustainable forest logging causes climate change) with a score of 3.58 in the very high category. The lowest average score is in answer to statement number 9 (I want to make efforts, even if it is only a simple effort to protect the environment from climate change), with a score of 1.7 in the very low category. The analysis based on the Percentage of Students by Category of the Attitude Aspect is presented in Table 7.

**Table 7.** Percentage of Students by Category of the Attitude Aspect

Category	Sum of Students	Percentage
Very high	73	30%
High	165	69%
Enough	2	1%
Low	0	0%
Very low	73	30%
<b>Total</b>	<b>240</b>	<b>100%</b>

Based on Table 7, it can see that most of the students are in the high category of climate literacy level for the attitude aspect.

### 3. The Aspect of Behavior

Based on data analysis on the level of student climate literacy in the behavior aspect, the average score is 3.59 is in the high category. The analysis of each statement of the behavior aspect is presented in Figure 4.

Figure 4 shows that the highest average score of students' climate literacy in the behavior aspect is in answer to statement number 5 (turning off the lights when not in use), with a value of 4.60 in the very high category. The lowest average score is in answer to statement number 6 (using a fan and air conditioner when feeling the heat), with a average score of 1.85 in the low category. The analysis based on the Percentage of Students by Category of the Behavior Aspect is presented in Table 8.

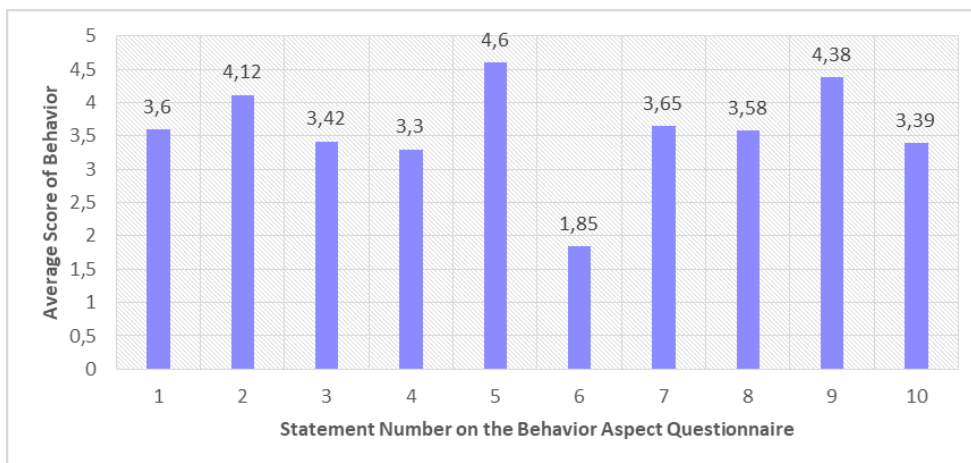


Fig 4. Result of the Behavior Aspect Each Number

Table 8. Percentage of Students by Category of the Behavior Aspect

Category	Sum of Students	Percentage
Very high	25	10%
High	124	52%
Enough	80	33%
Low	11	5%
Very low	0	0%
<b>Total</b>	<b>240</b>	<b>100%</b>

Based on Table 8, it can see that most of the students are in the high category of climate literacy level for the behavior aspect.

Discussion

Returning to the purpose of our research to the study results, we focus on students' level of climate literacy in basic knowledge, attitudes, and behavior.

1. The Aspect of Basic Knowledge

The results showed that students' level of climate literacy in the basic knowledge aspect was good, with most students in the good category, as shown in Table 6. Figure 1 shows that students' level of climate literacy on the indicator "knowledge about climate" is in a low category. Figure 2 shows a deficient level of climate literacy on several questions related to climate change in the questionnaire. The theme of climate change is not taught directly in secondary schools, so students can only obtain information about climate change from other sources such as television, the internet, or other sources [16].

In the high school curriculum in Indonesia, climate change is only integrated as a small part of the topic of Global Warming in High School Physics Subjects with one meeting time allocation. We believe this is one of the causes of the low level of student climate literacy in the aspect of basic knowledge on several questions in the questionnaire. Students' inadequate knowledge about climate change will be a challenge to expect students to be involved in fighting climate change. It will also make it difficult for students to make responsible decisions and efficient solutions to reduce future impacts of climate change. The topic of climate literacy and climate change is also a general scientific literacy problem, where misunderstandings and lack of access to educational resources further complicate the issue [2].



### 2. *The Aspect of Attitude*

Climate literacy includes attitudes, beliefs, motivational orientations, value, and self-efficacy [17]. Overall, the level of student climate literacy in the attitude aspect shows that most respondents have a high category of climate literacy, as shown in Table 7. A person's climate literacy correlates with their concern for global warming [18]. It is hoped that with the high level of student climate literacy in this aspect of attitude, high school students in East Kalimantan also have a high level of concern for the issue of climate change.

Figure 3 shows that the student's average score is highest in statement number 3, which is about the belief that sustainable logging causes climate change. This aligns with the current situation in East Kalimantan, where the amount of forest has decreased drastically. There is a lot of land clearing as part of industrial activities. This is increasingly a concern with the Indonesian government's policy to make the province of East Kalimantan the capital of the Indonesian state, which will further increase land-clearing opportunities and deforestation in East Kalimantan. Individual attitudes towards climate change can be changed when constantly monitored and given attention to climate change issues by practicing sustainable and pro-environmental living [10]. A wise attitude toward the environment will make students more concerned and take actions that can reduce environmental damage [19]. Therefore, students need to have climate literacy in the knowledge aspect and guide the attitude and behavior aspects of climate change mitigation and adaptation efforts.

### 3. *The Aspect of Behavior*

Table 8 shows the analysis results of students' climate literacy levels on behavior aspects. Most of the respondents showed a high level of climate literacy. Environmentally conscious behavior could help reduce environmental damage. When someone manages waste, uses environmentally friendly packaging, recycles, and uses electricity intelligently, intelligent behavior toward the environment [20]. The students' climate literacy level in the behavioral aspect shows that the respondents generally have behavior that is categorized as high.

Undeniably, some students state that they often have habits that can magnify climate change's adverse effects with behaviors contrary to efforts to overcome climate change problems. For example, fans and air conditioners are used when they feel hot (questionnaire statement number 6), as shown in Figure 4. Climate issues and climate change need to be integrated into the school curriculum with a contextual approach related to students' daily lives to create and increase awareness of climate change and prevent the negative impacts of climate change [21].

## CONCLUSION AND SUGGESTION

Based on the research results presented, in general, students have an attitude and behavior related to climate change in the high category. Still, from the aspect of knowledge, it is only in the sufficient category. This shows that students' climate change literacy, especially in the knowledge aspect, still needs to be improved. Some students still have attitudes and behavior in the low category, so these aspects still need attention to be integrated into learning.

Good knowledge, attitude, and behavior by teachers and the community must also support good knowledge, attitude, and behavior by students regarding climate change. What kind of learning process can facilitate increasing climate literacy in these three aspects still needs to be explored to support efforts to prevent and mitigate climate change.

These results can guide educational institutions to integrate climate change materials in schools to focus on aspects of knowledge and attitudes, and behavior. For educators, these results can be used as a guide for preparing and conducting lessons that can facilitate students to gain good knowledge related to climate change and strengthen students' attitudes and behavior in everyday life to prevent the negative impacts of climate change.

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