Profile and Relationship of Climate Change Awareness in the Cognitive Domain (CCA-C) with the Process of Cognitive Understanding

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Abstract

The primary cause of climate change is human activity. To combat this, we need to increase our awareness and take action towards climate change. In general, awareness of climate change is driven by attitude. A recent study focuses on the cognitive understanding of climate change knowledge and how it relates to our awareness. This study aims to describe (1) climate change awareness in the cognitive domain (CCA-C); (2) the process of cognitive understanding of climate change; and (3) the relationship between cognitive climate change awareness (CCA-C) and the process of cognitive understanding of climate change among high school students. Quantitative descriptive research uses data collection techniques with tests. In addition to the quantitative descriptive method in analyzing the results of the data, correlation coefficient tests and linearity tests were also carried out. Research conducted at SMA Negeri 21 Surabaya on 75 students in class X, showed a fairly weak level of climate change awareness in the cognitive domain (CCA-C) with a percentage of 50.34%, even though the cognitive understanding process was in the moderate criteria with a percentage of 50.55%. Climate change awareness in the cognitive domain (CCA-C) with the process of understanding cognitive change has a linear and very strong correlation with a correlation coefficient of 0.990. It can be concluded that climate change awareness in the cognitive domain (CCA-C) and the process of cognitive understanding of climate change have a mutual relationship. When climate change awareness in the cognitive domain (CCA-C) is weak, it can affect the low level of students' cognitive understanding of climate change processes. So that in forming climate change awareness it is necessary to involve the process of cognitive understanding of climate change to carry out climate action. Therefore, it is better if the learning provided by educators emphasizes knowledge related to real everyday life related to climate change material which will shape cognitive understanding and increase awareness of climate change.

Keywords: climate change awareness, cognitive understanding, climate change

Abstrak

Aktivitas manusia sebagai kontribusi terbesar pada terjadinya perubahan iklim. Aksi iklim digencarkan dan didasari kesadaran perubahan iklim. Pada umumnya kesadaran perubahan iklim berpacu sikap. Keterbaruan penelitian ini mengidentifikasi kesadaran perubahan iklim yang berkaitan dengan proses pemahaman kognitif dari pengetahuan perubahan iklim. Penelitian ini bertujuan mendeskripsikan (1) *climate change awareness* ranah kognitif (CCA-C); (2) proses pemahaman kognitif perubahan iklim; dan (3) hubungan *climate change awareness* ranah kognitif (CCA-C) dengan proses pemahaman kognitif perubahan iklim peserta didik SMA. Penelitian deskriptif kuantitatif menggunakan teknik pengambilan data dengan tes. Selain metode deskriptif kuantitatif dalam menganalisis hasil data, dilakukan uji koefisien korelasi dan uji linieritas. Penelitian yang dilakukan di SMA Negeri 21 Surabaya pada 75 peserta didik kelas X, menunjukkan level *climate change awareness* ranah kognitif (CCA-C) yang cukup lemah dengan persentase 50,34%, walaupun proses pemahaman kognitif dalam kriteria sedang dengan persentase 50,55%. *Climate change awareness* ranah kognitif (CCA-C) dengan proses pemahaman kognitif perubahan memiliki korelasi yang linier dan sangat kuat dengan koefisien korelasi sebesar 0,990. Dapat disimpulkan bahwa *climate change awareness* ranah kognitif (CCA-C) dengan proses pemahaman kognitif perubahan iklim saling memiliki hubungan. Ketika lemahnya *climate change awareness* ranah kognitif (CCA-C) maka dapat mempengaruhi rendahnya tingkat proses pemahaman kognitif perubahan iklim peserta didik. Sehingga dalam membentuk *climate change awareness* diperlukan keterlibatan proses pemahaman kognitif perubahan iklim untuk melakukan aksi iklim. Oleh karena itu, sebaiknya pembelajaran yang diberikan pendidik menekankan pengetahuan yang terkait dengan kehidupan nyata sehari-hari terkait materi perubahan iklim yang akan membentuk pemahaman kognitif dan meningkatkan kesadaran perubahan iklim.
Kata kunci: kesadaran perubahan iklim, pemahaman kognitif, perubahan iklim

INTRODUCTION

Scientific evidence leads to the formation of greenhouse gases caused by an increase in CO_2 in the atmosphere which causes global warming, this problem is based on human activity (Ainurrohmah & Sudarti, 2022). Based on observations at the Mauna Loa Observatory on April 26, 2017, the concentration of CO_2 in the atmosphere has increased from 280 ppm before the industrial revolution and further increased to 413 ppm. At that time, this increase affected the increase in global temperatures by up to 50% (Letcher, 2018). The increase in the temperature of the earth's surface which continues to increase causes the impact of risks that cause concern for all living things. The results of the Intergovernmental Panel on Climate Change (2022) show an increase in the earth's surface temperature in 2011-2021 has an average temperature increase of 1.09˚C. Activities that have increased the concentration of greenhouse gases (GHG), especially CO_2, CH_4, and N_2O in the atmosphere, such as the production and consumption of fossil fuels, the use of various agricultural chemicals, bush burning, waste from combustion processes and other industrial activities (Kweku et al., 2018).

Reporting to the UNFCCC (2007) youth in developing countries are significantly more vulnerable to the effects of climate change because countries in sustainable development have fewer resources to adapt socially, technologically, and financially (Barreda, 2018). The world of education, which is synonymous with young people who will socialize, still has a low understanding of the concept of climate change (Fernandez & Shaw, 2013;Ying & Osman, 2021).

Understanding is the ability to build meaning or understanding based on previous knowledge, connect new knowledge with existing knowledge, or integrate new knowledge into plans that are in students' minds (Widodo, 2006). Based on Bloom in Anderson & Krathwohl (2001) there are 7 indicators at the cognitive process level of understanding (understand), which consist of interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining (Widodo, 2006; Suryani, 2019; Kalsum et al., 2022).

The existence of climate awareness has a future goal, that the younger generation will be influenced by supporting the environment (pro-environment) for their current knowledge, perceptions, and attitudes about climate change (Harmuningsih et al., 2017). Knowledge of climate change is highly correlated with awareness of climate change so that it can motivate action or behavior (Tsaqib et al., 2020).

In knowing the level of climate change awareness in the cognitive domain, there are 5 indicators adapted from an article written by Nggole et al. (2019) and the goals of the Education for Sustainable Development Goals (ESDGs), namely climate action, researchers use cognitive or knowledge domain variables which consist of three sub-variables, namely the causes of climate change, the impacts of climate change, and the mitigation and adaptation of climate change.

The five CCA-C indicators consist of (PPI-1) Students understand the greenhouse effect as a natural phenomenon caused by an insulating layer of greenhouse gases; (PPI-2) Students understand current climate change as an anthropogenic phenomenon due to increased greenhouse gas emissions; (PPI-3) Students understand which human activities – at the global, national, local and individual levels – contribute the most to climate change; (DPI) Students understand about the major ecological, social, cultural and economic consequences of climate change locally, nationally and globally and understand how this itself can become a catalyst, a reinforcing factor for climate change; and (MAPI) Students understand about prevention, mitigation, and adaptation strategies at different levels (global to individual) and for different contexts and their relation to disaster response and disaster risk reduction.

Understanding concepts related to climate change knowledge and climate action is related to climate change awareness (Jener et al., 2019; Nayan et al., 2020). Concern for the environment related to the concept of climate change can be carried out in the world of education by looking at students' knowledge, attitudes, and awareness of climate change (Shendell et al., 2023). Low knowledge affects the creation of climate awareness, so this knowledge for climate change adaptation and mitigation must be successful (Awusi & Asare, 2016;Tsaqib et al., 2020).

Based on the background above, the objectives to be achieved by the researcher are to describe (1) climate change awareness in the cognitive domain (CCA-C); (2) the process of cognitive understanding of climate change; and (3) the relationship between cognitive climate change awareness (CCA-C) and the process of cognitive understanding of climate change among high school students.

RESEARCH METHODS

Researchers use a type of quantitative descriptive research. Descriptive research is research that aims to present facts and characteristics of certain populations accurately and systematically. Quantitative research is a research process that involves quantitative data in the form of numbers (Anwar, 2009). This type of research uses quantitative data functions in obtaining numbers and

also goes through a statistical process in analyzing the percentage of climate change awareness at the level of the cognitive domain and the process of understanding students' cognitive climate change. The research design is a correlational study by connecting two variables called the bivariate correlation in Figure 1.

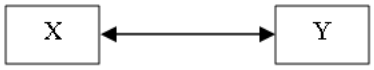

Figure 1. Bivariate Correlation Research Design

Information:

X : Climate change awareness cognitive domain (CCA-C)

Y : Bloom's cognitive understanding process in Anderson & Krathwohl (2001)

The researcher uses this design to describe climate change awareness at the level of the cognitive domain, the process of cognitive understanding, and how are the relationship between climate change awareness in the cognitive domain and the process of cognitive understanding of climate change in high school students.

Obtaining data is by testing using an instrument with 20 validated essay questions. The instrument includes 5 indicators of climate change awareness in the cognitive domain and 7 indicators of the cognitive understanding process (C2). The object of the research was carried out on 75 students in classes X-6 and X-10 at SMA Negeri 2021 Surabaya.

The analysis in describing the relationship between climate change awareness in the cognitive domain and the process of cognitive understanding of climate change uses a correlation technique using the Spearman correlation coefficient test and compares the percentage level of climate change awareness in the cognitive domain and the process of cognitive understanding (C2) between the two sample groups. In addition, a linearity test was carried out on the relationship between climate change awareness in the cognitive domain and the process of understanding climate change cognitively.

The results of the assessment of each variable and indicator aspect are made into percentages based on equation (1).

$$Value\ Percentage\ (\%) = \frac{\sum score\ obtained}{\sum maximum\ score} \times 100\% \quad (1)$$

The classification of the level of climate change awareness and the criteria for the level of cognitive understanding processes can be seen in Table 1 and Table 2.

Table 1. Table 1. Awareness Level Percentage and its meaning

Level of Awareness Qualification	Awareness Level Percentage
Weak	25.00% ≤Awareness Level ≤43.75%
Quite Weak	43.75% <Awareness Level≤ 62.50%
Quite Strong	62.50% <Awareness Level≤ 81.25%
Strong	81.25% <Awareness Level≤ 100.00%

(Nggole et al., 2019)

Table 2. Criteria for the Level of Cognitive Understanding Process

Criteria	Percentage of Value Intervals (%)
Very high	81-100
high	61-80
medium	41-60
Low	21-40
Very low	0-20

(Kalsum et al., 2022)

RESEARCH RESULTS AND ANALYSIS

All samples from the two class groups have homogeneous data but from class X-6 the data is not normally distributed either in the form of climate change awareness or cognitive understanding processes as shown in Tables 3 and 4.

Table 3. Normality Test Results

	Class	Shapiro-Wilk		
		Statistic	df	Sig.
CCA-C	CCA-C_X-10	,978	38	,646
	CCA-C_X-6	,888	37	,001
Process of Cognitive Understanding	Process of Cognitive Understanding _X-10	,976	38	,566
	Process of Cognitive Understanding _X-6	,872	37	,001

Table 4. Homogeneity Test Results

		Levene Statistic	df1	df2	Sig.
CCA-C	Based on Mean	1,675	1	73	,200
	Based on Median	2,080	1	73	,154
	Based on Median and with adjusted df	2,080	1	72,614	,154
	Based on trimmed mean	1,923	1	73	,170
		Levene Statistic	df1	df2	Sig.
Process of Cognitive	Based on Mean	1,392	1	73	,242

Understanding	Based on Median	1,679	1	73	,199
	Based on Median and with adjusted df	1,679	1	71,937	,199
	Based on trimmed mean	1,560	1	73	,216

a. Climate Change Awareness in the Cognitive Domain (CCA-C)

Climate change awareness in the cognitive domain (CCA-C) that is measured includes the following 5 indicators.

1. **(PPI-1)** Students understand the greenhouse effect as a natural phenomenon caused by an insulating layer of greenhouse gases;
2. **(PPI-2)** Students understand current climate change as an anthropogenic phenomenon due to increased greenhouse gas emissions;
3. **(PPI-3)** Students understand which human activities – at global, national, local and individual levels – contribute most to climate change;
4. **(DPI)** Students understand about the major ecological, social, cultural and economic consequences of climate change locally, nationally and globally and understand how this itself can become a catalyst, a reinforcing factor for climate change; And
5. **(MAPI)** Students understand about prevention, mitigation and adaptation strategies at different levels (global to individual) and for different contexts and their relation to disaster response and disaster risk reduction.

Each class has a level of awareness of climate change in the cognitive domain which is described in Tables 5 and 6.

Table 5. Climate Change Awareness Level Class X-6

CCA-C	Persentase (%)	Klasifikasi
PPI-1	48,32	Quite Weak
PPI-2	56,97	Quite Weak
PPI-3	60,54	Quite Weak
DPI	51,35	Quite Weak
MAPI	63,96	Quite Weak
Average	**55,73**	**Quite Weak**

Table 6. Climate Change Awareness Level Class X-10

CCA-C	Persentase (%)	Klasifikasi
PPI-1	47,79	Quite Weak
PPI-2	37,37	Weak
PPI-3	56,97	Quite Weak
DPI	39,82	Weak
MAPI	41,93	Weak
Average	**44,95**	Quite Weak

Both tables describe the level of awareness of climate change in the cognitive domain of each class, the two sample groups have averages in the fairly weak category. Each percentage is 55.73% and 44.95%. Overall, the two sample groups can be described in the following diagram.

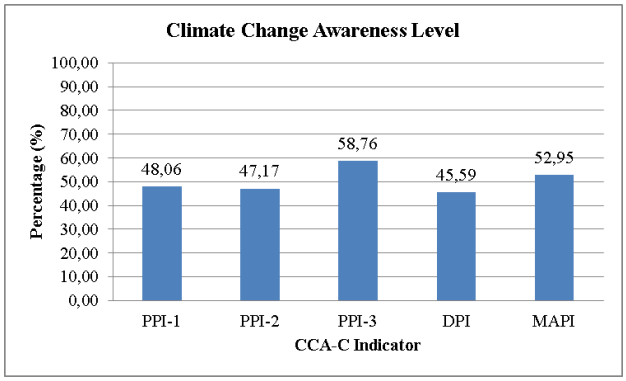

Figure 2. Cognitive Domain Climate Change Awareness Level (CCA-C)

b. Process of Cognitive Understanding

There are 7 indicators of cognitive understanding process (C2) described by Bloom in Anderson & Krathwohl (2001), namely

1. interpreting
2. exemplifying
3. classifying
4. summarizing
5. inferring
6. comparing
7. explaining

Tables 7 and 8 show the percentage of each indicator in class X-6 and X-10.

Table 7. Percentage of Cognitive Understanding Processes Class X-6

Process of Cognitive Understanding	Percentage (%)
Interpreting	52,52
Exemplifying	72,43
Classifying	53,84
Summarizing	46,49
Inferring	56,22
Comparing	56,94
Explaining	56,97
Average	**56,26**

Table 8. Percentage of Cognitive Understanding Processes Class X-10

Process of Cognitive Understanding	Percentage (%)
Interpreting	43,51
Exemplifying	53,68
Classifying	42,42
Summarizing	40,79
Inferring	41,58
Comparing	50,35
Explaining	43,16
Average	**44,84**

Overall indicators of cognitive understanding process (C2) in high school students have an average of 50.55% with the percentage of each indicator exposed in Figure 2.

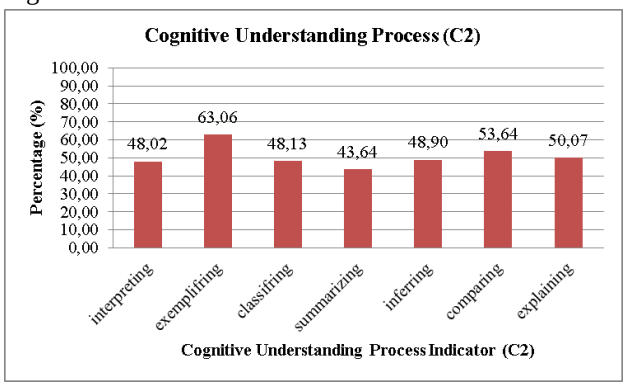

Figure 3. Process of cognitive understanding (C2)

c. Relationship between Climate Change Awareness in the Cognitive Domain (CCA-C) and the Process of Cognitive Understanding

Correlation analysis uses nonparametric statistics, namely the Spearman correlation coefficient test with the results shown in Table 9 below.

Table 9. Spearman Correlation Coefficient Test Results

			CCA-C	Process of Cognitive Understanding
Spearman's rho	CCA-C	Correlation Coefficient	1,000	,990**
		Sig. (2-tailed)	.	,000
		N	75	75
	Process of Cognitive Understanding	Correlation Coefficient	,990**	1,000
		Sig. (2-tailed)	,000	.
		N	75	75

**. Correlation is significant at the 0.01 level (2-tailed).

Based on the output from Table 8, it is known that with N or a total of 75 research data, it has a sig. (2-tailed) of 0.000 <0.05 indicates climate change awareness in the cognitive domain with cognitive understanding processes has a significant correlation or relationship. Furthermore, with a correlation coefficient value of 0.990, it shows a very strong relationship (Anwar, 2009).

Table 10. Linearity Test Results

			F	Sig.
CCA-C * Process of Cognitive Understanding	Between Groups	(Combined)	128,478	,000
		Linearity	6247,584	,000
		Deviation from Linearity	,997	,518

With the help of SPSS, the results of the linearity test analysis that with F Linearity 128.478 have a significance <0.05 indicating the relationship between climate change awareness in the cognitive domain and cognitive understanding processes can be explained by a linear model. Then F Deviation from Linearity 0.997 as $F_{count} < F_{Table}$ (1.84) with a significance of 0.518> 0.05 explains that there is a significant linear relationship between climate change awareness in the cognitive domain and cognitive understanding processes.

DISCUSSION

a. Climate Change Awareness in the Cognitive Domain (CCA-C)

Based on the results and data analysis, it is clear that the two sample groups have different levels of several indicators. Overall, the average percentage of CCA-C is 50.34%. From class X-6 it shows that almost all indicators have a fairly weak level of climate change awareness, except for the climate change mitigation and adaptation indicator which has a percentage of > 62.5% which identifies climate change awareness in this indicator which is quite strong.

On the other hand, in class X-10, out of 5 CCA-C indicators, the level of climate change awareness is dominated by a weak level. There are three indicators that have a weak CCA-C classification, namely PPI-1, DPI, and MAPI, with respective percentages of 37.37%, 39.82%, and 41.93%. Meanwhile, the other two indicators are in quite weak category.

(PPI-1) Students understand the greenhouse effect as a natural phenomenon caused by an insulating layer of greenhouse gases. This indicator shows that students should understand the concept of the causes of climate change from the process of the greenhouse effect. Based on Tables 5 and 6, it appears that classes X-6 and X-10 have a low level of awareness regarding climate change, falling below the standard of at least being quite strong. Both classes fall into the category of being quite weak. It is undeniable that climate change awareness is in the cognitive domain because students do not get sufficient

knowledge regarding the causes of climate change from the process of the greenhouse effect. Supported by the results of research by Agustini et al. (2022) have a 59% understanding of the climate change issue of pre-service science teachers related to the effect of greenhouse gases.

(PPI-2) Students understand current climate change as an anthropogenic phenomenon due to increased greenhouse gas emissions. Anthropogenic phenomena carried out by humans have contributed to causing climate change, but this awareness is too fragile if it is not accompanied by detailed knowledge about climate change (Tsaqib et al., 2020). Therefore, clear and in-depth knowledge is needed to provide climate change awareness for the current generation. This anthropogenic phenomenon is dominated by activities in developing countries. The development process for developing countries can worsen the environment which involves contributing to climate change, such as land expansion that removes forests or green plants (Satria, 2019). Based on the PPI-2 indicator, it appears that there is a lack of knowledge about anthropogenic phenomena in class X-10 and a weak understanding in class X-6. Understanding climate change involves recognizing both general control factors (natural) and special control factors that are heavily influenced by human activity (anthropogenic) (Aldrian et al., 2011).

(PPI-3) Students know which human activities – at global, national, local, and individual levels – contribute most to climate change. Awareness of climate change is seen from one's knowledge regarding human activities both on an individual and international scale. It is still related to the second indicator which is anthropogenic phenomena originating from human activities (Saputri et al., 2022). When students have awareness of climate change in the cognitive domain which is quite weak in section (PPI-3) as shown in Tables 5 and 6 it shows low knowledge regarding human activities that contribute to the causes of climate change. Activities at the individual level that contribute to climate change can trigger at the local, national, and global levels. This is because the knowledge of each race from the phenomena that are happening in the world is a key that will move human thoughts and activities to give the best response to them (Tsaqib et al., 2020).

(DPI) Learners know about the major ecological, social, cultural, and economic consequences of climate change locally, nationally, and globally and understand how this itself can become a catalyst, a reinforcing factor for climate change. Consequences are the ecological, social, and economic impacts of climate change. All of these aspects can accelerate or slow down climate change. The lack of understanding of the social dimension of the impact of climate change has the potential to cause efforts and programs in anticipating climate change to stalemate in their implementation which in the end the magnitude of the impact will be even greater (Aldrian et al., 2011). With a percentage below 62.5%, it indicates that climate change awareness at this indicator level needs to be increased in formal or informal learning as a forum for information related to the impact of climate change. Climate change is impacted by various human activities, including urbanization, deforestation, illegal clearing of peat land, coastal reclamation, industrialization, and improper waste management. These actions have far-reaching effects on agriculture, the economy, and even human psychology (Arwan et al., 2021). Efforts to mitigate and adapt to climate change will take these factors into account.

(MAPI) Students know about prevention, mitigation, and adaptation strategies at different levels (global to individual) and for different contexts and their relation to disaster response and disaster risk reduction. Demand for appropriate adaptation and mitigation strategies due to climate change and the complexity of its scale and impact. The range of understanding of adaptation and mitigation strategies for climate change impacts is still diverse and requires the same level of understanding and integration to prevent deadlocks and maladaptation and malmitigation, which in turn will have a bigger impact (Aldrian et al., 2011). Supported based on research results showing the diversity of understanding of climate change adaptation and mitigation strategies (MAPI) at the CCA-C levels of the two groups is different. Meanwhile, the key to climate change is adaptation which must be part of the development agenda to be able to withstand the current impacts of climate change and anticipate future impacts (Ainurrohmah & Sudarti, 2022). As for understanding a disaster, it is necessary to study the concepts and basics related to a disaster which include the physical process of the impact caused by the disaster (Fitransyah & Supardi, 2022). This indicator regarding climate change mitigation and adaptation is very important as disaster education in schools aims to increase students' awareness of the impacts of disasters and encourage students' preparedness for natural disasters (Miftahul Jannah et al., 2022).

b. Process of Cognitive Understanding

Students who always get learning will get a variety of knowledge. The learning process will hone 7 indicators at the level of cognitive understanding process (understand) from the knowledge they get, which consists of interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining. From the average

cognitive understanding process, which is 50.55%, the level of the cognitive understanding process is classified as moderate.

The first indicator is interpreting, changing from one form of information to another, for example from words to graphics or pictures, or vice versa, from words to numbers, or vice versa, or from words to words. words, for example summarizing or paraphrasing. Information (Widodo, 2006). Regarding the material on climate change, the question instrument displays the concept of the greenhouse effect process and students are instructed to apply it in the form of an image. Some students still think that the greenhouse effect is a house made of glass. This could be due to the minimal information received by students. In addition, learning can be caused by the knowledge of educators who do not reach the correct concept of the greenhouse effect. Based on the results of research by Rahayu & Ismawati (2022) shows that the sub-concept of the greenhouse effect in the indicator explaining the greenhouse effect and the process by which it occurs, 21% of prospective science teachers do not understand and have a misconception of 39% in the medium category. Therefore, it is reasonable when it is known that students in classes X-6 and X-10 have a percentage in the medium criterion on interpreting indicators.

Furthermore, in the indicator giving examples (exemplifying), it becomes an interesting finding on this indicator which has the highest percentage or value. Exemplifying is the ability of students to provide specific examples or examples of general concepts (Arisanti et al., 2017). Exemplifying can also mean identifying the meaning of the parts in a general concept (Suryani, 2019). In climate change material, students are able to understand further when applying examples related to material concepts. According to the research by Loyens et al. (2015) that when the context used is based on real phenomena that are commonly observed by students in their environment in everyday life, it allows students to more easily understand the concept of the material being studied.

Being part of the aspect of the cognitive understanding process, the classifying indicator is interpreted that the achievement of the classification process occurs when students can know something such as examples or events that are in a certain category, either in the form of certain categories of concepts, principles or laws (Kalsum et al., 2022). Of the various gases that either contribute or do not contribute to the greenhouse effect, the answers of many students still do not know that Oxygen (O_2) and Nitrogen (N_2) do not contribute to the greenhouse effect. But for good, these heated molecules (N_2, O_2) then pass their heat on to other molecules in the atmosphere and this keeps the Earth at an even temperature. The vibrational frequency of the O-O bonds in oxygen and the N-N bonds in nitrogen molecules are very different from the frequency of radiation so they are relatively unaffected in the formation of greenhouses (Letcher, 2018). With the ability to classify in the medium category in both classes, it shows that students have a moderate level of comparing, looking for similarities and differences, and looking for basic groupings related to the sub-chapter of climate change material (Solpa et al., 2022).

The fourth indicator, summarizing is the ability of students who have summarizing abilities when students can provide a single statement stating the information conveyed or topics in general (Suryani, 2019). One of the questions presented is in the form of reading about news on the impact of climate change related to the causes of urban spatial planning errors. However, many students have not been able to capture the context of the news presented to answer questions. Based on the research by Kamaliyah et al. (2022) that metacognitive abilities affect understanding of concepts related to information management such as summarizing, where students who cannot manage good information are less able to understand how to develop strategies in solving problems.

The fifth is drawing inferences (inferring), according to Widodo (2006) bringing the ability to find a pattern from a series of examples or facts. In presenting questions related to the use of electrical energy in Indonesia from fossil fuels, most of the facts that have been presented are that in 2019 Indonesia has a proportion of electricity production from fossil fuels. However, students still do not know the most contributing impact of climate change. This shows that students have not been able to draw inferences regarding human activities at the national level that contribute most to climate change. This ability to draw inferences will help develop critical thinking skills (Amalia & Hariyono, 2022; Shoba et al., 2023).

Then on the indicator comparing is a cognitive process that involves the process of detecting similarities and differences between two or more objects, events, ideas, problems, or situations, such as in the form of searching for correspondence or one-on-one pairs of an object (Kalsum et al., 2022). Working on questions regarding anthropogenic and non-anthropogenic phenomena, students do not know the difference between the two. So that students cannot compare the two activities that are classified as anthropogenic or non-anthropogenic phenomena. This is due to the lack of information regarding the understanding of anthropogenic and non-anthropogenic phenomena. In

line with the results of research on climate change awareness in the cognitive domain, the criteria are quite weak, even in class X-10 at a weak level. Besides that, Tsaqib et al. (2020) stated that even though humans are aware that climate change is happening due to anthropogenic activities, this awareness is too fragile if it is not accompanied by detailed knowledge about climate change. Meanwhile, comparing requires detailed information regarding the things being compared to find out the similarities and differences.

Finally regarding the indicator explaining is defined as the ability to construct and use a causal model in a system (Widodo, 2006). This indicator is still in the medium category, indicating that aspects of explaining to students still need to be improved. This is because students only know but cannot explain in detail (Puspitaningrum et al., 2018). The event is when you are less interested in learning, you will not try to look deeper into the concept being studied. So when later the child is asked to explain an event, the child tends to be inappropriate in interpreting it (Rahayu & Ismawati, 2022). Based on the results of research by Rahayu & Ismawati (2022) it shows that 10% of prospective science teachers do not understand explaining the meaning and process of global warming, even though it is relatively small this can affect the knowledge gained by students. In addition, 43% in the moderate category is the percentage of misconceptions related to the ability to explain the meaning and process of global warming.

c. Relationship between Climate Change Awareness in the Cognitive Domain (CCA-C) and the Process of Cognitive Understanding

Climate Change Awareness in the Cognitive Domain (CCA-C) of high school students is classified as weak. His cognitive understanding process is included in the medium criteria and is closer to the low-value interval. Of the two class groups, class X-6 outperformed CCA-C and cognitive and continuous understanding processes in class X-10, these two aspects had lower similarities than class X-6.

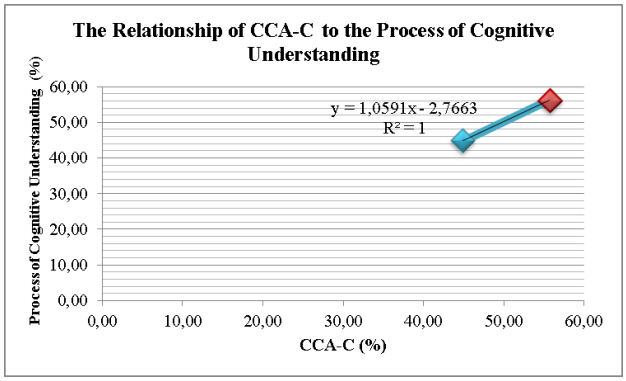

Figure 4. Graph of the Relationship between CCA-C and the Process of Cognitive Understanding

Figure 4 which is shown in the red coordinates is the highest percentage value from class X-6 and the blue coordinates belong to class X-10. This graph illustrates the relationship between climate change awareness in the cognitive domain (CCA-C) and cognitive understanding processes that influence each other. The higher the process of cognitive understanding, the higher the level of awareness of climate change in the cognitive domain. This relationship is supported by the results of Spearman's correlation coefficient test analysis which shows climate change awareness in the cognitive domain with cognitive understanding processes has a significant correlation or relationship with a correlation coefficient value of 0.990 indicating a very strong relationship.

A strong correlation shows when climate change awareness is weak in the cognitive domain, it can identify the lack of cognitive understanding processes. It is proven from the linearity test that F Deviation from Linearity 0.997 as $F_{count} < F_{table}$ (1.84) with a significance of 0.518> 0.05 explains that there is a significant linear relationship between climate change awareness in the cognitive domain and cognitive understanding processes. The results of the study describe that each aspect of climate change awareness in the cognitive domain and the process of cognitive understanding of climate change has a fairly weak and moderate level.

The lack of knowledge about the concept of climate change that students have can be a real threat to survival in the future (Hartati & Hariyono, 2020). In addition, awareness will be too fragile if it is not accompanied by detailed knowledge about climate change because the level of knowledge is related to awareness (Tsaqib et al., 2020). There is also the concept of climate change material which includes processes that cannot be seen with the naked eye making the average student not understand the concept of climate change material and the phenomena that occur (Arianti et al., 2020).

In addition, education is recognized as a means to enhance essential knowledge for disaster preparedness and recovery strategies (Anggaryani et al., 2022). This knowledge is acquired through cognitive comprehension during learning activities. As a result, teaching and learning activities need to incorporate more innovative approaches for climate change material to enhance understanding of the concept. Meanwhile, this knowledge is obtained from the process of cognitive understanding in learning activities. This is because understanding concepts related to climate change knowledge and climate action is related to climate change awareness (Jener et al., 2019; Nayan et al., 2020).

CONCLUSION

From the results of the analysis and discussion, it can be concluded that students at SMA Negeri 21 Surabaya show climate change awareness in the cognitive domain (CCA-C) which is classified as quite weak with a percentage of 50.34%. While the percentage of 50.55% is the level of cognitive understanding of climate change in the moderate category. Climate change awareness in the cognitive domain (CCA-C) with students' cognitive understanding of climate change has a very strong and linear relationship with a correlation coefficient of 0.990. This is because awareness of climate change in the cognitive domain is related to the conceptual understanding of climate change knowledge and climate action. The low synergy between the two is likely due to the limited availability of information on climate change from both formal and informal education. In addition, teachers should provide questions about the concept of climate change that are tied to everyday life because they are better able to provide a deep level of cognitive understanding so that it has an impact on students' climate change awareness.

Climate change awareness can be known from the aspects of knowledge, perceptions, and attitudes. This research focuses on identifying climate change awareness in the aspect of knowledge or the cognitive domain. The cognitive understanding process indicator (C2) is based on Bloom in Anderson & Krathwohl (2001). Therefore it is hoped that it will be more extensive in measuring climate change awareness which is integrated with cognitive understanding process indicators. Apart from supporting UNESCO's program, namely ESD (Education for Sustainable Development), by increasing awareness of climate change, one of the SDGs goals can be achieved, namely climate action.

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